North Country Forest Energy Project

Wood Heating in Coos County, New Hampshire

Report to the Neil and Louise Tillotson Fund of the New Hampshire Charitable Foundation • February 2008

Biomass Energy Resource Center
This report was written by Biomass Energy Resource Center to describe the first-year activities of the North Country Forest Energy Project to the Neil and Louise Tillotson Fund of the New Hampshire Charitable Foundation.

**Biomass Energy Resource Center**

The Biomass Energy Resource Center’s (BERC) mission is to achieve a healthier environment, strengthen local economies, and increase energy security across the United States by developing sustainable biomass energy systems at the community level. BERC is a national non-profit with expertise in institutional and community-scale wood energy systems to help industries, schools, and institutions initiate and implement biomass projects for their heating and power needs. Since 2005, BERC has worked with partners and stakeholders in New Hampshire and the other Northern Forest states to explore actively the potential for transforming the energy economies of the region’s communities by substituting locally supplied wood fuel for fossil fuels in heating, power production, combined heat and power (CHP), and distributed generation.
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Coos County buildings (from top clockwise): Groveton High School, NH Community Technical College in Berlin, Gorham Historical Society and Railroad Museum, and McIntyre School Apartments in Whitefield.
EXECUTIVE SUMMARY

OVERVIEW
This report completes our first year of work on the North Country Forest Energy Project under a grant from the Neil and Louise Tillotson Fund of the New Hampshire Charitable Foundation.

In the first phase of this project, the Biomass Energy Resource Center (BERC) implemented a three-part strategy to address and advance biomass energy development and use in Coos County. First, we set the program foundation for advancing a conversion of schools from fossil-fuel heat to biomass by engaging policymakers and state agencies in the need and value of such a program.

Second, BERC screened approximately 50 sites in Coos County for suitability for conversion from fossil fuel heat to biomass heat or combined heat and power, and narrowed the list down to 23 sites and two community districts with the most potential for additional feasibility work to be performed.

Third, we investigated and report here on creative financing mechanisms that might be available to facilitate implementation of these identified projects.

BIOMASS POTENTIAL
Biomass fuel has the potential to serve the county not only as an economical way to offset fossil fuels, but also as an economic development driver that keeps energy dollars in the community and supports sustainable forest management and infrastructure. Coos County has enormous potential to use wood residues produced from existing local forest products industries as well as low-grade wood from the region’s forests. Making efficient use of local resources for biomass heat can help support these forest products industries, maintain forestlands, and enhance the quality of life for Coos County residents.

COOPERATION
With regard to laying the foundations for a state-wide and supported program, in this phase of the project BERC gained support from the North Country Resource Conservation and Development Area, Inc., the New Hampshire Department of Education, and the New Hampshire Office of Energy and Planning for a New Hampshire Fuels For Schools program. Both expressed willingness to work on development of such a program, and it would be expected that in the next phase of the project, these entities and others throughout the county and state will work with BERC to identify barriers and public policy initiatives needed to advance the program, including possible legislation needed and suitable funding methods.
SITE ASSESSMENTS
To assess the potential for actual projects, data was collected and reviewed on all 45 communities of Coos County. Six communities lent themselves best to the possibility of biomass, either because of the size and concentration of the buildings, or because of the density of population. Ten schools and thirteen other public and private buildings were identified as being well-suited for further feasibility analysis. The square footage of buildings identified as good candidates for biomass conversions totals more than two million in area. If all of these were converted, almost a million gallons of fuel oil would be saved annually. Preliminary life-cycle cost analysis yields average annual savings of between $13,000 per year for the smallest schools to more than $95,000 for the largest.

Two communities—Groveton and Berlin—were identified as potentially suited to a district energy system that could serve its entire downtown area. Based on the size, density, and proximity of buildings, a centralized biomass energy system may make economic sense for these communities. Groveton is presently undergoing a feasibility study to determine its suitability, and we propose that further work be done in Berlin during Phase II of this Project to determine the feasibility of a district heating system for Berlin’s town center.

CREATIVE FINANCING
Too often, in spite of overall favorable economics, biomass energy projects do not go forward in public settings because up front capitalization is difficult to secure. The capital costs of wood-energy projects are high, and can exceed $1 million for a large school. In this report, several mechanisms have been considered to advance creative financing of these projects, including cooperative ownership, leasing, state cost-share programs, and both private and nonprofit versions of energy service companies.

WOOD FUEL SUPPLY
BERC is very committed to ensuring a sustainable wood fuel supply for all recommended projects. Sustainability is key to reaping the carbon benefits of using wood energy as well as to the long-term benefit of the affected communities. As such, we investigated forest growth and potential and existing wood-fuel supply sources, and evaluated these resources in the context of the potential projects identified herein as well as the large biomass power projects already under consideration in the county. Of the 6.9 million tons of new wood grown annually, 1.6 million tons is estimated to be low-grade and accessible. Based on economics of fuel supply, the community-scale projects considered in this report would have more than adequate fuel to support them; however, if the four major power projects under consideration all go forward, there would be a significant strain on the region’s forests. That said, BERC’s experience is that because community wood projects of the scale proposed here are displacing oil, they are very competitive with respect to ability to pay for fuel supply, and so it is the larger projects, not the small-scale projects, that would find it more difficult to meet their demand at a price they could afford.

CONCLUSION
BERC is grateful for the support of the Neil and Louise Tillotson Fund of the New Hampshire Charitable Foundation for funding this work, and we hope that Phase II of the North Country Forest Energy Project enables us to continue it to fully develop the infrastructure to support a Coos County Fuels For Schools Program, further assess the feasibility of the 23 sites and two communities identified, and work to establish financing mechanisms that can bring these projects to fruition.
INTRODUCTION

BACKGROUND
The Biomass Energy Resource Center (BERC) has been involved since 2005 in working with partners and stakeholders in New Hampshire and the other Northern Forest states to explore actively the potential for transforming the energy economies of the region’s communities through substituting locally supplied wood fuel for fossil fuels in heating, power production, combined heat and power (CHP), and distributed generation.

BERC is leading a three-year North Country Forest Energy Project to develop the potential for woody biomass to become both a viable energy source and an economic development driver for the North Country by focusing BERC’s ongoing work in project, program, and policy development on Coos County, New Hampshire.

The Neil and Louise Tillotson Fund of the New Hampshire Charitable Foundation awarded BERC a first-year $75,000 grant in February 2007 to support the North Country Forest Energy Project’s activities. This report summarizes BERC’s efforts in the last 12 months to study and support the use of biomass energy in Coos County through its North Country Forest Energy Project.

PROJECT DESCRIPTION
The North Country Forest Energy Project aims to increase the use of sustainably supplied woody biomass in municipal, public, and institutional energy applications that will:

- Reduce operating budgets for municipalities, schools, and other institutions
- Keep energy dollars circulating in local economies instead of exporting those dollars
- Create jobs
- Strengthen the forest products industry
- Improve forests and benefit forestland owners
- Provide energy security
- Sustain, revitalize, and empower communities
- Reduce climate change emissions in a meaningful way

SCOPE OF WORK
Work in the first year of the North Country Forest Energy Project is being carried out under a three-part strategy designed to combine on-the-ground project development with the creation of programmatic structures to support project activities over the long term.

Three-Part Strategy
1. Set the programmatic foundation for converting North Country schools to wood heating
2. Identify, prioritize, and study the best sites in Coos County for biomass use, including public schools, hospitals, state facilities, and community energy systems (district heating) for municipalities. In making site recommendations, BERC has assessed the amount of biomass fuel available in Coos County on a sustainable basis as an in-kind contribution to this project
3. Study and recommend means for creative financing for wood-energy projects. In cases where the capital cost of wood-energy projects currently exceeds the operating cost savings of substituting wood for oil, the strategy includes developing innovative ways of quantifying and internalizing societal benefits and using that additional value to bring capital into projects.
METHODOLOGY

The methodology follows the three-part strategy set out in the scope of work, and is described below.

**Strategy 1. Set the Programmatic Foundation for Converting North Country Schools to Wood Heating**

BERC worked closely with New Hampshire state education, energy, and forestry agencies and other stakeholders to lay the groundwork for a New Hampshire Fuels For Schools (NHFFS) program, creating institutional and programmatic support for the installation of wood-energy projects in the state. BERC has been developing the program concept with these partners since 2005, and has strengthened the effort through its North Country Forest Energy Project, with support from the Neil and Louise Tillotson Fund of the New Hampshire Charitable Foundation.

BERC attended key meetings and, working closely with the North Country Resource Conservation & Development (RC&D), helped organize participants, focusing primarily on schools and other institutional buildings.

An advisory committee was constituted for the program and renamed the ‘New Hampshire Community Scale Biomass Heating Program.’ The program’s main focus will be on schools, but also include other public buildings, municipalities, and communities. BERC presented the NHFFS program concept to the North Country Superintendents Association where there was a high level of interest and the superintendents agreed to provide information so that schools in their districts could be assessed as potential sites for biomass heating projects.

In addition, the New Hampshire Department of Education and the New Hampshire Office of Energy and Planning have both been supportive of the NHFFS program and agreed to assist in its development.

**Strategy 2: Identify, Prioritize, and Study the Best Sites in Coos Country for Biomass Use**

Through its considerable experience in site selection and feasibility studies, BERC has developed criteria to identify the most promising communities and facilities for wood heating.

**Site Selection.** With respect to community district energy, the criteria include population, size of the community, density and size of houses and buildings, layout of the community, and fuel used for heating. These criteria were used to analyze information collected in all 45 communities in Coos County and narrow the focus, resulting in the selection of six communities with reasonable biomass energy-use potential based primarily on population and building density. These communities are Groveton, Berlin, Lancaster, Colebrook, Whitefield, and Gorham. Based on the site visits, Groveton and Berlin were identified as good candidates for district energy systems.

To identify buildings with large loads and communities appropriate for district heating, BERC collected data on the location and size of all public schools in Coos County, analyzed the data and screened schools, and visited most of the schools throughout the county and those of the six selected communities that have aggregated downtowns. Buildings with larger loads can either be part of a district energy system or have potential for stand-alone biomass heating plants. BERC surveyed hospitals, other large institutional energy users, and state buildings in the county and created a list of potential wood-energy users.

BERC visited communities in Coos County on three separate occasions to make observations and collect data, surveying approximately 50 potential sites and buildings using a more focused set of criteria than was used for the community identification. From this, BERC developed a target list of more than 20 sites to explore further. Detailed heating data was gathered for as many of these sites as possible and a preliminary life-cycle cost analysis was conducted for each of the schools.

BERC’s study of Coos County identified six communities with reasonable biomass energy-use potential:

- Groveton
- Berlin
- Lancaster
- Colebrook
- Whitefield
- Gorham
BERC studied in greater detail the potential of community district heating systems for the six communities noted on the previous page and identified Groveton and Berlin as potential candidates worthy of further analysis based on the population density, vicinity of large “anchor” buildings, and layout of each town.

Fuel Supply Assessment. Understanding the fuel supply structure in a given area is a key first component to assessing the potential for woody biomass heating. While BERC did not receive Tillotson funding for this task, it did conduct a preliminary wood fuel supply analysis for the county as an in-kind contribution to ensure that the overall study was well-based. Three main components were explored in the fuel study:
1. Assessment of the forest’s capacity to supply low-grade wood for biomass energy
2. Evaluation of existing market demand for low-grade wood, and proposals for new large plants in the region
3. Identification of potential woodchip and pellet suppliers for facilities named in the site-selection process.

For the assessment of the forest’s capacity to grow wood, BERC identified a wood basket area of five counties, including and surrounding Coos County. Forest area, inventory, and growth data provided by the Forest Inventory and Analysis program of the USDA Forest Service was used to calculate the region’s sustained-yield capacity by means of methods and key assumptions developed by BERC.

For the assessment of the existing market demand and proposed projects, BERC telephone-interviewed many players in the forest products industry and others working to develop the proposed biomass energy projects. BERC used updated directories of sawmills in Vermont, New Hampshire, and Maine to identify potential sawmill suppliers of woodchips.

Additionally, BERC worked to assemble a comprehensive list of known logging contractors who own and operate whole-tree chipping equipment. This information was critically important in the site-selection process since the proximity of facilities being considered to a supplier is an important selection criterion.

STRATEGY 3: STUDY AND RECOMMEND MEANS FOR CREATIVE FINANCING FOR WOOD-ENERGY PROJECTS

BERC first examined ways that current school construction projects are financed in New Hampshire—through a combination of state aid to education and school bond financing. BERC analyzed the benefits and drawbacks of the current approach from the perspective of implementing school wood-energy projects, and then looked at conventional alternatives to these approaches through different types of grants and loans that might be available to school districts. Next, BERC studied various emerging and new means of providing capital for school wood projects, including municipal leasing, and examined the only currently available means to provide project finance assistance through monetizing the environmental benefits of a renewable energy system known as “green tag” payments.

The focus of developing new finance tools for school wood financing was then directed to payment out of savings, particularly through the use of energy services companies (ESCOs). BERC examined the benefits and drawbacks of the conventional for-profit ESCO approach to financing school energy projects, and laying the conceptual groundwork for a new type of nonprofit ESCO that would optimize the benefits of the ESCO approach while overcoming the aspects of ESCO project finance that are not beneficial to schools.
BIOMASS HEATING OVERVIEW

BENEFITS

ECONOMIC

Biomass systems in schools (and other publicly owned buildings) offer taxpayers not only savings, but also greater control over budgets. School decision makers and taxpayers alike have virtually no control over heating costs, and, in recent years, could only watch as these costs spiralled upwards. The only options were either to raise taxes or cut other budget areas to cover these increases. Wood biomass energy provides a means to control these costs as the price of woodchip fuel has remained relatively stable.

In addition to the direct fuel-dollar cost savings associated with using wood energy, there are other significant benefits to society from building and strengthening a vibrant wood-energy industry in the region. One is the local control and energy security benefits that come from replacing fossil fuels from outside the local economy with renewable fuels that are produced in the region. Another is the multiplier effect of strengthening the local forest products industry, maintaining existing and creating new jobs, and circulating energy dollars within the region’s economy — keeping the wealth at home rather than exporting it.

Community-scale biomass heating does more than merely provide a market for low-grade wood; it provides a long-term, stable market for this product rather than a single, large end user that might go out of business with changes in the global market.

Oil is the primary fuel currently used for heating in Coos County. In northern New England, the average annual consumption per square foot of heated space is approximately .46 gallon. The total area of the buildings identified as good candidates for biomass heating in this report has been estimated at about 2,064,000 square feet. If all of these buildings were to convert to biomass heating, an estimated 950,000 gallons of heating oil would be offset annually. To meet such demand, nearly 16,000 tons of woodchips would be consumed instead. Combustion of oil produces approximately 22 pounds of carbon dioxide for each gallon; sustainable, “carbon-neutral” biomass use would reduce the net amount of carbon dioxide contributed to the atmosphere by 10,450 tons annually. By using locally available biomass, the communities will avoid exporting more than $1 million by not purchasing oil, and at a price of $50 a ton for woodchips, approximately $800,000 would be added annually to the local economy.

Annual fuel savings for Coos County schools to switch to biomass range from $13,000 for the smallest of the schools to more than $95,000 for the largest schools in the county. Those savings can be passed on to taxpayers or invested in student education. $13,000 represents enough money to purchase new computers for a small school’s library and $95,000 can hire two new full-time teachers to lower student-teacher ratios, or, more likely, maintain teachers and programs that may otherwise need to be cut to pay for increasing fuel costs.
ENVIRONMENTAL

Emissions from Biomass

The emissions from wood-fired boilers are different than emissions from natural gas, propane, or oil. A number of these components are air pollutants and are discussed below. These emissions are typically measured in pounds of pollutant per million British thermal units energy input – or lb/MMBtu (a million British thermal units is the amount of heat energy roughly equivalent to that produced by burning eight gallons of gasoline or 250 pounds of woodchips).

In terms of health impacts from wood combustion, particulate matter (PM) is the air pollutant of greatest concern. Particulates are pieces of solid and liquid matter (or very fine droplets), ranging in size from visible to invisible. Relatively small PM—10 microns or less in diameter—is called PM10 and equal to one-seventh the diameter of a single human hair.

