Executive Summary
Phase I & II

Markets for Low-Grade and Underutilized Wood in New Hampshire

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Markets for low-grade and underutilized wood are critical to the practice of good forestry and the efficient operation of the forest products industry in New Hampshire. These markets provide an outlet for wood that cannot be used for the manufacture of lumber, but that are removed during forestry operations to allow other, better quality trees to grow into high value sawlogs. A viable market for low-grade wood enhances the future of the state's forest products industry, allows for the practice of sustainable forest management, and increase the economic viability of privately owned forestland in New Hampshire.

Additionally, markets for low-grade wood also provide an outlet for sawmill residue that is generated during the manufacture of lumber. Sawmills in New Hampshire generate between 400,000 and 600,000 tons of residue annually. In order to operate efficiently and economically, sawmills must be able to sell this residue or landfill it. In this respect, low-grade markets also serve as a critical component of the state's robust and growing sawmill industry.

The importance of markets for low-grade wood has been recognized in New Hampshire public policy for decades. Most recently this has been noted in the New Hampshire Forest Resource Plan (1996), Good Forestry in the Granite State (1997), the Final Report of Governor Shaheen's Forest Industry Task Force (1997), and legislation regarding the state's wood-to-energy facilities.

Traditional markets for low-grade wood and sawmill chips include pulp and paper manufacturing and, for the past two decades, wood-fired power plants.

The manufacture of pulp and paper has long been an anchor of New Hampshire's forest industry, and provides a market for an estimated 2.8 million tons of low-grade wood from New Hampshire each year. Until recently, Pulp and Paper of America's mills in Berlin and Gorham accounted for over 40% of this total. These mills are presently idled, the owner of the mills – American Tissue Company – is in bankruptcy proceedings, and their future is uncertain.

New Hampshire's wood-fired power industry developed in the 1980's, Following the energy crisis of the mid 1970's, both state and federal public policy encouraged construction of renewable and diversified sources of electricity. In New Hampshire, this resulted in construction of eight wood-fired energy facilities, six of which remain operational today. These six facilities use 1.3 million tons of wood annually -- primarily whole-tree chips. In the fall of 2001, the New Hampshire Public Utilities Commission approved the termination of "rate orders" – in effect contracts that assure operation of the facilities – for Bio Energy in Hopkinton and Whitefield Power & Light. Future operation of these facilities is uncertain, though both entered into short-term agreements with the New Hampshire Timberland Owners Association that should keep them operating for the near future.

The remaining wood-fired facilities have "rate orders" to sell their power to Public Service of New Hampshire at a specified price. These rate orders expire between 2006 and 2008. The operation of these

facilities, and their existence as markets for low-grade wood from New Hampshire's forests after the expiration or termination of these rate orders is highly uncertain.

Identifying and Evaluating Alternative Markets for Low-Grade Wood

Recognizing the importance of low-grade wood markets to New Hampshire's forest products economy, the New Hampshire Department of Resources and Economic Development commissioned a study with the goal of identifying and beginning the process of implementing one or more options to sustain these markets. The project has proceeded in two phases. The first phase evaluated a number of possible markets for low-grade wood, (using evaluation criteria that included, among others, potential market size, technical feasibility, economic feasibility, and environmental and social impacts) and identified the single option most likely to provide a market to replace the anticipated loss of several wood-fired energy plants. The second phase encompassed a detailed technical and financial analysis of this "preferred" option, which was planned to provide the foundation for economic development activity aimed at successfully promoting development of this option in New Hampshire.

Phase 1 – Evaluation of Potential Low-Grade Wood Markets

Phase 1 of this study is documented in the *Phase I Final Report: Use of Low Grade and Underutilized Wood Resources in New Hampshire* (NH Dept of Resources and Economic Development, January 2001, http://www.nhdfl.com/publications/div_publications.htm). In order to identify potential new markets for low-grade wood in New Hampshire, a total of fourteen markets that offered the promise of new or expanded use of low-grade wood were surveyed. These included:

- Pulp and paper manufacturing
- Fuel pellets
- Wood chip export
- Small-scale gasification
- Process heat / co-location
- Ethanol and biochemicals
- Co-firing with wood at the PSNH Merrimack coal-fired electricity plant
- Firewood
- Animal bedding
- Landscaping mulch
- Densified logs
- Lumber from small diameter material
- Solid wood composites (oriented strand board and medium density fiberboard)

After an initial technical and economic screening, six of these were analyzed in depth. For each potential new market the amount of wood that could be consumed by the market and current technological and economic forces that would impact the viability of the market were thoroughly researched.

