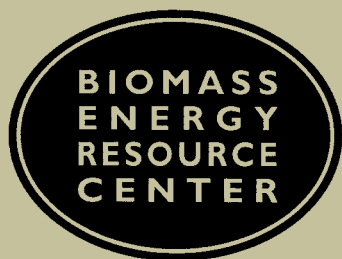


EXECUTIVE SUMMARY

Vermont Wood Fuel Supply Study

*An Examination of the Availability
and Reliability of Wood Fuel for
Biomass Energy in Vermont*



Report Preparation

Prepared for the:

- Vermont Department of Forests, Parks & Recreation
- Vermont Department of Buildings & General Services

Adam R. Sherman, Principal Investigator
Biomass Energy Resource Center
50 State Street, Montpelier, VT 05601
Christopher Recchia, Executive Director

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- Ryegate Power Station

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INTRODUCTION

With mounting interest and movement in Vermont toward further use of woody biomass for heating, power production, and (potentially) the production of liquid fuels, many questions have been raised about the availability and long-term reliability of woody biomass for these energy uses. How much wood is out there? Where specifically is it? How much of the forestland is actually available for some level of harvesting? How much will wood fuel cost in the years to come? How stable is the infrastructure necessary to make it available? What can be done to help the situation?

In an effort to better understand the forest resource capacity and the future availability of wood to reliably fuel biomass energy systems in Vermont, the Biomass Energy Resource Center (BERC), in partnership with the study's stakeholders, initiated the Vermont Wood Fuel Supply Study (VTWFSS). While Vermont has been a national leader in biomass energy for the past 20 years, this study is the first to address these questions directly and comprehensively.

This is an executive summary of a longer report of the same name that may be obtained from BERC or downloaded by visiting www.biomasscenter.org.



STUDY SCOPE AND METHODS

The geographic area this study consists of the 14 counties of Vermont and the surrounding 10 adjacent counties of New York, Massachusetts, and New Hampshire. Additional large consumers of low-grade wood such as biomass power plants and pulpmills outside the study area were factored in due to their impact on the supply of wood fuel in the study area. The study examines sources of woody biomass, both existing and potential.

Much of the available information on forest inventory, growth, and harvesting is incomplete and/or designed for examining the supply of higher-value timber products. Many of the studies conducted to date on wood supply similarly focus solely on timber products such as sawlogs and pulp. For these reasons, and given the specific questions the study sought to answer, this study and its approach are unique. The study developed three dynamic analysis tools (which are built upon the available information and use a series of reasonable assumptions) to:

- calculate current potential supply of low-grade wood from the net annual growth on timberland accessible and available for harvesting
- model the impacts of future market demand on the amount of in-forest supply
- examine the economics of wood fuel supply

This study addresses the sustainability of wood supply for energy broadly at the state and county levels. It quantifies the amount of low-grade, new-growth wood, beyond what is harvested today, that is available under different assumptions. Sustainability criteria can be built into assumptions which can be tested using the models developed for the study. In the fullest sense of the word, however, sustainability must be addressed in the forest management and harvest practices used on specific forest types and forestland parcels over time.

CURRENT WOOD FUEL SUPPLY AND DEMAND

The combined consumption of residue and low-grade wood for the pulpmills, biomass power plants, seasonal chip heating systems, and residential wood heating within the study area is estimated at 3.5 million green tons annually. A significant portion of this consumption is met with wood originating outside the 24-county study area.

The 24-county study area has:

- one active pulpmill consuming over 750,000 green tons of low-grade wood annually (there are another three just outside the study area boundary that impact the study area's wood supply)
- six biomass power plants consuming over 1.4 million green tons annually (with another five just outside the study area that have impact on the study area supply)
- numerous institutional and commercial seasonal heating systems consuming approximately 40,000 green tons annually
- widespread use of firewood for residential heating totaling an estimated 1.4 million green tons of low-grade hardwood each year

CALCULATION OF WOOD FUEL SUPPLY POTENTIAL FROM FORESTS

Based on USDA Forest Service information, Vermont and the surrounding counties in New York, Massachusetts, and New Hampshire have:

- 9.3 million acres of forested land area designated as “timberland”
- 1.1 billion tons of above-ground biomass inventory on timberland
- 24.8 million tons of net growth of new wood annually on timberland
- 4.8 million tons of average annual harvesting to supply all current wood product market demand (includes sawlogs, pulp, firewood, and biomass)
- 20 million tons of under-utilized wood grown annually

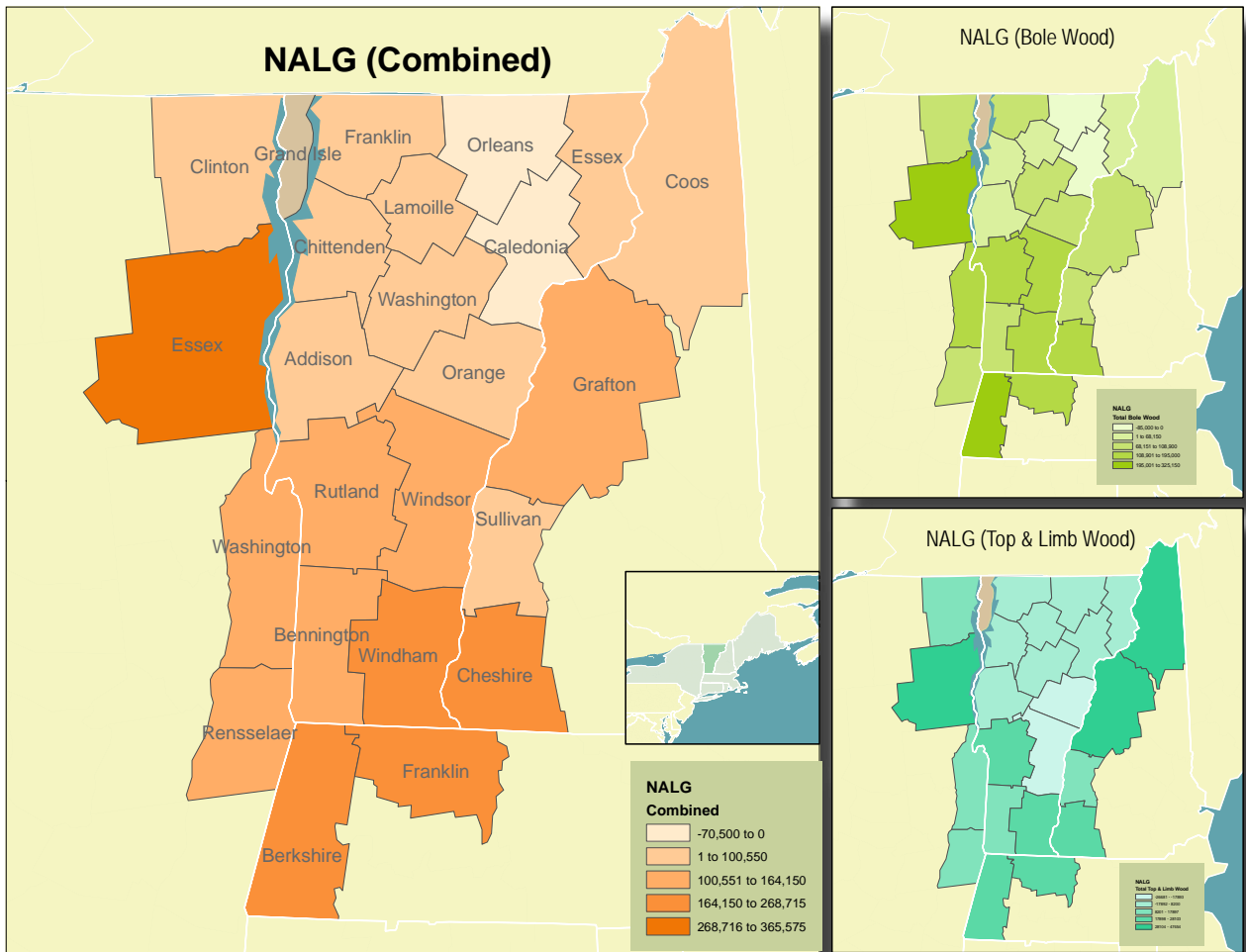
Of the 20 million tons of wood growth that is currently not utilized, what portion of this is low-grade wood appropriate for woodchip fuel production? Further, is it accessible and available for harvesting?