Small PM is of greater concern for human health than larger PM since small particles remain airborne for longer distances and can be inhaled deep within the lungs. Increasingly, concern about very fine particulates (2.5 microns and smaller) is receiving more attention by health and environmental officials for the same reasons. Work investigating wood-boiler emissions of very fine particulates is ongoing. BERC will actively engage in this discussion and recommend changes in combustion techniques and pollution-control options as appropriate based on the state of the scientific information.

Modern wood systems are clean burning and efficient and should not be confused with residential outdoor wood boilers or even modern wood stoves with respect to the amount of pollutants emitted. Unlike home woodstoves, there are virtually no visible emissions or odors associated with community-scale biomass systems. In addition, the respiratory health risk to a child attending a wood-heated school is negligible compared to the risk of living in a home where a wood stove is in regular use. Children are potentially at much greater risk from particulate matter in the exhaust of idling school buses than from wood-heating system emissions. Based on air emissions tests performed on small-scale wood-fired boilers, typical 2-3 million Btu input units without particulate control systems produce 0.12-0.15 lb/MMBtu of PM10. All but the very best wood burning systems, whether in buildings or power plants, have higher PM emissions than do corresponding gas and oil systems.

Sulfur oxides (SOx), nitrogen oxides (NOx), carbon monoxide (CO), and volatile organic compounds (VOCs) are other air pollutants of concern emitted during fuel combustion. Modern wood systems emit more SOx than natural gas, but have less than two percent the SO2 emissions of fuel oil and about 50 percent the SOx emissions of propane. Wood, propane, and fuel oil combustion have similar levels of NOx emissions; however, burning any of these emits almost twice as much NOx as combustion of natural gas.

All fuel combustion processes produce carbon monoxide (CO). The level produced by wood combustion depends very much on how well the system is tuned. Even so, wood combustion produces significantly more CO than oil, natural gas, and propane. This, in addition to PM, is a good
reason to make sure the stack is tall enough to disperse any emissions away from ground level. CO emissions from burning wood, however, are of relatively minor concern to air-quality regulators, except in such areas as cities that have high levels of CO in the air from automobile exhaust.

Volatile organic compounds (VOCs) are a large family of air pollutants, some of which are produced by fuel combustion. Some are toxic and others are carcinogenic. In addition, VOCs elevate ozone and smog levels in the lower atmosphere, causing respiratory problems. Both wood and oil combustion produces VOCs—wood is higher in some compounds and oil is higher in others. VOC emissions can be minimized with good combustion practices.

**Climate Change**

Unlike fossil fuels, biomass is a renewable, carbon-neutral heating fuel. Carbon dioxide (CO$_2$) build-up in the atmosphere is a significant contributor to global climate change. Fossil fuel combustion takes carbon that was locked away underground (such as coal, crude oil, and gas) and transfers it to the atmosphere as CO$_2$. When wood is burned, however, it recycles carbon that was already in the natural carbon cycle. Consequently, the net effect of burning sustainably harvested wood fuel is that no new CO$_2$ is added to the atmosphere. When biomass replaces fossil fuel, the net impact on climate change is positive, as it replaces a carbon-adding fuel with a carbon-neutral one.

### Forest Ecology

Sustainably harvested biomass energy is good for maintaining forestlands and forest ecosystems. Providing a market for low-grade wood contributes to the long-term management of a parcel of forest land as forest land. Without markets for low-grade wood, many forest parcels are increasingly logged once for the high-grade lumber and then sold for development. Properly done, forestry operations improve the health and ecological diversity of a forest resource. Woodchip heating systems provide a long-term, stable market for low-grade wood, allowing local forests to be managed for high-grade lumber, recreation, wildlife, and other ecological values, while serving to reduce the economic pressure on private land owners to sell forest land for development.

If all facilities identified in this report were to switch over to biomass heating, using an estimated 16,000 tons of woodchips annually, this would represent the sustainable management of approximately 53,280 acres of forest land.

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**Criteria Air Pollutants (in lb/MMBtu)**

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<tr>
<th></th>
<th>WOOD</th>
<th>OIL</th>
<th>NATURAL GAS</th>
<th>PROPANE</th>
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<tr>
<td>PM10</td>
<td>0.1</td>
<td>0.014</td>
<td>0.007</td>
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<tr>
<td>NOx</td>
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<td>0.143</td>
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<td>0.73</td>
<td>0.035</td>
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<td>0.021</td>
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<tr>
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<td>0.5</td>
<td>0.0005</td>
<td>0.016</td>
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<tr>
<td>CO$_2$</td>
<td>gross 220 (net 0)</td>
<td>159</td>
<td>118</td>
<td>137</td>
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</table>

Resource Systems Group, 2001
Biomass systems consist of fuel delivery and handling, storage, conveyance to the boiler, combustion in the boiler, and associated controls. Usually, these systems are housed in a dedicated building, or they can be integrated with other facility systems.

Biomass Technology Overview

The following are brief descriptions of biomass heating systems typically used in school and community building applications.

Fully Automated Woodchip Boiler Systems

Fully automated systems employ a chip storage bin, typically below grade, that can hold one and a half to two tractor loads of woodchips (35-50 tons). The bin is loaded by a self-unloading truck with no need for onsite staff assistance. From the chip storage bunker, the fuel is fed automatically to the boiler. No operator intervention is required for fuel handling. Vendor systems vary in terms of capacity and automation features.

Fully automated systems generally require very little operator attention—typically about one hour daily. They are a good match for buildings where the maintenance staff has a large work load and cannot spend much time on the heating plant. These systems are best suited to larger schools and other buildings with significant heat loads and high conventional fuel costs since the system construction costs are relatively high.

Equipment provided and installed by the vendor includes the automated equipment to unload the storage bin, fuel-handling equipment that carries woodchip fuel to the boiler (conveyors and augers), combustion chamber and boiler, combustion air supply fans, boiler connection to the stack, controls, safety devices, and possibly emissions-control equipment.

Semi-Automated Woodchip Boiler Systems

Fully automated woodchip heating systems, which feed the chips from the storage bin automatically to the boiler, can be very expensive. A more cost-effective alternative for smaller facilities with lower heating loads is the semi-automated system.

The semi-automated system is typically installed in an on-grade slab building that includes both a boiler room and chip storage (a chip pile on the slab floor). The system also includes a day bin fuel hopper of sufficient capacity to supply the boiler automatically for one-to-two days without reloading. In the fully automated system, fuel is delivered to the boiler with augers and conveyors. The day bin of a semi-automated woodchip system is loaded by an operator using a small tractor with a front end bucket or skid steer. Semi-automated systems have automated controls to manage fuel supply and combustion air, although the controls are simpler than those in a fully automated system. Semi-automated systems can range in capacity from 0.5 MMBtu/hour to 2.0 MMBtu/hour.

The attraction of a semi-automated system is that both the building that houses the system and the vendor equipment are less expensive than a fully automated system. The system takes the operator an estimated additional 30-minutes per day over the typical operation and maintenance time required for a fully automated system; this additional time is for loading the day bin. The semi-automated woodchip system is a good match for a smaller rural school or office building where the additional time in fuel handling is not a significant burden to maintenance staff.

Vendor supplied equipment includes the day bin and the automated fuel-handling system from the day bin to the boiler, the boiler and combustion chamber with combustion air fans, connection from the boiler to the chimney, and controls. No emission controls are anticipated for these small-scale systems.
On-Grade Slab Fully Automated Woodchip Boiler Systems

Fully automated, on-grade slab systems combine the functionality of a fully automated woodchip system with the lower capital cost of a semi-automated system. Fully automated systems incorporate conveyors and augers for all movement of chips, and semi-automated systems reduce capital cost by manually moving the chips to the day bin with a tractor. Fully automated on-grade slab systems use the chip storage of a semi-automated system, thus reducing building construction costs and the full automation of chip movement (although a small tractor or lawnmower equipped with the right front end may be needed to push chips).

Self-unloading trucks deliver chips to the storage area with no need for onsite staff assistance. The chips are stored directly on the floor at a two-foot level difference between the chip storage floor and the boiler room floor, rather than in a below-grade bin. From the chip storage area, the fuel is fed automatically through augers and conveyors to the boiler. No additional operator intervention is required for fuel handling. Not all vendors offer this version of a woodchip system. These systems are effective in a size range from 1-3 MMBtu/hour.

Like the conventional fully automated systems described above, these systems generally require very little operator attention, typically about one hour daily. Fully automated on-grade slab woodchip systems are a good match for buildings where the maintenance staff has a large work load with no available time to spend on the heating plant. These systems are best suited to larger schools and other buildings with significant heat loads and high conventional fuel costs since capital costs are relatively high.

Equipment provided and installed by the vendor includes the automated equipment to unload the chip storage area, the fuel-handling equipment that carries woodchip fuel to the boiler (conveyors and augers), the combustion chamber and boiler, combustion air supply fans, boiler connection to the chimney, controls, safety devices, and possibly emissions-control equipment.

Wood Pellet Boiler Systems

Pellet systems are fully automatic in fuel feed and ash removal, yet they offer low costs for both capital and operation.

In a complete pellet boiler system, fuel is stored in a relatively low-cost grain silo and automatically fed to the boiler or boilers with no operator intervention using the same auger systems used for conveying feed grain on farms. Pellets are discharged from the silo and automatically conveyed to the boiler’s combustion chamber. The fuel-handling system employs electric motors and is run by automated controls that provide the right amount of fuel to the combustion chamber based on facility demand. No operator involvement is needed for moving pellets from storage to boiler, and pellets, unlike chips, will not jam the auger system. Daily maintenance is limited to ash removal and the maintenance of motors and augers. The maintenance time for these systems is estimated to be about one hour per day, but is often less than that. These systems are effective in a size range from 150,000 Btu/hour to 1.5 MMBtu/hour.

Vendor-supplied equipment includes the metal fuel silo, fuel-handling augers, the pellet boiler, chimney connection, and automated controls. No emission controls are anticipated for these small-scale systems.

While pellets are more expensive per ton than chips, pellets can be more easily moved, using less-expensive, automated equipment.
DISTRIBUTED HEATING

District energy systems use one or more central plants to provide thermal energy to multiple buildings. This approach replaces the need for individual, building-based boilers, furnaces, and cooling systems. Underground pipelines from the heating (or cooling) plant to each of the connected buildings distribute thermal energy in the form of hot water, steam, or chilled water. Energy is then extracted at the buildings and the water is brought back to the plant, through return pipes, to be heated or cooled again.

District heating systems can provide space heating and domestic hot water for large office buildings, schools, college campuses, hotels, hospitals, apartment complexes, and other municipal, institutional, and commercial buildings. These systems can also be used to heat neighborhoods and single-family residences.

Municipalities can incorporate district energy into the infrastructure of their downtown business districts or encourage its use in such new developments as office building complexes and industrial parks. When local biomass fuels, such as woodchips, are used instead of oil or gas, the benefits of renewable energy can be brought to many buildings.

Advantages of District Energy

A district energy system—particularly one that increases the use of indigenous biomass—has the following advantages for both system customers and the surrounding community:

Low, Predictable Energy Costs. Higher fuel usage provides access to the lower costs associated with bulk purchasing. The use of locally grown biomass as a portion of the fuel mix further enhances the cost-stabilizing benefit of district energy. The price of wood fuel is not linked to world energy markets or unstable regions, but instead determined by local economic forces. For this reason, biomass systems do not experience the price instability of conventional fuel systems.

Fuel-Type Flexibility. Because a central heating plant can have boilers that burn different fuels, the option exists to use whichever fuel is the most economical at any given time.

Air Quality. Air quality improves—as does community livability—when emissions from a single, well-managed plant replace uncontrolled stack emissions from boiler plants in many individual buildings. The result is magnified when district energy systems, as they often do, replace multiple systems that use conventional fossil fuels.
If the central system uses wood fuel, the emissions of sulfur dioxide (which contribute heavily to acid rain) will decrease, while emissions of particulates and certain toxic air contaminants will increase. The emissions increases, however, do not result in a higher concentration in the air because of changes in the location of the emissions and the improved dispersion of pollutants resulting from a single tall stack. Yet another advantage in improving air quality with district heating is the ability to install best available technology emissions control equipment that may not be affordable in individual building heating plants.

**More Local Jobs.** Conventional energy systems require labor in fuel extraction, processing, delivery, operation, and maintenance as well as in system construction and installation. Fossil fuel supply is based on energy resources outside the community, thus, all jobs associated with extraction and processing are outside the local and regional economies. By contrast, jobs and most of the raw materials associated with wood fuel extraction, reforestation, and fuel transport are within the local and regional economies.

**Dollars Remain in the Local Economy.** Unlike fossil fuels that come from outside the northern New England region, wood fuel is a local and regional resource. The businesses associated with wood supply (logging operations, trucking companies, and sawmills) tend to be locally owned, retaining profits in the regional economy. These activities contribute to the state and local tax base. Conversely, the use of fossil fuels creates a net economic drain on a community and state.

**Revitalized Communities.** District energy infrastructure and stable rates improve a community’s business climate, make local businesses more competitive, help to revitalize downtowns and urban core areas so they can better compete with suburban sprawl, and, using biomass as the fuel source, help build a sustainable infrastructure.

**Reliable Equipment.** District energy systems have an unparalleled record of reliable service. They achieve this by well-managed central plant operation, using multiple fuels, having backup boilers in one or more locations, and having standby power at the central plant.

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**The concept of district energy dates back to ancient Rome,** where hot water was used to heat public baths and other buildings. Urban steam systems first became common about 100 years ago (the first North American system was built in 1877 in Lockport, NY), and modern hot water systems have been used extensively in Europe since the 1970s. Unlike parts of Scandinavia and Northern Europe, the United States has not significantly developed or used community-wide district heating technology. Today, as modern district energy rapidly gains acceptance, systems are being built in increasing numbers in cities and communities across North America.

**Reduced Environmental Risks.** District energy systems can help to mitigate environmental risks by consolidating fuel storage to one or a very few locations compared to numerous onsite storage tanks that serve individual buildings. Conventional onsite fuel storage includes underground and aboveground storage tanks. Aboveground tanks can pose fire hazards as well as the risk of dislodging in the event of a flood. Failing underground tanks can pose a threat to ground and surface waters.

**Power Generation Systems.** In addition to the need to find new ways to heat buildings, there should be new ways to provide electricity from locally available, renewable resources. Current technology using wood residues to fuel power plants is inefficient. New “emerging technologies,” such as gasification for both small-scale combined heat and power (CHP) and utility-scale power plants need to become commercially available and deployed for the benefit of regions like the North Country.

While this report focuses on using currently available technology for heating buildings with wood, there is a future opportunity for CHP when technologies now under development become mature.
MAJOR ACCOMPLISHMENTS

SITE SELECTION
The basic factors in determining if biomass heating is a good choice economically are the annual consumption of fuel and the price paid. Buildings fewer than 10,000 square feet in area generally do not have heating bills high enough to justify the costs of installing a fully automated woodchip heating system. Semi-automated systems and pellet systems provide an alternative for these smaller buildings.

Economics and Life-Cycle Cost Analysis
BERC has developed a 30-year Life-Cycle Cost (LCC) analysis tool. The tool is used to analyze the cost-effectiveness of purchasing, operating, and maintaining a woodchip heating system. Numerous inputs—including woodchip price, fossil fuel price, system cost, and operation and maintenance costs—are weighed against the annual cost of operating and maintaining the existing heating system. Two calculations are of particular interest when assessing the outcome of the LCC analysis: the first-year fuel cost savings and the 30-year net present value (NPV) of savings.

First-year fuel cost savings can be shown as a percentage or dollar amount. Facilities with a fuel cost savings of 40% or more are good candidates for woodchip heating.

Net present value (NPV) is the difference, in current-year dollars, between the value of the cash inflows and the value of the cash outflows associated with operating a wood system. A positive 30-year NPV of savings indicates, from society’s economic perspective, that the project is worth doing. A negative 30-year NPV of savings indicates that the project is not worth doing.