1. <u>Oriented Strand Board (OSB):</u> Replacing plywood in many applications, OSB is a structural panel of roundwood flakes bonded together using resins. A modern OSB plant could consume almost 500,000 tons of wood annually, though because of flake specifications could not use sawmill residue. While OSB consumption is expected to grow over the next decade, existing and planned capacity significantly exceed demand. A total of thirteen new OSB facilities are expected to be constructed between now and 2005, adding to an already glutted market. For this reason, it was determined that OSB is not a viable potential market for low-grade wood in New Hampshire.

2. Ethanol and Bio-chemicals: Ethanol and other bio-chemicals can be derived from wood, and can utilize roundwood and mill residue as feedstocks. The United States Department of Energy is presently working with "bio-ethanol" projects that produce 20 million gallons per year (GPY), and believes that bio-ethanol is approaching economic viability. A 50 million GPY facility, a size anticipated in the near future, would use 2,000 bone-dry tons of wood daily, or roughly 1 million green tons each year. However, wood and mill residue are economically unattractive feedstocks for such operations, which can utilize almost any biologically based material as a raw material. Wood, which presently costs over $30 per dry ton, would compete with other feedstocks such as agricultural waste, municipal solid waste, and construction waste, which have much lower or even negative procurement costs.

3. Chip Export: Exporting paper chips out of the Port of Portsmouth to foreign or domestic markets has been discussed and researched for at least a decade, though no chip exports have occurred to date. Chip exports could provide a market for up to a half-million tons of low-grade wood, including sawmill residue, annually. But several factors combine to eliminate this as a viable potential market for New Hampshire chips. Japan is by far the largest importer of paper chips, but is very distant from New Hampshire by shipping lanes, much further than from competing sources of chips. This fact, combined with a strong dollar that makes export of low-value commodities nearly impossible, suggest that chip exports will not provide a stable market for low-grade wood in the foreseeable future.

4. Co-Firing with Coal: Supplementing wood in a coal-fired boiler is referred to as "co-firing", and is used in many coal-fired boilers across the nation. Co-firing with wood at a rate of 5-7% of BTU value in a facility the size of PSNH's Merrimack Station would use roughly 270,000 tons of wood annually. Co-firing has been used to achieve reductions in emissions of SO_2 and NOx in other coal-fired boilers, including cyclone boilers of the type installed at Merrimack, and wood is cost competitive with coal as a Btu source. Although a potential long-term option, co-firing at Merrimack is impractical in the near to mid-term, however. PSNH's pending sale of Merrimack Station (as part of its divestiture of its generating assets) eliminates any incentive the utility might have to investigate co-firing – an investigation that in any event would be expensive and time-consuming – and the utility would derive no benefit from possible emission reductions. Nor is there any guarantee that co-firing will in fact be technically feasible at Merrimack Station. A future owner might be encouraged to investigate this option, but until the plant is sold it does not merit serious consideration.

5. Pulp & Paper Manufacturing: The pulp and paper industry has long served as one of the anchors of the Northeast's forest industry, and is the largest market for low-grade wood in New Hampshire. However, North American paper production is and is projected to remain flat, as the industry invests the bulk of its resources in expansions in Latin America and Asia, where raw material (tree and other organic fiber) growing cycles are faster, labor and raw material costs are less, exchange rates are favorable, and environmental restrictions are less stringent. Given these factors, it is unlikely that this market will see any meaningful increases in the near future, particularly in the Northeast.

6. Medium Density Fiberboard (MDF): MDF is a wood-based composite panel used in non-structural applications, such as furniture and cabinets. A modern MDF plant would use roughly 400,000 tons of wood annually, including a significant portion of mill residue and a variety of tree species found in New Hampshire. The market for MDF is growing rapidly, in both the U.S. and worldwide, and manufacturing facilities are being built throughout North America to meet anticipated demand.