Candidacy for fully automated woodchip heating is dependent on the relationship between the amount of heating fuel used per year and the average price paid for the fuel. Good candidates for fully automated woodchip heating systems are buildings using more than 10,000 gallons of fuel oil per year (or the equivalent) and paying $2.50 or more per gallon. A school using 20,000 gallons of fuel oil per year would likely be a good candidate for a fully automated woodchip system if the price paid per gallon was $1.70 or more. Fully automated woodchip heating systems are likely cost effective for facilities using 30,000 gallons per year when the price is $1.30 or more per gallon; those using 65,000 gallons of fuel oil per year could afford to switch over to wood at a price of just over $1 per gallon. (These assessments were based on woodchips prices of $45 per green ton for large facilities and $50 per green ton for smaller facilities.)
Other Criteria

There are other factors to consider in addition to economics when considering biomass heating. There must be enough available area near the boiler room of the facility to construct a storage system for the woodchip fuel. While the size is not readily apparent because they are usually constructed below-grade, woodchip storage bins are quite large, sized to receive a full tractor trailer load of woodchips.

Access for the woodchip delivery trailers is another spatial issue. Unlike oil trucks that deliver fuel through long hoses and can park quite a distance from the storage tank, the self-unloading woodchip trailers must back directly up to the storage bin. Some facilities cannot provide access, and for others, this means additional construction costs to accommodate the trucks.

Shorter shipping distances mean less fossil fuels used for transport, keeping energy dollars in the local community in the fullest sense of the word. This may also keep woodchip prices low.

A site-specific feasibility study considering all the above factors will need to be undertaken before any financial decision is made on any of these pre-screened facilities or districts.

SCHOOLS

Schools are an excellent place to begin looking when considering heating with biomass. While huge savings are realized when switching from fossil fuels to woodchips, chip systems are expensive to construct and require a large initial outlay of capital, putting them out of range for other types of facilities.

Schools have access to sources of construction capital that other facilities do not. In New Hampshire, state funds help schools with construction costs. The state funding formula is based on the tax base of the community; Coos County towns receive 40-60% assistance from the state on construction projects. Schools can also acquire capital bonds with the voters’ approval for the rest of the capital, a fundraising mechanism not available to many other types of facilities.

Schools are also a good candidate for biomass heating because the savings are shared by the taxpayers of the entire community, making it a win-win situation for the local economy. Coos County school superintendents are enthusiastic about the potential for school wood heating.

Annual fuel savings for Coos County schools to switch to biomass range from $13,000 for the smallest of the schools to more than $95,000 for the largest. Those savings can be passed on to taxpayers or invested in student education. $13,000 represents enough money to purchase new computers for a small school’s library, and $95,000 will hire two new fulltime teachers to lower student-teacher ratios, or, more likely, maintain teachers and programs that may otherwise need to be cut to pay for increasing fuel costs.

Schools (from top clockwise): Berlin Junior High, Marston Elementary in Berlin, and Groveton Elementary.
BERLIN HIGH
75,000 SF, 600 students

The economics are very positive for a woodchip heating system. The school uses 50,000+ gallons of oil for heating annually at $2.39 per gallon. Heating with woodchips would save approximately $80,000 in fuel cost the first year alone. Net present value of savings for the project is $1,928,221. The woodchip system would pay for itself in about 10 years. There is appropriate area around the school to house a new boiler room and woodchip storage.

BERLIN MIDDLE/HILLSIDE ELEMENTARY/
MARSTON ELEMENTARY
143,700 SF, 700 students

This campus has very positive economics for woodchip heating. Berlin Middle is sited next to and interconnected with Marston and Hillside elementary schools. Collectively they consumed 63,700 gallons of heating oil in the 2006-07 heating season and currently pay $2.39 per gallon. The first-year fuel savings would be $2,479,934. The system would pay for itself in 8.3 years.

BROWN ELEMENTARY, BERLIN
12,000 SF, 200 students

The economics are positive for woodchip heating. The first-year fuel savings would be $25,708 and the net present value of savings for the project is $398,209. The school consumes a high amount of heating oil for its small size at 18,408 gallons annually. This school would benefit from bringing an energy conservation component into the overall project. As woodchip prices lower to economies of scale, this analysis assumes that smaller schools such as Brown are paying more for woodchips than larger schools with bigger heating loads ($50 per ton for smaller schools versus $45 for larger). If Berlin school district were to install more than one woodchip heating system and the chips were purchased collectively, the savings would be even greater.

EDWARD FENN ELEMENTARY, GORHAM
35,500 SF, 211 students

Edward Fenn is one of the smaller schools in the county. With an annual fuel usage of just over 10,000 gallons, a fully automated woodchip system would not be economically feasible at current oil prices. A pellet system would be a better choice economically, with a first year fuel cost savings of $3,316 and a net present value of $14,980 in savings. It is the least economically positive candidate for school wood heating in Coos County. As oil prices continue to rise, the economics will become more positive.

GROVETON HIGH
57,573 SF, 300 students

Located in downtown Groveton, this school would benefit if the proposed biomass district heating system in Groveton is built. If not, a pellet system would be a better option than a woodchip system. While the economics are favorable for a woodchip heating system, the downtown location that works in the school’s favor for district heating works against it for woodchip heating. There is limited area around the school and would be difficult to find space for woodchip storage. A pellet silo would be a better fit onsite. Economics for a pellet system yield a first-year fuel savings of $15,804 and a net present value of savings of $553,286. The system would pay for itself in 9.4 years.

GROVETON ELEMENTARY
29,678 SF, 200 students

This school uses 13,000 gallons of oil annually. Like Groveton High, it is downtown so can take advantage of district heating if built, but its downtown location also impacts the space available for construction of a stand-alone system. While the economics for a woodchip system are somewhat favorable, the logistics of the site and the economics are better for pellet heating. With the installation of a 1.0 MMBtu/hour pellet system, it would save $8,933 the first year. The net present value of savings for the system would be $220,793. The pellet system would pay for itself in 16.7 years.
GORHAM MIDDLE HIGH
67,635 SF, 350 students
The economics are positive for a 2 MMBtu per hour fully automated system with a first-year fuel savings of $22,556 and a net present value of $175,842.

LANCASTER ELEMENTARY
52,000 SF, 500 students
The economics are somewhat positive for this school to install a 1.0 MMBtu/hour woodchip heating system. In the last heating season, the school used 19,198 gallons of oil. It would save $18,911 in first-year fuel costs and the net present value of the savings is $132,443. With a pellet system of the same size, the school would save $4,089 in fuel costs in the first year, but the lower cost of constructing and operating the pellet system yields a net present value of savings of $136,441. A woodchip system would pay for itself in 29.1 years; a pellet system in 21.8 years.

WHITEFIELD ELEMENTARY
52,200 SF, 326 students
Whitefield has an annual fuel consumption of 16,200 gallons of oil. School officials report paying a relatively low price for heating oil—$1.84 per gallon. These low oil costs yield barely positive economics for a woodchip heating system. Economics for a pellet system are better, with a first-year fuel savings of $2,726 and a net present value of savings of $58,993. As heating oil prices continue to rise, a biomass heating system will become more economically attractive.

OTHER PUBLICLY OWNED BUILDINGS
Coos County has several buildings owned by state agencies or municipalities large enough to merit investigating biomass heating. These buildings can be good choices for woodchip heating because, like schools, they have access to tax dollars from states and municipalities to construct the system, and can pass fuel savings on to taxpayers. Many state agency offices in the county, however, are located in buildings too small to be good candidates for individual biomass heating.

NORTH COUNTRY RESOURCE CENTER, LANCASTER
The North Country Resource Center and Fish and Game offices in Lancaster is one of the buildings potentially suited to biomass heating. The site consists of an administrative building and several garages and outbuildings. The administrative building alone is likely large enough to merit a pellet system and combined with the heat load of the additional buildings on site may be large enough for a semi or fully automated woodchip system.

COOS COUNTY SUPERIOR COURT HOUSE, LANCASTER
Downtown Lancaster has a particularly intriguing possibility. The new Coos County Superior Courthouse is large enough to merit an investigation of biomass heating on its own accord. It is also separated from two other municipal buildings, Weeks Library and the Lancaster post office, by a swath of lawn. If biomass heating is studied in more detail for the courthouse, it would make sense to investigate the economics of the project if the system were sized to heat these two other buildings as well. Buried pipe could be laid through the grassy lawns in between, and all three buildings could be heated off the same system.

NORTHERN NH CORRECTIONAL FACILITY, BERLIN
A 500,000-square foot correctional facility is being built in Berlin. The federal government assessed using a variety of heating fuels—including biomass—and decided on conventional oil as the primary source. Current plans call for one of the boilers to have wood-pellet capacity. Construction on this project has already begun and will be completed in the spring of 2008.
APARTMENT COMPLEXES
Apartment complexes can also be good candidates for biomass heating. A low-income housing development in Barre, Vermont has had great success with its woodchip heating system, saving fuel costs for both residents of the complex and taxpayers alike. The Berlin Housing Authority operates a subsidized housing complex at Serenity Circle in Berlin. A woodchip heating system might be a good possibility for this site.

HOSPITALS
Hospitals tend to have a high heat load for their sizes and can benefit from the cost savings of biomass fuels. The North Country Hospital in Newport, Vermont has been successfully operating a woodchip heating plant since the late 1990s.

There are two large hospitals in Coos County, Weeks in Lancaster and Androscoggin Valley in Berlin. Both facilities are large enough to merit further investigation of biomass heating. The Weeks Hospital also has a physician’s office across the street that may be large enough to consider a pellet system or, if a woodchip system were built at the hospital, a pipe connection to enable it to be heated from the hospital’s wood plant.

COLLEGES
Colleges can be good candidates for biomass heating. There is one college in Coos County, the New Hampshire Community College in Berlin. Most of the campus is in a single building, with two smaller outbuildings across the street. The central building is on the smaller side, therefore a pellet system may prove to be more appropriate.

PRIVATELY OWNED BUILDINGS
Woodchip heating can be a good choice to heat large residential and commercial buildings as well, but it can be difficult for private owners to obtain the initial capital to install a biomass system. The payback periods on the boilers can exceed the life of a private-sector loan. Many business owners, however, motivated to reduce their carbon footprints and dependency on foreign energy, have successfully installed biomass heating systems as long-term investments that pay a return.

Several privately owned buildings are good candidates for biomass heating in Coos County.

The McIntyre School Apartments in Whitefield are one of two senior living complexes in the county. The building was converted from the former high school building on Highland Street. It is likely a better match for a pellet than a woodchip system because of the small building size and limited space around the facility for development. Truck access could pose a problem and would need to be studied in further detail.

The St. Regis Home for the Elderly in Berlin is a converted monastery and one of the larger buildings in downtown Berlin. It is likely large enough for a woodchip system, but space constraints may dictate a pellet system.

The Mount Washington Regional Airport is located on Hazen Drive in Whitefield. With a terminal building and lounge and many outbuildings, the airport has one of the larger areas of heated space in the county. Neither space for construction or truck access should be an issue at this site.
The **Gorham Historical Society and Railroad Museum** in Gorham is another good possibility. The facility consists of a converted rail station and several outbuildings of exhibits. The combined heat load of all the facility’s buildings may be large enough to investigate woodchip or pellet heating.

Perhaps the best candidates for private-sector biomass heating in Coos County are the Mountain View Grand Resort and Spa and the Mount Washington Hotel.

The **Mountain View Grand Resort and Spa** in Whitefield is one of the area’s famed grand hotels, constructed in 1865. It has a very large heat load and thus would save proportionately on its heating bill if it were to switch over to woodchips. The Balsams Grand Resort Hotel in Dixville Notch is a successful model of heating a large resort of this period with woodchip fuel.

The **Mount Washington Hotel** in Bretton Woods on the southern side of Coos County is also an excellent candidate for a fully-automated woodchip heating system. The Mount Washington is in the early stage of building a significant residential complex on the property, now in the public hearing phase. A large new construction project like this presents a key opportunity to install a central biomass heating plant to heat the entire property—including the hotel—since money that would be otherwise spent on individual building boilers could be put toward the cost of the central wood plant. Now is the time to put the wood option on the table so that the opportunity will not be lost to heat the new buildings with a local renewable fuel instead of expensive fossil fuel, an opportunity that will be much more expensive to take advantage of in the future. The hotel also has an opportunity to create a green marketing advantage.

Several of these buildings, most notably those in Berlin with space constraints that would tend to favor pellet systems, may benefit from a community (district) heating system that operated on wood chips instead; The following section discusses community heating systems using biomass fuel in more detail.
COMMUNITY HEATING SYSTEMS

The impact of modern wood-heating technology on the economies of rural, forested areas can be increased through creating wood-fired community district energy systems that serve the heating needs of whole downtown areas of small and large cities. While this technology is not common in the United States, it is widely used in Scandinavia, Austria, and other European countries, particularly those with aggressive climate-change mitigation and carbon-reduction policies and programs at the national level. The largest example in the United States is District Energy St. Paul, a 20-year old nonprofit energy company in Minnesota that uses biomass to heat, cool, and supply electricity to all of downtown St. Paul.

Community or district energy systems require one or more buildings with large heating loads—termed “anchor” buildings, such as hospitals and large schools. Community district energy projects tend to be capital intensive, like any other type of municipal infrastructure. The communities of Coos County are considerably smaller than those normally considered for community energy systems based on building size, number of buildings and density of heating energy use.

The challenge in this first phase of work was to determine whether small-scale, wood-fired community energy systems have potential for the larger communities of Coos County. Two communities with the best potential are Groveton and Berlin, followed by Lancaster. A small, three-building district system for Lancaster has already been discussed. Because there is considerable interest in district energy for Groveton—including an Economic Development Administration grant-funded study soon to commence—BERC has presented the Groveton example in some detail and intends to make this information available to the community and the contracting firm.

**GROVETON, NH**

**Residential Housing Area** (based on number of rooms in 519 houses as of 2000 census)

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<th>Est. SF/House</th>
<th>Total SF</th>
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<td><strong>Total</strong></td>
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District Heating Project in Groveton. With about 8,900 heating degree days annually (the total number of degrees Fahrenheit that each day’s mean temperature is below 65 degrees), Groveton is one of the colder locations in the continental United States. The town has total population 1,197, with 519 houses for 323 families. The area of the town is 2.2 square miles, having the house density of 236 houses per square mile.

The total estimated residential area is 896,800 square feet. Assuming that it will be feasible to cover two-thirds of the area by a district heating system, the estimated residential area that can be heated by the system is approximately 600,000 square feet. The estimated peak load for this area will be 20 MMBtu/hour. Currently, 93% of the houses in the town use oil for heating.

Groveton has one elementary school with 226 students and an estimated annual consumption of 13,000 gallons of oil, and a high school with 284 students and estimated annual consumption of 23,000 gallons of oil. Both schools could be heated by a district heating system. The peak combined load for the schools would be approximately 3 MMBtu/hour.

Other major buildings in Groveton with estimated present use of oil are listed below, followed by the estimated fuel use in gallons for each:

- Roehl Transport: 3,500
- Emerson Outdoor Outfitters: 8,000
- Emerson & Son Hardware: 3,500
- St. Francis Xavier Hall: 6,500
- St. Francis Xavier Church: 6,000
- United Methodist Church: 8,500
- St. Marks Episcopal Church: 3,500

Total: 39,500

There are other buildings along the proposed district heating route, including the town garage and town dump, Grey Mist Farm, a Department of Transportation garage, an American Legion, a funeral home, the outdoor town pool, two banks, a post office, the town offices, a laundromat, two grocery stores, an auto parts store, a pizza parlor, and senior apartment complexes. The total estimated peak load for all of the above will be about 7 MMBtu/hour. Thus, the total peak heat load including residential buildings is estimated to be about 30 MMBtu per hour.

FOREST PRODUCTS INDUSTRY

Groveton is one of the major industrial towns in Coos County with a long history of supporting forest-based industries, the existence of a committed and talented work force, and access to supporting infrastructure. It had two paper mills near the entrance to town. The larger mill, Groveton Paper Board, discontinued its operation in the spring of 2006. Another paper mill, Wausau Paper, was also closed as of January 1, 2008. The Wausau Mill has a 7.5 MW gas turbine with 170,000 lbs/hour heat recovery steam generator, a 6 MW steam turbine, and additional boiler capacity. The boilers and gas turbines at both of the facilities are likely still functional whereas it may be possible to use them for a new combined heat and power (CHP) project. The idle capacity for a CHP project makes the potential for a district heating system very attractive. A large CHP project can offer economical electricity and thermal energy to any new industrial development in the town. It would be instrumental in drawing new industrial development and reviving the town.

PROPOSED RENEWABLE ENERGY PARK

Tamarack and XGenyses corporations are collaborating with North Country Renewable Energy LLC (NCRE) on a project in Groveton called the Groveton Renewable Energy Park, which intends to construct a biomass electrical generating facility and a renewable biofuels production facility. Plans include constructing a wood-fired power generation facility along with a biofuel production facility. Up to 1.2 million tons of whole-tree woodchips and clean biomass materials such as forest residues, low-grade wood, and other clean wood products will be used as fuel annually. A 45-75 MW project would create 300-350 construction jobs and directly create 150-250 permanent jobs in addition to hundreds of secondary jobs for local businesses, including foresters, loggers, and truckers. The project is still at the proposal stage with plans for implementation still being considered.
The proposed site for the renewable energy park is at the north end of town and the paper mills are at the south end, approximately 3.5 miles apart. There are large number of options for generation, transmission, and use of both electrical and thermal energy at different locations in the town. A hot water district heating system can connect the renewable energy park and the new facilities at the paper mills, providing the thermal energy on the way to every building in the community and surrounding area.

With the district heating system, each building would have an energy transfer station to exchange heat from the hot water network to heat building spaces and provide hot water for domestic use. The district heating system can also provide snow melting (using the cooler return water) and other residential and industrial heating needs. Each transfer station will include a meter to measure energy, flows, and temperatures that are reported to a real time metering network with a web interface. Hot water absorption chillers can also be installed to provide cooling during the summer, thereby reducing electrical demand for air conditioning in the summer.

District heating in Groveton can provide favorably priced steam, hot water, and electricity to closely located industrial users, aiding in cost reductions and increasing the long-term viability of both the existing industries and new development.

The district heating system would multiply the benefits of biomass heating by providing biomass heat to homes and facilities too small to consider a heating system on their own. This added value will help retain or create jobs while having other direct and indirect benefits.

Another goal is to help maintain stable markets for low-grade wood. Energy produced from domestic renewable resources reduces dependence on imported oil, creates new job opportunities, and expands economic growth.

There is a possibility to create a 501(c)(3) not for profit entity for the project. The project could possibly be funded by the Nonprofit Bond Financing Program of the New Hampshire Business Finance Authority, according to University of Rochester professor Morris Pierce.

BERC has played a role with both local and state agencies and organizations to further develop the idea of biomass district heating in Groveton. One of the active local organizations is the Groveton Regional Economic Action Team (GREAT). North Country Council (NCC), a regional planning body, has been awarded a grant from the US Department of Commerce, Economic Development Administration in support of Coos County’s Economic Adjustment Implementation Plan. The North Country RC&D (NCRCD) is assisting NCC by carrying out a preliminary feasibility study for a district heating project at Groveton.

The objective of the project is to support growth of new business and industry, reduce heating costs for residents, churches, and commercial and municipal buildings, and maximize energy conversion efficiencies for the producer (biomass or other fuel power plant). There may also be opportunities to facilitate maintenance of existing municipal systems such as water and sewer lines during the construction phase of the project. The use of local, renewable energy supplies, such as biomass, is an additional objective.

NCRCD’s role is to administer the development of a preliminary feasibility analysis that would define the benefits, costs, and other information to install a steam and hot-water system within the Village of Groveton. NCRCD has organized an advisory committee that is overseeing this study project. Although the project has been awarded to another contracting firm for feasibility and design work, BERC will maintain a working relationship with the advisory committee and share its findings with the contractor.

Thus far, BERC attended a meeting in Groveton on April 5, 2007 to discuss the concept of district heating systems, and the Groveton co-location/district heating advisory committee had its first meeting on August 21, 2007 where BERC explained the work to be done under the Tillotson Grant.
District Heating in Berlin. Since the feasibility of district heating in Groveton is now being assessed at the conclusion of Phase I of BERC’s work, BERC will focus greater attention on Berlin in Phase II. Its downtown area is well-suited for district heating with most of the buildings contained in a compact business district along Route 16. There are currently no plans for district heating in Berlin, thus the type of preliminary assessment noted above for Groveton would be necessary for Berlin. Some preliminary work has been done already, and is discussed below.

The population of Berlin was 10,331 in the 2000 census. In July 2006, estimates reduced that number to 9,954. The land area is 61.7 square miles. The population density is about 163 people per square mile.

The public schools in Berlin include Berlin Senior High, Hillside Elementary, Berlin Junior High, Brown Elementary, Bartlett Elementary, and Marston Elementary. There is one private school—the St. Michael Catholic School. The public schools use an annual total of 135,367 gallons of fuel oil, for a heat load of 2.2 MMBtu per hour, however, the larger schools are located outside the downtown area.

The other important buildings in the city are the Androscoggin Valley Hospital, Berlin Public Library, Northern Forest Heritage Park, the Post Office, Berlin City Juvenile Court, Northway Bank, Citizens Bank, Brown Company House, Northern White Mountains Chamber of Commerce, Christian Life Center, Berlin City Hall, and about nine churches, two hotels, 17 dining places, and about 30 shops and general services buildings. The New Hampshire Community college and the correctional facilities are located away from the downtown.

Most of the above buildings are relatively small in size, therefore individual biomass heating systems may not make sense. The potential of a community heating system for the whole community or a group of some of the above buildings is worthy of further examination.
A NEW HAMPSHIRE FUELS FOR SCHOOLS PROGRAM

OPPORTUNITIES
Converting buildings and institutions to wood heating can serve as the foundation for a whole new biomass energy industry that will make Coos County a renewable energy model for the rest of New Hampshire and the nation. Stimulating the development of the first few successful wood-energy conversion projects creates demonstrations and models that inspire, educate, and assure other public entities and building owners. This incremental approach will take time to grow to a level of providing significant impact and benefit for Coos County.

An alternate, more aggressive approach is to set up programs designed to identify and overcome barriers to widespread implementation. There is growing recognition of the need to develop such an aggressive program in the form of a statewide Fuels For Schools (FFS) program. A programmatic approach will stimulate the conversion of more buildings, create a powerful critical mass of successful installations, and provide significant societal benefits in a faster time frame.

Fuels For Schools Program
Biomass heating technology is already being used successfully in several areas of the United States and Canada to reduce heating costs for schools and other institutions. FFS programs that promote wood heating in schools are growing across the country. The program concept started in Vermont and is now being refined by BERC and its state agency partners as the Vermont Fuels For Schools (VFFS) initiative.

Currently, 20% of all public school students in Vermont attend a wood-heated school, with the number of schools above 30 and growing rapidly. This has been done, over 20 years, without creating any full-time state or federal government positions to administer the program. A key ingredient to the success of VFFS was the existence of state 30% capital cost-share grants for all necessary school construction projects, and legislative action that raised the cost-share level for wood and other renewable energy projects to as much as 90%.

Critical to the success of the program has been close cooperation among state energy, forestry, and education departments, the Vermont Superintendents Association, and equipment vendors interested in expanding this market. These parties have been coordinated and supported by BERC through the years.

The US Forest Service (USFS) created the Fuels For Schools name and is actively promoting the program in five western states that have significant federal forest land. The program started with the first successful school woodchip project west of the Mississippi in Darby, Montana, designed and managed by BERC and its subcontractors. The USFS, in cooperation with state forestry agencies, has a growing number of projects in Montana, Idaho, Utah, Nevada, and North Dakota that have been very successful at coordinating the roles of key players in biomass utilization and development in each state. While the program (now named “Fuels For Schools and Beyond”) initially focused on schools, the envisioned New Hampshire program will extend its scope to cover college and university campuses, municipal buildings, and other public, institutional, and private facilities in the state.

NH Community-Scale Biomass Heating Program
BERC is working closely with the New Hampshire state education, energy, environmental services, forestry agencies, and other stakeholders to develop a New Hampshire Fuels for Schools (NHFFS) program to create institutional and programmatic support for wood-energy projects in the state.

BERC has been developing the program concept with these partners since 2005 and strengthening the effort through the North Country Forest Energy Project with funding from the Tillotson Fund, the US Department of Energy, and other sources. BERC attended key meetings over the last year and helped organize participants focused primarily on schools and other institutional buildings, working closely with the North Country RC&D (NCRC&D). NCRC&D formed a program advisory group of which BERC is a member. BERC presented the NHFFS program concept in a North Country RC&D-coordinated meeting with the North Country Superintendents Association.
The title “Fuels For Schools” was found to be limiting. The advisory group chose the name New Hampshire Community-Scale Biomass Heating (NHCSBH) program, extending its scope beyond the Fuels For Schools concept to include other state buildings interested in converting to biomass heating.

NHCSBH is a partnership of federal, state, and private agencies. The program is being designed to coordinate the efforts of all partners to install cost-effective biomass heating systems and can provide a comprehensive set of biomass fuel options and resources for Coos County and the State of New Hampshire.

Program Partners
The major program partners and members of the advisory group of the NHCSBH Program are listed below with brief descriptions.

The North Country Resource Conservation and Development (RC&D) Area Council. The RC&D Area Council was established to address problems and opportunities in New Hampshire’s North Country, encompassing the counties of Belknap, Carroll, Coos, and Grafton. Its mission is to facilitate cooperative action and inspire leadership with people, organizations, and communities for a sustainable economy rooted in the conservation and development of our natural resources.

North Country RC&D convened the advisory group of stakeholders and interested agencies to promote Fuel For Schools in New Hampshire, as described above. As the program coordinator, North Country RC&D is committed to move this program forward.

NH Department of Education (NHDOEd). NHDOEd provides educational leadership and services that promote equal educational opportunities and quality practices and programs that enable New Hampshire residents to become fully productive members of society. School Building Aid is a program through which the state provides financial assistance to local school districts for construction or substantial renovation of educational facilities for grades K-12. School districts may receive up to 60% of the cost of construction, land acquisition, planning & design, furniture, fixtures, and equipment.

NHDOEd also provides information and technical advice on planning, construction, and maintenance of school facilities. The aid is made available for bond payments. Aid is provided based on two specific formulas: using the number of towns involved in a cooperative school district or the median family income of the population within the school district.

NHDOEd is supportive of the NHCSBH program and has agreed to assist in its development, including being the first contact point for schools interested in NHCSBH. Other possible points of entry to the program are the NH School Board Association, NH Superintendents Association, and NH School Administration Association.

Salem and Litchfield High Schools have already expressed interest in the NHCSBH program and there are 30 schools with upcoming construction projects that might also benefit from it.

NH Office of Energy and Planning (OEP). OEP is part of the Executive Department within the Office of the Governor, and responsible for exploring opportunities to expand the use of renewable, domestic energy resources such as biomass, wind, and solar. OEP provides information, data, and guidance to assist decision makers on issues pertaining to development, land protection, energy use, and community planning. OEP guides the state’s future growth through public policy development, education, research, and partnership building. OEP could be the contact point for businesses interested in biomass heating as its business outreach centers are well positioned to do this.

NH Partnership for High Performance Schools (PHPS), Jordan Institute. NHPHPS, an initiative of The Jordan Institute, was founded in 1995, and is a science-based, non-advocacy, nonprofit organization, developing initiatives that focus on the intersection of a healthy environment, healthy people, and a healthy economy. It works to increase the number of high performance schools constructed in the state in partnership with the Henry P. Kendall Foundation, Public Service of NH, NH Office of Energy and Planning, NH Department of Education, and NH Department of Administrative Services.

The advisory group chose the name New Hampshire Community-Scale Biomass Heating (NHCSBH) program, extending the program beyond the scope of the Fuels For Schools concept to include colleges, hospitals, and other state buildings.
The Jordan Institute, through NHPHPS, has been helping to develop the NHCSBH program by promoting installation of biomass heating systems in schools and has been working with more than 15 NH schools interested in wood heating.

**Division of Air Resources, NH Department of Environmental Services.** The division’s mission is to achieve the maximum reductions in emissions of pollutants that pose the greatest risk to public health and the environment, as quickly as possible, and as cost effectively as possible. With guidance from the New Hampshire Air Resources Council, it is committed to promoting cost-effective, sensible strategies and control measures to address today’s complex and interrelated air quality issues. These issues include, but are not limited to, ground-level ozone, particulate matter, regional haze (visibility), mercury emissions, increasing concentrations of greenhouse gases, acid deposition, and air toxics. BERC has been in contact and met with the DES in discussing how best to promote the NHCSBH program.

**University of NH (UNH) Cooperative Extension Services.** UNH Cooperative Extension provides New Hampshire citizens with research-based education and information, enhancing their ability to make informed decisions that strengthen youth, families and communities, sustain natural resources, and improve the economy. UNH Cooperative Extension is a partnership of public, private and community resources focused on New Hampshire’s natural resources, families, communities and youth. UNH Cooperative Extension Service strengthens communities through a Community Profile process, involving local citizens in identifying community issues and creating strategies for working together to address them.

**New England Wood Pellet.** New England Wood Pellet, a pellet fuel manufacturer and distributor, provides wood pellets, a renewable biomass energy source, contributing to reducing the nation’s overdependence on fossil energy. Its Jaffrey plant, in southeastern New Hampshire, produces approximately 75,000 tons per year of premium and standard grade wood-pellet fuel. Most is bagged and shipped to retailers throughout the northeast, but also delivered in bulk by truck to larger pellet users. The plant purchases nearly 175,000 dry and green tons of wood residues each year from sources throughout the Northeast, providing a valuable market for wood waste and low-grade timber resources.

Other members of the advisory group are:
- NH Division of Forests and Lands
- NH Sustainable Energy Association
- US Department of Energy
- Public Service of New Hampshire
- Northeast Regional Biomass Program
- NH Timberland Owners Association
- Center for Rural Partnerships, Plymouth State University
- NH Local Government Center

**Meetings of the NHCSBH Advisory Group.** The advisory group held its first meeting on November 1, 2005, and to date has held seven more (November 2005; August and September 2006; April, November, and December 2007; and January 2008). NH Department of Education and the Office of Energy and Planning have been identified as the best points of contact for interested schools and communities. It was also suggested that the NH Local Government Center could be an alternative as well as the previously listed organizations that serve the school administration community.

In 2005, BERC was invited to provide information and become part of the group. Out of the above meetings, BERC attended four (September 2006; April and November 2007; and January 2008). BERC will continue to work with North Country RC&D to further define and organize the NHCSBH program.

**Program Challenges**

Some challenges identified by BERC and the advisory group are:
- Efforts need to be made to educate the public on the value and potential of wood waste as a pertinent renewable resource
- Schools are risk adverse, usually not wanting to be on the “leading edge” when it comes to critical services like building heating
• Motivation for the public sector may be different than for other markets and could therefore need different outreach strategies

• Operating costs are always viewed separately from construction costs. Initial construction cost will be an issue in New Hampshire. A super majority is needed by state law to pass bond issues. If not all, most of the communities in Coos County would qualify for the 60% state construction aid; however, even with this level of aid, small communities still find it difficult or impossible to initiate school construction projects

• There are limited financing options for biomass heating projects for community buildings, and no state funding currently available for such projects

• The small size of the projects, hence savings, is generally not sufficient to attract involvement of energy service companies (ESCOs)

• A funding source needs to be identified for the advisory group to hire technical support and provide cost-share funds for preliminary feasibility studies

• There are expressed concerns over the wood supply reliability and wood fuel price stability

• The wood supply infrastructure is not mature; current suppliers of chips and pellets are not used to dealing with customers like schools or other institutions

• There is no established bole woodchip supply infrastructure. There is a need for funding to help loggers determine the business feasibility of producing bole chips

• There is skepticism about institutional wood-heating systems among architects, engineers, and general and mechanical contractors

• The length of time for studies, engineering, and planning is a barrier to projects moving forward

• There is no state or regional voice actively promoting smaller-scale biomass heating systems for institutional and commercial sites

**NHCSBH Program Goal and Objectives**

The goal of this program would be to promote and encourage the use of low-grade wood residues from the forest products industry and direct forest harvesting as a locally available, renewable energy source for heating and powering schools, universities, and other public and community-scale facilities. BERC has articulated and proposed the following objectives:

• installing cost-effective, successful biomass heating systems

• further developing prospects for alternate biomass system and fuel options, including semi-automated, pellet, and other biofiber systems

• assessing, reporting on, and developing the biomass fuel supply market

• increasing vendor competition and raising the bar on technology development

• collecting and managing data on biomass heating systems in New Hampshire schools, college campuses, and other state, public, institutional, and commercial facilities

• educating the public on the benefits of heating with woodchips and pellets

**Demonstration Projects**

Wood-heating projects in public schools in Coos County need to be advanced to the implementation phase. A good first step would be to construct new or showcase existing projects as demonstrations. This strategy addresses the fact that the goal of real, effective assistance to communities in considering the potential for using local wood for heating buildings cannot be met without on-the-ground project development and creating programmatic structures to support project activities over the long term.