The results of Phase 1 indicated that, of all markets analyzed, Medium Density Fiberboard is the most likely to provide an economically viable market for a significant amount of low-grade wood in New

Hampshire. For this reason, a full feasibility study was conducted on this potential market in Phase 2 of the study.

Phase 2 – Medium-Density Fiberboard: Feasibility Analysis

Phase 2 of the study comprised a detailed feasibility assessment for Medium Density Fiberboard (MDF). Its goal was to provide economic and technical analysis in sufficient detail to support efforts to attract an MDF manufacturer to locate in New Hampshire. This work is documented in *Phase II of a Project: Feasibility Analysis of Medium Density Fiberboard Manufacturing in New Hampshire* (NH Dept of Resources and Economic Development, July 2001).

The manufacture of MDF has grown rapidly in the United States and worldwide in the past 15 years. MDF is manufactured by first pulping roundwood or mill chips to release individual wood fibers (in a semi-mechanical process analogous to the corresponding operation in the pulp and paper industry), drying the fibers, coating them with a synthetic (urea formaldehyde) resin, and then pressing the fibers into a panel. Panels are manufactured between 1/8" and 1-1/2" thick, and four or five feet in width. With the development of continuous pressing processes, panels can be sawn to practically any length, but are most often marketed at eight feet and twelve feet. Because of its fine texture, MDF surfaces and edges can be readily machined, and provide an excellent substrate for paints, veneers, and other surface coatings. On the strength of its cost and technical characteristics, MDF has captured a large and growing market share formerly held by solid wood products in the furniture and related industries.

MDF production is a capital-intensive operation, requiring substantial investment and economies of scale in order to achieve acceptable profit. The facility modeled for New Hampshire, similar in size to other facilities now being developed in the U.S., would utilize 420,000 tons of roundwood and sawmill residue each year in order to produce 130 to 150 million square feet (3/4" basis) of MDF.

A facility of this size would require substantial energy – in the form of heat and electricity – equivalent to the dedicated output of a 10-megawatt (MW) power plant. Because of the comparatively high cost of electricity in New Hampshire, as well as the need to dispose of bark and other wood waste, a 25 MW wood-fired electric generating plant was modeled as a necessary part of the MDF facility. The excess electricity generated (beyond the plant's own 10 MW requirements) would be sold into a competitive marketplace, providing an additional source of revenues. (The possibility of co-locating an MDF facility with one of New Hampshire's existing wood energy facilities was evaluated, but was determined not to be feasible because of very specific requirements for use of thermal energy and emissions controls needed for an MDF plant.)

Total capital costs for an MDF facility of this size would be $132 million for the MDF production operations, plus $21 million for electric and thermal energy generation. Annual operating costs for this facility would be roughly $38 million for raw materials, labor, administration and other expenses. Income, based on projected MDF and wholesale electricity sales prices, is projected to equal approximately $54 million per year.

The analysis reached the conclusion that a facility of this size, although profitable, would not generate sufficient levels of profit to attract a developer to invest in a New Hampshire plant. Under reasonable economic assumptions, the facility described above generates a projected Return on Investment of 11.5% and an Internal Rate of Return (IRR, a measure of the quality of investment) of 9.35%. These values are below the returns required by the industry for investment in new MDF capacity. The industry expectation for IRR is between 14% and 16%.

Three factors are primarily responsible for the fact that MDF is not financially attractive in New Hampshire. First is New Hampshire's high cost of electricity. Industrial electricity rates in New Hampshire are roughly twice as high as rates in much of the southern U.S., where much of new MDF capacity is being developed. Even with cogeneration, the cost-revenue balance associated with electricity is a major drag on MDF's economic performance in this state. Second is the high cost of wood. The delivered price of MDF-ready chips in New Hampshire is approximately $18.00-$20.00 per ton, which is about 20% higher than the cost of equivalent forest products in the southern U.S. Third is New Hampshire's distance to end use markets for MDF (located primarily in the southern U.S. and Canada), which imposes a significant freight penalty, coupled with an unfavorable exchange rate, which makes it difficult for American products such as MDF to penetrate Canadian markets.

Phase 2 of the analysis concluded, therefore, that although MDF is the most viable potential market for low-grade wood in New Hampshire, it is in fact highly unlikely that a developer of MDF capacity could be attracted to the state in the near future.

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