Several schools and facilities previously studied would be excellent demonstration projects that could be developed under the NHCSBF program. Once these projects are constructed, other schools and facility owners can look to them as examples. For this reason, it is critically important that initial projects be successful.

Once projects are constructed, other schools and facility owners can look to them as examples. For this reason, it is critically important that initial projects be successful.
Under the NHCSBH program, demonstration projects will be supported by BERC through:

- Determining the appropriateness and cost effectiveness of wood heating
- Assisting in setting up, designing, and implementing projects
- Providing wood fuel specifications and help in soliciting bids from fuel suppliers
- Developing wood fuel procurement strategies and contract provisions to strengthen relationships with fuel suppliers
- Providing commissioning, testing, and monitoring services during the first year of operation.

Monitoring activities will allow the program partners to collect data on newly constructed systems to inform measures to improve projects and the program as a whole in the future. These projects will serve as examples to schools or facilities that may wish to convert in the future, and commissioning reports is an excellent way to disseminate information on projects as well as a way to document lessons learned and the successes of the projects and program to state and federal agencies.

**Defining the Roles of Implementing Partners**

The following are some ideas for programmatic approaches to implementing wood-heating projects in Coos County. There are different approaches to how such programs can be designed and implemented. In BERC’s experience, it is not necessary to create new government bureaucracies or even an expansion of permanent jobs in state government to achieve the desired results, particularly when installations can be driven by the dollar savings that accrue from converting from expensive imported fuels to significantly less-costly local fuels.

A program approach might first identify and study other similar candidate facilities in Coos County and the rest of the state. The advisory group needs to advance the ideas in close coordination and partnership with existing efforts to identify opportunities and barriers. The complementary actions of each partner participating in the NHCSBH program will promote the use of biomass heating in New Hampshire schools and other facilities as a sustainable resource with local economic benefits.

The advisory group should streamline the process of identifying schools that are likely to show positive economics. An agency should be identified to act as a clearing house for biomass projects in the state, providing staff technical support for schools and help with permitting issues. Two points of contact—one for schools and another for businesses—would be useful.

The next activities by the advisory group include working with the North Country RC&D to convene action-oriented organizational meetings that further identify partners and stakeholders in establishing the NHCSBH program, and assessing the willingness and interest of various state and other agencies to play active roles in the program.

**NHCSBH Program Elements**

**Information and Education.** Information and education provide an inexpensive means to make programs and initiatives more effective, and increase the general public acceptance necessary for implementing projects particularly when it is unfamiliar with the technology for institutional wood energy. The types of resources ideally developed would include educational materials and presentations, technical information and specifications, system information, and vendor and fuel-supplier directories, among others.

Under the NHCSBH program, the implementing partner would be responsible for providing information and assistance to schools and facility owners interested in converting to biomass heating. The group should organize workshops and presentations to excite candidate users of the technology potential, and opportunity. It could conduct tours to demonstration projects and provide expert witness support for public and permit presentations. Providing public education for decision makers and the voting public is also critically important in public-sector project development, and is needed as part of the decision-making process.

Providing ready access to good information about wood-energy technologies and their applications is essential to any biomass energy initiative. The advisory group should assemble an information package with all pertinent facts and figures for targeted users of the technology. An initial information packet should be provided to any school or facility interested in heating with biomass.
The packet would contain the program description, benefits of heating with a cost-effective, locally available and renewable fuel source, information on technology, and next steps in pursuing conversion to biomass heating.

**Training for Design Professionals.** Well-informed design professionals—engineers and architects—are critically important resources for implementing successful projects. While many skilled design professionals will be willing, eager, and capable to take on a new challenge, it is not BERC’s experience that successful projects can be carried out by professionals who have had no prior experience with wood-energy systems. These professionals need specific technical assistance, assistance that BERC is experienced in providing. Trying to re-invent the wheel has been the source of many failed or less-than-successful biomass energy projects. The advisory group, with the assistance of experts, must create professional training packages for design professionals based on past experience in implementing successful projects.

**Feasibility Studies.** The advisory group would help the facilities identify experienced consultants to carry out feasibility studies for establishing the viability of a biomass heating conversion project. Any school or facility interested in converting to biomass heating should be a good match for the technology. A preliminary assessment of logistical feasibility can be done over the phone or during a site visit, at which time basic data on the space and heating requirements can be collected and analyzed. A more in-depth financial analysis can then be performed using a life-cycle cost analysis tool. The advisory group needs to find program dollars to fund the feasibility assessments.

**Wood Fuel Supply Assistance.** Since the closure of paper mills in Berlin and Groveton, there has been tremendous focus on the potential of biomass energy in this region to offset the decline of the pulp and paper industry.

BERC proposes that technical information, such as woodchip and pellet fuel specifications used for soliciting bids from various fuel suppliers, be developed and supplied to interested schools and facility owners. In addition, BERC proposes that the NHCSBH program work with local fuel harvesters and suppliers to develop procurement strategies and contract provisions that strengthen relationships by ensuring a successful market for their material.

BERC has completed, as part of this study, a preliminary assessment of the woody biomass fuel supply available in the Coos County region. This fuel supply study should be extended to incorporate additional feedstocks, such as grass, corn, or other biofibers across New Hampshire, and ideally, the Northern Forest Region (NY, VT, NH, and ME). Such a study should include a more comprehensive survey of the amount of woody biomass available annually and the willingness of suppliers to provide it. BERC is working to increase the availability, reliability, and sustainability of woodchip fuel for Vermont schools and can assist New Hampshire in doing the same. These efforts can be carried out on a number of levels. Specifically, BERC suggests:

- A fuel supply study to help identify opportunities for increasing the supply of woody biomass chips as a fuel for biomass heating systems in schools and other facilities
- A directory of fuel suppliers provided to all schools and facilities interested in biomass heating
- Fuel supply assessments for additional biomass feedstocks
- An expanded woody biomass fuel supply assessment to cover the rest of the state
- Engagement with wood suppliers to help them shift to new customers bases
- Education of wood suppliers on the unique needs of schools and other public customers
- Development of emergency wood fuel procurement protocols

The development of a fuel supply database through networking with foresters, sawmills and other forest products suppliers can build local economies and strengthen both the forest products industry and rural communities.
Community Program. One further refinement of the NHCSBH program concept is the identification of large buildings in close proximity that could be combined in small or large district heating configurations that do not exist today. While this adds to the complexity and cost of new buried pipe connections, it also extends the reach of biomass heating technology, increases the financial benefit to each facility and the region as a whole, and utilizes higher volumes of low-grade wood residues.

NHCSBH Funding Sources
Identifying a sustainable funding mechanism for the modest program costs associated with running the NHCSBH Program is critically important to get the fledgling program up and running. This funding is needed to facilitate meetings of the implementing partner agencies and further develop each item in the program’s action plan.

The funding mechanism for biomass heating projects at schools already exists in New Hampshire. Most of the schools in Coos County will get nearly 60% of the project cost as grant funding from the Department of Education. The plan of work includes developing the project cost finance mechanism for biomass heating projects for other public buildings and communities, and assessing the need for additional capital for schools to implement wood-heating projects. The implementing partner agencies will establish the partnerships and program concepts for an NHFFS initiative with recommendations for sustainable program funding and project finance. The advisory group will focus on creating state legislation that will provide incentives to help schools study and implement projects. The advisory group will solicit funding for the NHCSBH program from concerned state agencies and the US Forest Service, and approach other foundations for funding assistance such as the Tillotson Fund, Jordan Institute, and Kendall Foundation. Some of the partners will be approached for funding and some for significant in-kind matches. The group needs to consider developing new methods, including third-party finance and performance contracting, to help pay for school wood-heating projects in New Hampshire.

A project financing plan would be devised and tailored to the way capital projects are usually funded at these facilities. See Creative Financing for Wood Heating Systems (starting on the next page) for more details on financing options.

New Technology Initiative
This report focuses on currently available technology that uses wood residues—primarily woodchips—to fuel combustion systems for producing space heat, steam, and domestic hot water. It touches lightly on the use of wood pellets to heat smaller schools or similarly sized institutional and commercial buildings. Until recently, pellet boilers have been available only as a residential and light commercial-scale technology, but that is beginning to change as new, larger pellet boilers are coming on the market. Since pellet systems are less costly than automated woodchip systems, pellet systems can be advantageous for smaller buildings by trading off some of the fuel dollar savings for lower capital costs. Corn boilers are also beginning to come into use, although the long-term success of this technology for institutional uses is not yet proven. There is an opportunity to study and promote the use of smaller boilers that use pellets, corn, or other agricultural crops grown on fallow farm land as local biomass fuel sources that would complement wood residues as part of a broad policy-based initiative to promote local energy.

Combined Heat and Power (CHP) Projects
Biomass can be used in CHP projects to generate power and thermal energy for heating simultaneously. Biomass is combusted in a boiler to generate high-pressure steam that runs a turbine and generator to produce electricity. The low-pressure exhaust from the steam turbine can be used for heating buildings. A new technology being developed gasifies biomass to generate syngas (synthetic gas) and uses it in an internal combustion engine to generate electricity. Another technology being demonstrated at New England Wood Pellet in Jaffrey, NH uses a hot gas turbine to generate electricity. Once these new technologies are commercialized, Coos County will be in a good position to take advantage of the enhanced efficiency of CHP biomass projects.
CREATIVE FINANCING FOR WOOD-HEATING SYSTEMS

The Need
The study work done by BERC on creative financing for wood-energy systems has focused on the school market and the particular ways that school districts secure capital for building projects. Project capital is an important piece in developing a New Hampshire Fuels For Schools program as well as the installation of new wood-energy systems in other settings.

There are at least two approaches to securing capital funds for school projects:

Voter-Approved Bond Financing. This covers the balance of project costs not covered by state aid to education. This approach requires public education for voters on the benefits of wood heating, particularly since they may resist any bonding regardless of how favorable the economics are for the school district.

Creative Financing. Several possibilities have been considered for Coos County, including state cost-sharing programs, energy service companies (ESCOs), cooperative ownership, or any combination of these. BERC has also begun to develop a new approach—creating a nonprofit ESCO to serve communities and public entities.

Over the last 20 years, the idea of using wood to heat schools and other public buildings has gained wide acceptance. In the mid-1980s, although automated systems for burning wood-chips were a mature technology in the forest products industry, using these systems in schools was a novel idea. Now, when close to a third of all public school students in Vermont attend a modern wood-heated school and when wood-chip and wood pellet boilers are spreading rapidly to New Hampshire and other states, wood-fueled systems have proven to deliver stable, low-cost heating to schools reliably in a time of volatile and sharply increasing oil and gas prices. As the price of fossil fuels continues to rise, the demand for school wood systems is expected to increase.

The capital cost of woodchip energy systems is high. A school must not only buy and install the woodchip boiler system—including automated fuel handling—but also construct an expensive boiler room and chimney with a large-volume covered wood-storage bin. Wood pellet systems are significantly less expensive to build, but still include the elements of boiler, fuel-handling system, stack, and fuel-storage silo. The total project cost for installing a woodchip system at a large school reaches or exceeds $1 million in many cases, while pellet systems are likely to cost close to half as much. And, while these systems replace 80-90 percent of fossil fuel usage, a full-capacity oil or gas system is generally kept in place for backup and redundancy to the solid fuel system. The high cost of the wood system is not offset by savings from not having a conventional fuel system.

The cost of a school wood-system project has generally been met through some combination of state grant and bond financing. It has been rare for a school district to install a wood system without some level of state or federal grant. There has been no federal grant money in the eastern states except in unusual cases where earmark funds are awarded to pay for the first school wood system in a state as a demonstration project.

The willingness of state legislatures to commit millions of dollars for wood-system construction is uneven. Some states provide no capital assistance to local school districts for wood system projects while others pay a high percentage. Maine provides 100% of wood system cost in new construction and zero for most retrofit systems. Vermont now pays 75% of wood system cost, although the local school district must bond for the full amount because the state commitment is not always met in the year of construction. New Hampshire treats wood systems like any other school construction cost, with the state share tied to an index of the school district’s wealth. Poorer school districts may get more than half the cost of a system from the state, up to a maximum of 60%, while wealthy districts get the minimum state-aid payment of 30%. Schools in Coos County will get a 40-60% share paid by state-aid funds. The balance must be raised locally. In sum, New Hampshire already has a good state-aid program to support wood heating systems. BERC does not believe it necessary to increase this state cost share.
In an era of tighter budgets and reluctance to fund new initiatives, Congress and state legislatures cannot be counted on to provide generous grants for school wood systems in the future. This will put the capital source problem back on local school districts. Bond financing is the vehicle that is most readily available and is in many ways ideal for schools. School construction bonds are long term—often 20 years—a good match for the long payback periods of wood systems. School bonds, a type of municipal bond, are available at low-interest rates compared to commercial bank rates; however, some school districts may choose not to borrow money because their bond or borrowing capacity is near its cap.

The more important issue is that school bonds must be approved by voters. Successful bond votes depend on good public education and the willingness and faith on the part of the voters to borrow money for something that they are told will pay back. It is not true that voters will always vote their own financial self-interest. An energy cost-saving bond, such as for a wood system project, may be voted down simply because the voters are not in a mood to borrow money or because they fear that the future is uncertain, so voting “no” to a money issue is safer than voting “yes.” In hard economic times, poorer school districts are less likely to pass bond votes than wealthy ones.

There is a clear need to find a new method for providing capital to wood-energy projects, a method that does not require state or federal grants nor involve bond votes. An easy-to-use capital project finance mechanism that does not require voter approval would be a useful tool for school boards and business managers.

The Options

There are a number of alternatives to state funding and conventional school bond financing for wood-heating systems, some more likely than others to achieve the policy goal of rapidly increasing the number of public schools that replace fuel oil or gas with locally supplied wood fuel.

GRANTS

Grant sources from other than the state and federal government are limited. The question is: Who would be interested in granting significant money to school districts to achieve their objectives or support their mission?

Foundations. In rare cases, a foundation may grant funds to a particular school to achieve an outcome supported by the foundation’s mission, particularly if it targets its grant making to a particular region or state. Foundations generally, however, are not interested in putting money into investments they feel should more appropriately be made by government. Foundations might be better suited to provide seed grants for setting up a school wood-energy financing program or a loan fund for that purpose, particularly if there was a mechanism for the foundation to recoup its investment.

Private Donors. Private donors may be sources for funding societally beneficial projects at schools, but usually only for a school in the donor’s own community. The issues are similar to those of foundations, but the potential scope is much more limited.

LOANS

State law generally prohibits school districts from borrowing significant funds for capital projects without voter approval; thus, loans are rarely more advantageous to the school district compared to bonding for capital projects.

Commercial Lending. In some cases, a school will finance a capital project through a commercial loan from a local bank, rather than go through the bonding process. While interest rates are likely to be higher, schools will sometimes take the bank-loan route because they have a particularly good relationship with a local lender who may offer rates almost as low as a bond rate. The disadvantage is that, in most cases, it offers little or no advantage compared to bonding.
Revolving Loan Funds. Revolving loan funds are set up to provide loan access at reasonable rates to a limited number of borrowers. Funds are set up so that the initial capitalization of a fund provides loan money that then is paid back to the fund, allowing the fund to continue to make loans in the future beyond the amount of its initial capitalization. Revolving loan funds would be a good option for school wood-energy systems because the borrowers (school districts) are stable public institutions, provide an essential service, rarely “go out of business,” and can be expected to repay. Also, wood-energy systems generate reliable savings that increase as fossil fuel prices go up, which should mean that repayment ability will increase over time. In this way, if the fund is properly set up and managed, the pool of funds available to be loaned could grow over time.

One major weakness of the revolving loan fund concept for school wood projects is that the original capitalization requires a large sum that would likely have to come from state or federal sources. A state legislature that is not prepared to commit to providing ongoing capital cost share for school wood-energy projects because of budgetary constraints may find it equally difficult to come up with the one-time money to capitalize a loan fund. Other sources of seed capital, like foundations, are unlikely to be able to capitalize a fund at anywhere near the level that a public entity with taxing authority could.

A revolving loan fund, inherently limited by the amount of its initial capitalization, is less likely to stimulate large numbers of school districts to install wood-energy systems, compared to bond financing or state grants. The capitalization level will determine how many loans could be made at any time.

USDA Rural Development. It has been reported that some rural electric co-ops are setting up revolving energy loan programs to help their member/users finance measures that reduce electric consumption, using funds from USDA Rural Development. The recaptured money can then be subsequently loaned out for projects not limited to electrical reductions, such as projects that reduce costs for fossil-fired heating and cooling. This approach could provide a new way to capitalize revolving loan funds that would be able, among other things, to loan money to school districts for wood-energy projects.

Another advantage is that rural electric coops have the experience and institutional capacity for developing and managing energy projects and so provide a good vehicle for programs to promote and finance school wood-energy systems. Such a fund, however, would still be of limited advantage, compared to bond financing, unless the loans were legally permissible without school district voter approval.

Other Nonprofit Loans. There are community loan funds and economic development funds that loan money for worthwhile projects. As currently constituted, these loan sources are unlikely to provide significant funding for school wood-energy projects and offer few benefits compared to bond financing; however, if a new revolving loan fund were capitalized, these institutions could be good vehicles for administering the program.

LEASING

Equipment leasing is a financial mechanism under which the supplier of the equipment continues to own the asset for use on the customer’s site. The customer makes monthly payments, typically on a lease-to-own basis, so that ownership transfers to the customer at the end of the lease period. The major advantage is that the customer does not have to come up with the capital to purchase and install the equipment. The vendor, through its own resources, provides the capital and recoups its investment through the lease payments. The vendor, who is typically the equipment manufacturer, might not use its own capital but may have a leasing company as partner to supply the capital. Leasing is also advantageous to schools because it does not require voter approval.

Vendor Leasing. Manufacturers and installers of wood-heating equipment who now supply this equipment to schools could offer it on a lease basis. To BERC’s knowledge, this has not been done to date, although some pellet-system installers appear to be interested in the idea. The concept could be attractive in the pellet-system market because pellet-system investments for schools are mostly for installed hardware, with minimal or no building construction required.

The concept of leasing a pellet system from a pellet manufacturer or installer could be attractive in the pellet system market, because pellet system investments for schools are mostly for installed hardware, with minimal or no building construction required.
Woodchip systems would be more difficult because about half the cost of the project is for building construction, for both construction of the boiler-room space and a large fuel-storage bin. Yet, it would be possible for a school to purchase the installed woodchip system hardware through a lease and finance the building construction through another mechanism.

The limitation to this approach is that vendors may not be interested or may not have the capacity to offer this type of financing. Today most manufacturers and installers of wood-heating systems are small, privately held businesses with limited financial resources. While they could attempt to partner with leasing companies to access capital, the leasing companies might find the technology unfamiliar, thus hesitant to enter the business.

**Municipal Tax-Exempt Leasing.** Municipal leasing is a well-established business that may be a good option for financing school wood-energy systems. The customers—municipal and public entities like schools—constitute a good market because they are well-established, financially stable, long-term purchasers who pay their bills and are supported by a taxing authority. The leasing company does not worry about default. Under municipal leasing there is typically a quick availability of funds with very low transaction costs. For a public school, the lease does not count against debt limits, shows on the books as an encumbrance one fiscal year at a time, does not require appropriation or bonding, and does not require voter approval. The lease can be set up so that at the end of the lease period the school owns the asset, in this case the equipment of a wood-energy system.

Municipal leasing is a good vehicle for cost items that are too big for the annual budget but too small for a bond. The hardware of a school wood-energy system fits well into this category. The weakness for school wood-energy systems is that it has not been done before, thus it is not known how the leasing companies will look at school wood-energy systems as appropriate equipment for leasing. Nor is it known whether the lease terms would be attractive to schools compared to other finance options like bonding. Another weakness of the concept is that the annual reduction in fuel cost (from using inexpensive wood in place of expensive oil or gas) is the effective revenue stream that determines how much the school can afford to make in lease payments each year. With simple paybacks for wood systems often greater than 10 years, schools may be hesitant to sign a lease that requires that it be paid off in 10 years, a common municipal-lease term.

To make this approach work for a woodchip system project, the school would likely have to bond for the building construction over 20 years and lease the wood system over 10 or 15 years. At this point it is not known whether this would be an attractive package both for the school and for the leasing company. As noted above, a pellet system would be a better match because the total project cost is weighted toward equipment, with minimal building construction cost.

**SALE OF GREEN TAGS**

Green tags are the positive environmental attributes of a renewable energy system. They have a value separate from the value or sale price of the energy itself, thus can be treated and traded separately. For example, a private generator of wind energy may sell the electricity from the wind system to the grid for market price. They can sell one or all of the environmental attributes to others who want or need to buy these credits. The emerging carbon market is based on attaching a market value to the carbon dioxide (CO₂) emissions reduction associated with an efficiency or renewable energy project. This carbon credit can be used to demonstrate compliance with any requirement for CO₂ reduction, whether it is on the part of the business entity that took the carbon-reducing action or whether that entity sold the carbon credit to some other entity. The carbon market in the United States is voluntary since the US did not sign on to the Kyoto Protocol, and for this reason, carbon credit values are low compared to those in Kyoto-participant countries where industry is required to reduce CO₂ emissions.

There are many firms that are packaging and selling green tags, such as carbon credits, in the voluntary US market by acting as brokers between those who create environmental benefits associated with energy projects and those who want to buy those credits. One such company, Native Energy, has expressed interest in buying green tags associated with school wood-energy projects. Un-
nder its business model, it would make a lump-sum, up-front payment of about $20,000 (depending on school fuel use) in return for ownership of 20 years of green tags from the project. One catch is that they require that the project not go forward without their payment, so that it can be said that the environmental benefit would not have been achieved without the green tag payment.

For woodchip projects, green tags are unlikely to make much difference in the ability to finance a project since the value is low compared to the overall budget. The situation is somewhat better with wood-pellet projects. Nevertheless, if the US joins the global non-voluntary carbon market and other environmental attributes increase in value, green tags may become a more important part of financing wood-energy systems.

**PAYMENT OUT OF SAVINGS**

Of all the ways to finance school wood-energy projects, making payment out of the revenue stream associated with the fuel-cost savings is in many ways the most attractive. At current prices paid by schools, woodchips save 68% compared to the same amount of heat provided by fuel oil; wood pellets save 35%.

Under conventional bond financing for a proposed wood-heating project, the school carefully compares the annual bond payments with the fuel-cost savings that will result from reducing the oil or gas heating bill in the first year as well as in the next 20 years or more (the detailed analysis also includes changes in operating and maintenance costs). The goal is to have the year-one savings be greater than the bond cost, so that positive cash flow is achieved in the first year. It is rarely possible for the school to see positive cash flow in the first few years unless it has received a significant grant of state or federal money. Typically, the fuel savings-generated positive cash flow would grow each year as fossil fuel prices increase faster than wood fuel prices. Some school districts may be willing to go ahead with projects even if bond costs exceed savings in the early years, in anticipation that oil prices will rise. To date, this anticipation has been well founded. Twenty years ago, when the first school wood projects in the Northeast were built, woodchips cost $25 per ton delivered. That cost has approximately doubled in 20 years. In the same period, the oil price paid by schools has gone from $.60 to $2.50 per gallon, a four-fold increase.

So in fact schools have been using a payment out of savings approach: they have paid the project finance costs out of their annual fuel cost savings. A different approach is to engage some other entity, a third party, to bring in the project financing with the site owner reimbursing the third party for its costs. Under third-party financing, the school would use the fuel-cost revenue stream to pay the third party for its services. Because the success of third-party financing depends on the project’s future energy cost savings performance, this is often called performance financing.

**Energy Service Companies (ESCos).** Energy service companies grew out of the need of some energy users to make energy improvements to their facilities without using their own funds or borrowing money. A third-party ESCO generally provides the following services:

- analysis of energy savings options
- preparation of a package of cost-saving measures
- provision of capital
- design engineering
- project management
- commissioning
- ongoing verification and guarantee of savings

Other services, such as operation and maintenance of the heating plant and purchase of fuel, may also be included in the ESCO contract. In return, the facility agrees, through the contract negotiated with the ESCO, that it will make the contract-stipulated payments to the ESCO throughout the term of the contract. The ESCO guarantee of savings assures the facility owner that there will be adequate savings to make the ESCO contract payments over the course of the contract. The contract will assure the ESCO that it can cover its costs and make a profit. Since it is obligated to take the risk for certain costs that change over time in unpredictable ways, an ESCO builds into its contracts adequate payment to compensate for risk. ESCO contracts take many forms and are very complex because the ESCO guarantees savings and takes risk.

At current prices paid by schools, woodchips save 68% compared to the same amount of heat provided by fuel oil; wood pellets save 35%.
ESCOs are generally selected on the basis of how well they can convince the building owner—whether it is a state buildings agency or a public school—that the ESCO will carry out high-quality improvements that will financially benefit the owner. At the start of a relationship with an ESCO, the building owner does not know what energy improvements will be implemented. In fact, owners are cautioned not to pick the improvements they want to carry out so that the ESCO will have a free to hand to analyze all options and craft the best package of measures to reduce overall energy costs. Low-cost, quick payback measures like efficient lighting, water conservation, and controls upgrades are the most likely to be at the top of the list of the package developed by the ESCO. The ESCO is unlikely to study and select a high-cost, long-payback measure like installing a wood-heating plant. Generally, ESCOs and the public institutional market are a good match for doing energy and water-efficiency improvements. They are less suited for doing long-payback renewable energy projects.

ESCOs like institutional clients because the public-sector building owners are in it for the long haul, pay their bills, and are willing to enter into long-term financial contracts. Also, many of the major national ESCOs were controls contractors who already had relationships with large public-sector building owners and wanted to lock in long-term contracts to supply and maintain the controls equipment they sold. Being selected by a university, for example, to be the contractor for energy improvements helps cement the ESCO’s relationship as vendor and service provider of all proprietary controls packages in the campus system.

Large public institutions are attracted to ESCOs [as sources of funding] because they are a vehicle for getting important energy projects done without borrowing money or using the institution’s own funds. The ESCO approach works best for large institutions, such as state building agencies and universities, that have professional staffs of engineers, project managers, and financial analysts. For smaller institutions, such as rural school districts, understanding the complexities of performance contracting may be very difficult. In the negotiation of contract terms, the large national ESCO is clearly at an advantage compared to a school district. Despite the fact that there are guidelines for public-sector building owners (see www.energyservicescoalition.org), it can be almost impossible for a school district with limited institutional capacity to avoid a contract that is far more advantageous to the ESCO than it is to the school district. It is possible that a school could enter into a contract with an ESCO that actually increased costs to the school district without the district ever being aware of it.

While there are clear advantages for schools to use the ESCO approach, there are also other downside risks to the school district, both generally and specifically as a vehicle for implementing school wood-energy projects. Because ESCOs are private for-profit companies, the profit motive is always their bottom line. ESCO profit is always one cost element for the project, an element that is not present when a school carries out a project on its own. Also, to the extent that the ESCO takes risk, compensation for that risk drives up the cost to the school district. ESCO profit and risk mitigation are costs that increase overall project cost to the school and make it more likely that the ESCO package of measures will be skewed away from large, capital-intensive measures like installing wood-heating plants.

For example, most ESCO contracts guarantee operating savings to the owner. An ESCO can do this by selecting the safest, most proven, quick payback measures when it puts together a package of improvements for the owner. They can also afford to guarantee savings by adding to their contracts additional revenue, a cost that would not be present if the school district carried out the energy project on its own. Under normal circumstances, the school takes the risk of fuel price increases as an uncontrollable cost of operation and passes annual fuel costs on to the taxpayers. Effectively, it is the school district taxpayers who take the fuel price risk.
If a building’s owners are worried about the future cost of fuel, they could decide to have the ESCO operate the heating plant and purchase fuel, taking all risk for future fuel increases. The ESCO in turn will build into the contract enough additional revenue to reduce the risk to a level that is acceptable to the ESCO.

For a school, ESCO profit and risk mitigation drive up the cost of a wood-heating plant, increase the payback period, and make it less likely as a viable candidate for performance financing. Compared to a woodchip system, the ESCO approach may work better for a pellet system, where the capital cost is significantly lower and there is limited building construction; however, the savings stream for a pellet system is half the size of the savings for a chip system, thus undermining the performance finance potential.

**Nonprofit ESCOs.** The idea of creating a nonprofit energy service company specifically to help schools install long-payback renewable energy systems like wood-heating plants is new. Such a public benefits entity could be called a NESCO. The core concept is to use the elements of third-party financing that are most beneficial to schools (principally access to capital and non-debt financing for energy improvements) with a vehicle that takes profit out of the picture and handles risk in a way that keeps cost to the school district low.

The role of a NESCO focused on school wood-heating systems should include the following.

- Wood-energy system feasibility analysis in the context of the school’s overall energy use and costs
- Preliminary wood-system design and cost estimation
- Initial assessment of wood fuel supply and its sustainability
- Wood-system project definition
- Assessment of other, directly and indirectly related mechanical and energy improvements
- Risk assessment
- Presentation and interface with school decision makers
- Supply of project capital (augmenting any grants and incentives available)
- Engineering and architectural design
- Qualification of vendors and assistance with vendor selection
- Permitting, particularly with respect to air emissions
- Project management
- Commissioning
- Ongoing verification and reporting of savings

Establishing a NESCO for school wood-energy systems will be a significant new undertaking, requiring careful thought and planning. The key factors to success will be:

- The financial viability of the concept (in particular, whether school wood-energy project fuel-cost savings are great enough to support all NESCO costs without grants funds)
- Whether a NESCO can be structured to reduce wood-system project costs compared to the current way of implementing projects
- The regular availability of state or federal grant funds
- Access to low-interest project capital
- Availability of seed money and start-up operating capital for establishing the NESCO

A NESCO could be a new, stand-alone nonprofit enterprise or it could be hosted by an existing nonprofit entity that already has some of the necessary skills and capabilities. These include experience in: energy project assessment and implementation, engineering design, project finance, ability to communicate well with school partners and the public, working knowledge of wood-energy technology, and environmental permitting (particularly air permits). Additionally, a host that has or could easily develop a relationship of trust with public school officials would bring an important strength to the NESCO concept.

The list of potential hosts includes: rural electric co-ops, other energy co-ops, economic development organizations, state renewable energy funds, and nonprofit loan funds. Another route to creating a NESCO would be to combine a host organization having some of the necessary skills and experience with a new nonprofit organization that would incorporate the remaining capabilities.

The core concept [of nonprofit ESCOs] is to use the elements of third-party financing that are most beneficial to schools (principally access to capital and non-debt financing for energy improvements) with a vehicle that takes profit out of the picture and handles risk in a way that keeps cost to the school district low.
Biomass comes in many forms—any plant or animal-derived material can be considered biomass. Despite the wide range of biomass options, the one material in huge supply here in the North Country is wood.

In the Northern Forest Region of New York, Vermont, New Hampshire, and Maine (and the adjacent eastern provinces of Canada), forests cover a large majority of the total land area.

Biomass is renewable, but its supply is not infinite. There is a finite capacity of wood that can be sustainably removed from our forests. If close attention is not paid to the question of how much, we run the risk of growing our wood fuel demand beyond the forest’s capacity to supply.

Wood fuel comes in all shapes and sizes. Low-quality trees are felled, bucked, and split into firewood; slabs are cut off sawlogs and fed to the sawmill’s chipper; dust from sawing logs into lumber is collected; and tree tops from whole-tree timber harvests are chipped into the back of trailers. All these different forms of wood fuel have benefits and drawbacks. For the purpose of this project, BERC has focused on woodchips as the most abundant and versatile wood fuel for community-scale heating.

Coos County Region Forest Resources
To better estimate the capacity of the region’s forests to provide increased amounts of wood fuel for community-scale biomass energy systems several, steps must be taken:

- identify and examine the forestland area
- review the inventory or amount of wood on the forested land
- understand the rate of forest growth building upon existing inventory

For the first step, a 50-mile radius from the approximate center of Coos County, NH was used to identify a wood basket for the various potential community wood-energy projects being studied. Within this general woodbasket area are Coos County, the NH counties of Grafton and Carroll, Essex County in Vermont, and Oxford County in Maine. Unfortunately, the land area within the 50-mile radius that falls into Quebec has very little published data regarding the forest resources and thus was not included in this analysis.

Forested Land Area
While examining forestland area is important, it is too broad a category because it includes forest preserves and unproductive forest areas like forested wetlands. For this project, a more specific subset of forestland area was examined.

Timberland is defined by the USDA Forest Service as “forestland capable of producing 20 cubic feet of industrial wood per acre per year and not withdrawn from timber utilization.”
The White Mountain National Forest (WMNF) accounts for 626,184 acres of timberland area in NH (161,058 acres in Carroll County, 174,812 acres in Coos County, and 290,313 acres in Grafton County). An additional 47,238 acres of the WMNF are in Oxford County, Maine. While the forest resource of the WMNF is vast, the amount of wood that can be harvested in a given year is relatively small in comparison to the amount of wood grown in the forest annually.

The WMNF has an Allowable Sale Quantity (ASQ) of 27 million board feet of timber per year. Evidence suggests that the amount of wood actually harvested on WMNF annually is well below the established ASQ and a majority of what is harvested is higher-quality sawlogs. For all practical purposes, WMNF is inaccessible for timber harvesting and has been excluded from total forestland area in Table 1.

### Inventory and Composition of Forests

The next step is examining the current amount or inventory of trees on the timberland. Because it is impossible to count every tree, the USDA Forest Service Forest Inventory and Analysis (FIA) Program uses a scientifically designed sampling method. First, photo interpreters study aerial photographs of the forest. Next, a grid of thousands of points is overlaid on the photos. If forested, each point is classified according to land use and tree size. Using this information, a sample of hundreds of plots is selected for measurement by FIA field crews. The sample includes plots that were established during previous forest inventories. The re-measurements yield valuable information on how individual trees grow.

Field crews also collect data on the number, size, and species of trees, and the related forest attributes. All this information is used to generate reliable estimates of the condition and health of the forest resource, and how it is changing over time.

According to the data gathered and provided by the FIA, there is nearly 400 million green tons of wood standing in the region’s forests. On average the bole of the tree (or the main stem) accounts for 88% of the above ground tree inventory and only 12% is the top and limb wood.

The FIA data also indicate that region’s forests are predominantly hardwood species. Hardwood species account for an average of 73% of the total standing inventory and only 27% are softwoods.
FOREST GROWTH AND SUSTAINED-YIELD CAPACITY

As trees grow each year, they add weight and volume. The actual growth rates vary according to a wide range of factors, including soils, species, stand age, how crowded the trees are, etc. Young trees grow faster than older trees. Very young trees put most of their growth into height, adding little volume. Older trees will put less growth into height and more into diameter, which contributes far more volume to the stand. Very old trees will grow very slowly, with most of their growth in diameter rather than height.

When forests are examined from the 30,000 foot perspective, wood inventory can be compared to money invested in a bank account that earns interest annually. The total annual growth of trees in a forest is analogous to the interest earned on capital. A wise financial investor strives to only spend the annual interest and not dip into the principal. Forests are the same: a wise forest manager only harvests out of the annual growth.

For the purpose of this project, the net annual growth of new amounts of wood was chosen as the indicator of how much wood the forests of these counties can provide on a sustained-yield basis. While it is important to understand the total amount of wood growing on forestland loosely defined as timberland, one cannot assume that all of this is accessible and actively managed. Further, it would be inappropriate to include high-quality wood otherwise capable of yielding merchantable wood for sawlog production. For these reasons, a series of reasonable assumptions were used in this analysis to calculate a more probable amount of wood available for various low-grade wood markets including community-scale biomass energy.

Figures presented in Table 3 are the calculated amount of low-grade wood growing annually on timberland assumed to accessible and actively managed. They do not account for the existing market demands for low-grade wood from residential heating and pulpmills and power plants in the area surrounding Coos County. Further accounting for ongoing market demand must be factored in to understand whether there is further capacity within the region’s forests to supply additional volumes of wood. The most up-to-date information on how much wood is harvested annually is from 2005 and still reflects the demand from the now closed pulpmills. Figures are calculated values based on the FIA data and the key assumptions outlined above.

Coos County is renowned as being the most bountiful woodbasket in the Northern Forest region; however, 1.6 million tons is not a lot of wood once it has been divided up between the various existing and future markets for low-grade wood.

### TABLE 2.
**Inventory of all Live Above-Ground Wood (in green tons)**

<table>
<thead>
<tr>
<th></th>
<th>Growing Stock</th>
<th>Cull Wood</th>
<th>Total Wood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coos County</td>
<td>69,104,000</td>
<td>8,332,000</td>
<td>77,436,000</td>
</tr>
<tr>
<td>Grafton County</td>
<td>86,566,000</td>
<td>8,614,000</td>
<td>95,180,000</td>
</tr>
<tr>
<td>Carroll County</td>
<td>61,202,000</td>
<td>6,388,000</td>
<td>67,590,000</td>
</tr>
<tr>
<td>Oxford County</td>
<td>104,898,000</td>
<td>8,504,000</td>
<td>113,402,000</td>
</tr>
<tr>
<td>Essex County</td>
<td>26,162,000</td>
<td>2,610,000</td>
<td>28,772,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>347,932,000</td>
<td>34,448,000</td>
<td>382,380,000</td>
</tr>
</tbody>
</table>

### TABLE 3.
**Net Annual Growth of Low-Grade Wood on Accessible and Managed Timberland**

<table>
<thead>
<tr>
<th></th>
<th>Bole Wood</th>
<th>Top &amp; Limb Wood</th>
<th>Total Wood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coos County</td>
<td>329,044</td>
<td>25,441</td>
<td>354,485</td>
</tr>
<tr>
<td>Grafton County</td>
<td>307,121</td>
<td>24,097</td>
<td>331,218</td>
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<tr>
<td>Carroll County</td>
<td>230,076</td>
<td>17,888</td>
<td>247,964</td>
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<tr>
<td>Oxford County</td>
<td>534,777</td>
<td>42,576</td>
<td>577,353</td>
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<tr>
<td>Essex County</td>
<td>143,927</td>
<td>11,290</td>
<td>155,217</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>1,544,945</td>
<td>121,292</td>
<td>1,666,237</td>
</tr>
</tbody>
</table>
WOOD FUEL SUPPLY SOURCES FOR POTENTIAL PROJECTS

For the potential community-scale wood-heating projects identified in this report, there are several options for wood fuel supply as outlined below.

SAWMILLS

Woodchips from sawmills are often the best fuel for biomass heating. Mill chips tend to be the highest-quality chips available for chip fueled heating systems because of their uniformity and ease of use for system operators. Mill chips are produced from the waste wood of sawmills (off-cuts and slabs from sawing logs into lumber). Because logs are debarked before sawing, mill chips are very clean and have relatively low ash content.

LOGGING AND CHIPPING CONTRACTORS

Logging contractors who own and operate chipping equipment are likely suppliers capable of producing either whole-tree chips or bole chips.

Whole-Tree Chips. Whole-tree chips (despite the name) are most commonly made from tops and limbs and byproducts of commercial harvesting of sawlogs and pulpwood. After a tree is felled and skidded to the landing, it is processed into a merchantable log (typically down to a four-inch diameter for pulpwood) by removing the tree top and limbs. These tops and limbs are the forest residue that could be chipped into useable biomass fuel. This top and limb wood is sometimes left at the stump where the tree is cut when the harvesting operation uses chainsaw and skidder harvesting methods.

When more mechanized harvesting equipment is used, these tops and limbs are often accumulated at the log landing or roadside as part of a whole-tree harvest. In the absence of a viable local market for low-grade logs, whole-tree chips can also be produced from the entire tree (bole or main stem, tops, branches, and foliage).

Bole Chips. Bole chips are produced from low-grade or pulp logs. Unlike whole-tree chips, bole chips do not include the branches or foliage.

When the trees are harvested the limbs are removed and the slash is left on the ground in the woods or at the log landing (depending on where it was de-limbed).

While bole chips can be a high-quality wood fuel and help soil health by returning nutrients to the forest soil, they are typically the most expensive chips to produce. It costs roughly the same to fell, de-limb, skid or forward, and load a saw grade log as it does a pulp grade log; however, saw grade logs fetch a much higher price at the sawmill than do pulp grade. Bole chips also require the additional cost of delimbing the log prior to chipping whereas whole-tree chips avoid this extra cost.

WOODCHIP BROkers

Woodchip brokers offer several advantages over sourcing woodchip fuel directly from the various sources. Brokers are able to pool volumes of chips from multiple sources to meet market demand. In many cases, brokers also provide increased supply reliability by immediately drawing upon different suppliers should one supply source experience an interruption to their operations.
WOOD PELLETS
For those heating projects too small for a woodchip system, wood pellets can be a viable wood fuel. Pelletized fuel can be made from a variety of biomass materials, but wood is the sole feedstock of nearly all commercially available pellets on the market today. Wood pellets are made from by-products of the forest products industry, such as sawdust, shavings, and woodchips that are re-ground, dried, and pressed into pellets. Natural plant lignin holds the pellets together without glues or additives.

Wood pellets are of uniform size and shape (1-1 ½ inches long by ¼ - 5/16 inches diameter). They store in less space than other biomass fuels because of their higher energy content by weight (roughly 7,750 Btu per pound at 6% moisture content) due to their densified nature and low moisture content (typically 4-6% percent moisture by weight).

Although wood pellets have historically been available exclusively in bags geared toward the residential heating market, more wood-pellet manufacturers are now expanding into providing pellet fuel deliveries in bulk, several using standard grain delivery trucks. These trucks vary in size but typically carry 10 tons compared to a typical woodchip delivery truck that carries 22-26 tons of chips.

EXISTING WOOD DEMAND FROM THE FOREST PRODUCTS INDUSTRY
Healthy, local markets for low-grade wood are extremely important to the long-term management of the region’s woodlands. Without markets and revenue from the sale of low-grade wood, landowners are under significant economic pressure to harvest only the best and most profitable trees and possibly turn around and sell the land for the highest price (often as smaller parcels). This pattern of land fragmentation and parcelization is a threat to the long-term viability of woodlands throughout the Northeast.

For many decades, the region’s forests have been the wood basket for sawmills, pulpmills, biomass power plants, and firewood. Along with 20 years of biomass energy plants in New Hampshire and the ages-old tradition of residential wood heating, pulp mills have been major consumers of low-grade wood from the forests since the early 1900s.

Pulp Mills
Over the past decade, pulp mills in the Northeast have been negatively impacted by international competition. In this time, pulp mill and paper mill ownership turnover and mill closures in the Northeast have been at an all-time high. In New Hampshire in 2006, both the Fraser Paper pulp mill in Berlin and the Groveton Paperboard mill closed. When these pulp mills shut down, numerous loggers and trucking contractors who supplied the mills were forced to sell equipment and find other lines of work. The rest have been able to keep in business by selling their wood to the various mills and plants outside Coos County.

Despite the major losses to the low-grade wood market from the closure of the Groveton and Berlin pulp mills there are still significant market demands encircling Coos County, detailed below.

New Page Paper, Rumford, ME. This pulp mill was previously owned by Mead Paper and was recently sold to the New Page Paper Company. It consumes an estimated 800,000 green tons of pulpwood annually.

3 grades of wood pellet:
• premium (ash content less than 1%)
• standard (ash content 1-2%). Suitable for any wood pellet boiler with automatic ash removal, including most institutional- or commercial-scale applications.
• industrial (ash content 3% or greater). Industrial grade pellets, or those with ash content greater than 3%, should be avoided due to the increased risk of clinker (fused ash) formation.
Verso Paper, Jay, ME. Verso Paper’s Androscoggin pulp mill consumes an estimated 600,000 green tons of pulp wood annually.

Borelex Energy, Stratton, ME. This 45MW wood-fired power plant consumes an estimated 325,000 green tons of mill residues and whole-tree chips annually.

Whitefield Power & Light, Whitefield, NH. This 19MW wood-fired power plant consumes an estimated 200,000 green tons of mill residues and whole-tree chips annually.

Pinetree Power, Bethlehem, NH. This 16MW wood-fired power plant consumes an estimated 220,000 green tons of mill residues and whole-tree chips. The facility is owned and operated by Suez Energy.

Tamworth Power Station, Tamworth, NH. This 22.5MW wood-fired power plant consumes an estimated 280,000 green tons of mill residues and whole-tree chips. The facility is owned and operated by Suez Energy.

Domtar/Weyerhauser, Windsor, QB. This pulp mill routinely sources a portion of its pulpwod from the northern counties of Vermont, New Hampshire and Maine. This mill consumes an estimated 700,000 tons of pulp wood annually.

Carrier Chipping, Shelburne, NH. This is one of two chip mills servicing the pulp market located in New Hampshire (the other is the HHP mill in Henniker). The Carrier mill takes in pulp logs and chips onsite. Pulp chips are sold exclusively to New Page Paper in Rumford, Maine. The Carrier chip mill has 500,000 annual tons of capacity but actually processes an estimated 350,000 tons per year.

Energex, Lac Magantic, QB. Energex owns and operates a wood pellet plant that consumes an estimated 100,000 green tons of mill residues annually. Energex produces both premium- and standard-grade pellets and offers fuel in bulk or 40-pound bags.

**PROJECT PROPOSALS FOR NEW LARGE BIOMASS DEMANDS IN THE REGION**

Since the closure of the Fraser Paper Company’s pulp mill in Berlin and the Groveton Paperboard Company’s paperboard plant in 2006 there has been an urgent need to find replacement industries to take the place of the pulp mills. The communities of the North Country have relied on these mills for tax revenue, jobs, and low-grade wood markets.

Several large projects have been proposed to fill the niche left by the pulp mills – two large wood fired power plants, a large wood pellet production mill, and an integrated wood fired power plant with cellulosic ethanol production. It is difficult to predict which proposed plants will actually be built.

Laidlaw Power. Laidlaw Berlin, LLC, an affiliate of Laidlaw Energy Group, Inc., is moving forward with plans to construct a new 65 megawatt wood-fired power plant at the former Fraser Paper pulp mill site in Berlin. Under the deal, 40 jobs would be created at the plant, and another 500 jobs would be created for truckers and forest
product workers, according to the company. This plant would consume 500,000-700,000 green tons of wood residue and harvested low-grade wood annually.

**Greenova LLC.** In June of 2007, a proposal for an 180,000-ton wood pellet plant in Berlin, NH was publicly announced. Greenova LLC (formerly Woodstone USA) has plans to file for permits to build a wood pellet plant in Berlin. The company has already purchased four lots in the city and hopes to open the plant as early as 2009. While some of the pellets produced will likely be sold into the expanding pellet heating market in the Northeast it is expected that a large volume would be exported to the robust European market.

**Clean Power LLC.** A local biomass energy developer, Mel Listen, has proposed the construction of a 30MW wood-fired power plant at a site in Berlin. It is expected that this project would only move forward if either the Laidlaw or Woodstone projects fall through. This plant would consume an estimated 350,000 tons of wood residue and harvested low-grade wood annually.

**Tamarack Energy.** North Country Renewable Energy, LLC (a subsidiary of Tamarack Energy) proposes to develop a biomass energy park in Groveton, NH to include a 45-75MW wood-fired power plant, cellululosic ethanol production and distributed steam for heating and industrial processes to several other facilities within the larger park. The plant would consume 500,000-1.2 million green tons of woody biomass each year. The developers estimate the plant would create approximately 150-250 permanent jobs for the region. The electricity produced would be sold on the ISO New England electricity grid. In addition to the power generation facility, the developers plan to develop, construct and operate a cellululosic ethanol plant. The resulting liquid fuel would be marketed to fuel-blending companies.

If all of these proposed projects move forward to construction and operation, there will be a significant strain on the region’s forests. Based on the forest inventory data and the supply calculations depicted in Table 3, there is only approximately 1 and 1/2 million green tons of wood that can be used annually without depleting the standing forest inventory. Between the four proposals, there is as much as 2.4 million tons of demand. The region’s pulp mills have left a legacy of boom and bust growth over the years. Will biomass energy continue that legacy? Or can biomass energy be further developed at the community level, using efficient technologies, to provide a smaller, yet more sustainable market for low-grade wood that is well within the region’s forest growth capacity?

**ECONOMIC CONSIDERATIONS OF WOOD FUEL SUPPLY**

There are two types of woodchips—chips that are produced as a by-product from some other primary activity and chips that are produced (grown, harvested, processed, transported, etc.) as the primary or commodity product. The economic factors which impact the pricing of chips differ significantly between by-product and commodity chips.

While prices for residue chips may rise in the future, the volumes produced will not change in response to an increase in demand (since it is unlikely that sawmills will make less lumber and more waste from each log processed.) By contrast, the supply of chips produced as a primary fuel, such as whole-tree chips and bole chips, will respond to increased demand if it is of sufficient volume and the price is right.

Historically, biomass (low-grade wood chipped for energy) is not a profit center for the logger—it merely helps the cash flow of a logging business. Harvesting sawlogs and other higher value forest products has, on-average, subsidized the market price of biomass fuels. Current prices for chips derived from other primary activities such as sawmills do not reflect the full cost of harvesting, processing, and transporting chips. The perceived value gap, however, is not as wide as many may believe.
Harvesting costs depend largely on harvesting efficiency, and this efficiency is highly variable. In some situations (large harvest areas with relatively high harvest levels in cords per acre), independent harvesting of low-grade material can be profitable using efficient, mechanized harvesting techniques. Conversely, the harvesting costs for horse logging are very high and low-grade wood is difficult to harvest profitably. These are the exceptions to the rule, however, not the norm. Most typical harvests require some sawlog removal to subsidize the removal of the low-grade wood. Costs per unit of wood harvest can vary widely. The following are significant factors in the variable costs of harvesting:

- Accessibility (distances to nearest roads, terrain, skid distances, existing layout of skid roads, etc.)
- Harvest area size
- Harvest volume per acre
- Harvesting methods and equipment used
- Ratio of sawlog to pulpwood (and/or other low-grade products)
- Species mix

Additional costs of chipping and transport to the end markets can also be highly variable. Chipping costs fluctuate as widely as transport costs but can range from $2 per ton and upward to $10 per ton based on the size of the chipper and how efficiently the operator uses the chipping equipment. Transport costs of moving 20-24 ton loads out of the woods and to the markets depend on multiple factors, but the most important is the haul distance.

SUPPLY CONCLUSIONS

- Demand for mill residues is very strong and supply is weak. If chips are used they will likely come from harvesting.
- There are 3.3 million acres of timberland in the region on which there is 382 million green tons of standing trees.
- The 382 million green tons yields 6.9 million tons of new wood grown annually.
- Of that only, 1.6 million green tons are estimated to be low-grade and on forestland that is accessible and actively managed.
- Despite the loss of the two major pulp mills in Coos County there is still significant demand for low-grade wood from plants and mills surrounding Coos County.
- There are four major proposed projects that would consume up to 2.6 million tons of additional low-grade wood.
- If all of these proposed projects move forward to construction and operation, there will be a significant strain on the region’s forests.

See listings of area sawmills, logging and chipping contractors, woodchip brokers, and wood pellet suppliers in wood supply appendices starting on page 49 of this report.
RELATED WORK

The North Country Forest Energy Project comprises a broad set of actions and initiatives made possible by support from the Neil and Louise Tillotson Fund of the New Hampshire Charitable Foundation. This work is further enhanced by the Northern Forest Biomass Energy Initiative (see below) and a number of other initiatives that also focus on the North Country of New Hampshire and surrounding states.

The Neil and Louise Tillotson Fund grant to BERC provides a unification of purpose that advances the same agenda of community economic development through wood energy across these initiatives, with the ultimate benefits flowing to Coos County and the rest of the region.

Northern Forest Biomass Energy Initiative (NFBEI)

The overall purposes of the initiative are to explore the potential for woody biomass from the Northern Forest to provide an increased source of renewable, sustainable energy for the region, and determine what needs to happen for that potential to be realized. The Northern Forest Biomass Energy Action Plan is the outcome of intensive work with diverse stakeholders across Maine, New Hampshire, Vermont, and New York. Its vision can be summarized in the term local biomass energy and is premised on five guiding principles:

• Sustainable Forestry
• Maximized Efficiency
• Local Energy
• Energy Security
• Climate Change Mitigation

Endorsements have been collected, and currently the action plans are being presented to the four state governors and Congressional delegations to petition support for implementing its recommendations.

Many of the North Country Forest Energy Project initiatives, funded by the Neil and Louise Tillotson Fund of the New Hampshire Charitable Foundation, were designed to apply to Coos County the policy recommendations made in the NFBEI action plan.

US Forest Service Jump Start Grant

The North Country RC&D submitted a successful proposal to the US Forest Service “Jump Start” solicitation for a set of activities called Increasing Community-Scale Biomass Heating in New Hampshire. The North Country RC&D and its partners will develop public education materials, conduct tours of wood-energy systems for potential users and other stakeholders, and carry out preliminary 50% cost-shared feasibility studies for wood energy at Plymouth State University (PSU), a state Division of Forest and Lands warehouse facility, and three schools or similar public buildings. BERC has been influential in providing the conceptual basis on which the RC&D project is based and worked closely with PSU Center for Rural Partnerships in formulating the scope of its biomass feasibility study. BERC expects to be significantly involved in the implementation of this grant.
The advisory group will develop informational materials to be distributed to schools and municipal officials. Three workshops are being planned for schools and municipal buildings during the last week of March 2008 with morning information panels and afternoon field trips.

Feasibility assessments will be awarded competitively based on evaluation of proposals submitted by the school or municipality. Once selected, it will conduct its own consultant search and selection process. North Country RC&D will provide a list of firms with experience in this type of feasibility assessment. Reports of the feasibility assessments will be completed by September 15, 2008.

**White Mountain National Forest Administrative Complex**

BERC has been working with the White Mountain National Forest for almost two years to help with the conceptual design for a wood-energy system to be included in the construction of a new administrative complex. BERC expects to play a continued role in the design and implementation of the wood system.

**Coos County Symposium 2007**

The first Coos County Symposium (May 2-4, 2007) held at the BALSAMS in Dixville Notch, New Hampshire was collaboratively planned by the Carsey Institute, the University of New Hampshire, the North Country Region and the Neil and Louise Tillotson Fund of the New Hampshire Charitable Foundation, the Center for Rural Partnerships and Center for the Environment of Plymouth State University, Public Service of New Hampshire, the Northern Forest Center, and the New Hampshire Electric Coop.

Over the course of three days, participants examined socioeconomic trends in rural America and discussed Coos County’s opportunities related to health, jobs, natural resources, youth, and the creative economy. BERC’s founding executive director, Timothy Maker, participated along with more than 100 other leaders from the region as a voice on the potential role of wood energy in the county’s future. Maker and BERC’s current executive director, Christopher Recchia, have also been active participants in the 2007/08 Tillotson Fund Grantee Learning Community.

**Groveton North Country RC&D**

BERC is working closely with the North Country RC&D on the North Country Council’s grant from the US Economic Development Administration to study the potential in Groveton of creating a community-energy system based on the planned Tamarack biomass power and biofuels project.

**New Hampshire Wood Fuel Supply Study**

Earlier this year, BERC published the Vermont Wood Fuel Supply Study, which examined the amount of wood by-product generation and low-grade wood grown annually in Vermont’s forests as well as the economics of the wood fuel supply and reliability of the supply infrastructure. The Vermont study quantified the available wood resource from not only Vermont counties but also from those of bordering states, including Coos County. BERC is working to extend this study to the other three states of the Northern Forest region to provide a comprehensive, county-by-county assessment of the wood supply across the region.

BERC’s original concept paper to the Neil and Louise Tillotson Fund of the New Hampshire Charitable Foundation included a funding proposal to carry out the New Hampshire portion of this four-state study. This work was not included in the scope of the funding awarded; however, BERC has continued this effort with the New Hampshire State Forester and other stakeholders in the state to secure funding to complete the study.

BERC is working closely with the North Country RC&D on the North Country Council’s grant from the US Economic Development Administration to study the potential in Groveton of creating a community-energy system based on the planned Tamarack biomass power and biofuels project.
CONCLUSION

The communities of the North Country are literally at the end of the pipeline for fossil fuels and currently dependent on fuel oil and propane for economic survival. When non-renewable fossil fuel prices rise sharply, as they have already started to do, and as competition for available oil resources sharpens, these communities will be among the hardest hit.

And yet, the North Country is blessed with its own abundant, renewable resource—surrounding forests that support and define its communities. While homeowners know that when push comes to shove they can turn to a wood stove to stay warm, no such assurance currently exists for the region’s schools, community buildings, hospitals, and downtown areas.

Coos County has historically had a strong paper and forest products industry that provided the backbone of the local economy. As paper mills around the area have closed, the economy lost an important market for low-grade wood.

Coos County represents an enormous potential for using locally available, sustainable wood resources to replace fossil fuels and sharply curtail the outflow of energy dollars from the region’s economy. Coos County has the unique combination of an extensive forest land base and a healthy, diversified forest products industry. Biomass heating would serve to bolster the forest products industry in this region by supplying new markets for low-grade wood, which would begin to alleviate the loss of several area paper mills.

There is an immediate opportunity, represented by high oil and gas prices and low prices for available low-grade wood residues, to convert facilities in this region from fossil-fuel dependence to wood heating. The amount of wood residues produced from the existing local forest products industry and the amount of low-grade wood grown annually in the region’s forests far exceed the wood fuel that would be required by the schools and larger facilities studied here.

Oil is the primary fuel currently used for heating in Coos County. The average annual consumption per square foot of heated space is about 0.46 gallons in northern New England. BERC has identified candidates for biomass heating projects, including schools, hospitals, communities, and public buildings. There is a potential of considering installation of biomass heating systems at ten schools, one college campus, one correctional facility, four public buildings, two hospitals, five private buildings, and two communities.

The total area of the buildings identified as good candidates for biomass heating in this report has been estimated at about 2,064,000 square feet. If all of these buildings were to switch over to biomass heating, an estimated 950,000 gallons of heating oil would be offset annually. Nearly 16,000 tons of woodchips would be consumed instead. With woodchips priced at $50 per green ton, approximately $800,000 would be added to the local economy annually if all the facilities considered here converted to woodchip heating.

As combustion of oil produces approximately 22 pounds of carbon dioxide per gallon, this would reduce the amount of CO₂ contributed to the atmosphere by 10,450 tons annually. Biomass heating not only saves the user on their fuel bill, it keeps those dollars circulating in the local economy rather than exporting them. At a price of $50 a ton, approximately $800,000 would be added to the local economy annually.
Support for the North Country Forest Energy Project by the Tillotson Fund and the New Hampshire Charitable Foundation has allowed BERC to strengthen efforts in developing a Fuels For Schools program in New Hampshire as well as identifying and prioritizing ideal sites for wood-energy projects and investigating creative ways to finance them.

The North Country Forest Energy Project has brought focus and expertise to an area that has been gaining national momentum: increased economic and energy security for rural communities through the use of local, low-grade wood resources for energy supply. BERC has established key partnership with program and project stakeholders in Coos County as well as the state of New Hampshire.

Tillotson funding to BERC has already provided the impetus for a significant body of related work initiated by BERC and its partners to advance the concept of community-scale wood energy and implement wood-energy projects in Coos County and the rest of the North Country. During the first year of the project, BERC is developing the New Hampshire Community-Scale Biomass Heating Program concept with state agencies and other partners convening regularly to ascertain means of securing program support and develop education and outreach materials.

BERC has recommended strategies for securing upfront financial support for these projects. As stated above, there is a clear need to find a new method for providing capital to wood-energy projects, a method that does not require—or at least minimizes—the need for state or federal grants, and that does not require voter approval. Of the options outlined above, those that show the most promise are municipal tax-exempt leasing and nonprofit energy service companies. Both are new approaches to financing and implementing school wood-energy projects and so would take considerable work and development to determine whether they would provide good alternatives to traditional school bond financing. BERC has also quantified the amount of woody biomass potentially available in Coos County to fuel these biomass heating projects.

All of this significant work would not have been possible without the Tillotson Fund’s support for BERC and its North Country Forest Energy Project.
WOOD SUPPLY APPENDICES

<table>
<thead>
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<th>Sawmills</th>
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<th>County</th>
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<td>Perras Lumber, Inc.</td>
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<td>Warren</td>
<td>NH</td>
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<td>Northeast Square and Dowel, Inc.</td>
<td>N. Haverhill</td>
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<td>Jefferson</td>
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<td>Milan</td>
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<td>Penley Corporation</td>
<td>West Paris</td>
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### Logging & Chipping Contractors

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<tr>
<td>Larry Brown</td>
<td>Granby</td>
<td>VT</td>
<td>Essex</td>
<td>(802) 328-2671</td>
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<tr>
<td>Currier - 3D Logging</td>
<td>Gorham</td>
<td>NH</td>
<td>Coos</td>
<td>(603) 466-2757</td>
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<tr>
<td>AB Logging</td>
<td>Lancaster</td>
<td>NH</td>
<td>Coos</td>
<td>(603) 788-3255</td>
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<tr>
<td>K. C. Chipping</td>
<td>Littleton</td>
<td>NH</td>
<td>Grafton</td>
<td>(603) 444-5403</td>
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<tr>
<td>Dunkerton Logging</td>
<td>Canaan</td>
<td>NH</td>
<td>Grafton</td>
<td>(603) 523-7570</td>
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<tr>
<td>RC Chipping</td>
<td>Pittsburg</td>
<td>NH</td>
<td>Coos</td>
<td>(603) 538-6330</td>
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<tr>
<td>Welch Logging &amp; Chipping</td>
<td>West Ossipee</td>
<td>NH</td>
<td>Carroll</td>
<td>not available</td>
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<tr>
<td>Fadden Chipping</td>
<td>Conway</td>
<td>NH</td>
<td>Carroll</td>
<td>(603) 939-2462</td>
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<tr>
<td>Paul Boutin</td>
<td>Littleton</td>
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<td>(603) 444-6349</td>
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<td>Timberwolf Logging</td>
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<td>NH</td>
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<td>(603) 444-7115</td>
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<tr>
<td>Stockley Trucking</td>
<td>Lisbon</td>
<td>NH</td>
<td>Grafton</td>
<td>(603) 838-2860</td>
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<tr>
<td>RJ Chipping Enterprises</td>
<td>Gorham</td>
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<td>Coos</td>
<td>(603) 466-5447</td>
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<tr>
<td>Foster Brothers Logging</td>
<td>Littleton</td>
<td>NH</td>
<td>Grafton</td>
<td>(603) 444-6949</td>
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<tr>
<td>Heath Bunnell</td>
<td>Monroe</td>
<td>NH</td>
<td>Grafton</td>
<td>(802) 793-6594</td>
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### Woodchip Brokers

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<tr>
<td>Cousineau Forest Products</td>
<td>Henniker, NH</td>
<td>(603) 428-7155</td>
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<tr>
<td>North Country Procurement</td>
<td>Rumney, NH</td>
<td>(603) 786-2289</td>
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Both businesses supply a wide range of wood materials including sawdust, paper chips, bark, whole-tree chips, etc. to various markets in the northeastern United States.

### Wood Pellet Suppliers

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<tr>
<th>Business Name</th>
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<tbody>
<tr>
<td>New England Wood Pellet</td>
<td>(603) 532-4666</td>
<td>Produces and sells wood pellets in bags but offers delivery in bulk from Jaffrey, NH</td>
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<tr>
<td>Biomass Commodities Corporation</td>
<td>(413) 458-5326</td>
<td>Brokers bulk pellet fuels from rail-road hub in St. Johnsbury, VT</td>
</tr>
<tr>
<td>Energex</td>
<td>(819) 583-5131</td>
<td>Offers bulk delivery of standard-grade pellets to northern New England from its Quebec plant.</td>
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<tr>
<td>Strong Green Energy</td>
<td>(207) 750-4216</td>
<td>Not in operation yet. Company acquired a toothpick mill and plans to convert to a wood pellet mill</td>
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<tr>
<td>Maine Wood Pellet Company</td>
<td></td>
<td>Plant is under construction</td>
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