While the current consumption of low-grade wood for fuel and fiber represents a significant demand on the region’s forests, the forests are growing wood much faster than the current rate of harvesting. An in-depth analysis was conducted to determine the forests’ capacity to supply low-grade wood for biomass energy by examining the growth on standing forest inventory. For this study, a Microsoft Excel-based tool was created for calculating the amount of Net Available Low-Grade Growth (NALG).

From this point, the numerous variables were accounted for as part of the calculation of the forest’s under-utilized annual growth of low-grade wood suitable for biomass energy, including the rate of forest growth; the amount of forest biomass designated as low-grade wood deemed suitable for harvesting; physical and legal limitations on accessibility to the timberland on which the inventories stand; and the additional political, social, and economic limitations to the availability of the timberland. Based on these variables, a range of NALG wood was identified.

Net Available Low-Grade Growth (NALG)

Scenario	Key Assumptions	Vermont Counties (green tons/yr)	Total (all counties) (green tons/yr)
Conservative	No harvesting on public lands and on privately owned lands fewer than 50 acres; 40% bole volume classified as low-grade and 0% tops and limbs	387,491	1,137,267
Moderate	Based on current patterns, moderate harvesting on public lands and very little on privately owned lands fewer than 50 acres; 60% bole volume classified as low-grade and 50% tops and limbs	1,466,982	3,423,082
Aggressive	Increased harvesting on public lands and on privately owned lands fewer than 50 acres; 70% bole volume classified as low-grade and 100% tops and limbs	2,342,053	5,343,465



The counties with the greatest concentrations of NALG were Windham County, Vermont, Essex County, New York, and Berkshire County, Massachusetts.

Windham County has a long history of strong saw-log markets, but is far from the large pulp markets of northern New Hampshire and eastern New York, and therefore has a large inventory of low-grade material.

Similar factors explain Berkshire County's high concentration of NALG.

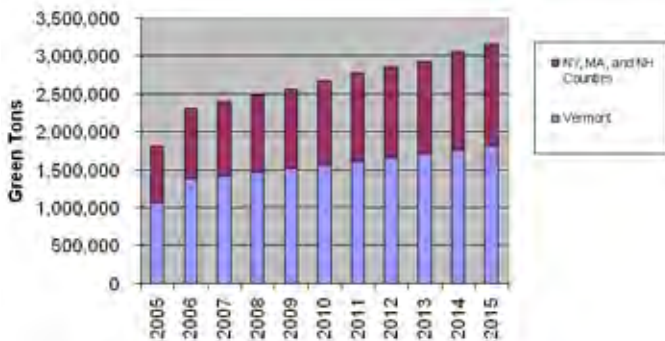
The indicated high concentrations of NALG in Essex County, New York are likely due to underestimations of the county's harvest.

SUPPLY/DEMAND COMPUTER MODEL

Four different modeling scenarios (runs) were tested looking 10 years forward using a supply and demand computer model (results below).

It is important to note that the purpose of the model is not to predict the supply and demand into the future, but to better understand the various factors that impact it.

Constant Demand Run (both biomass and timber, including pulp)



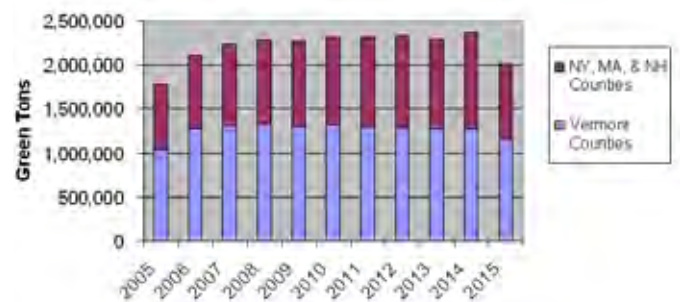
Key Assumptions

- Constant levels of harvesting on public and private timberland
- 60% bole volume classified as low-grade and 50% tops and limbs
- Flat consumption for sawlogs, pulp, firewood, and chips
- Assumes Berlin and Groveton remain closed

Results

Under the conditions of a Constant Demand Run—where the annual harvesting levels, timberland ownership, and amounts of wood designated as low-grade remained constant but forests continued to grow—the county inventories of NALG wood grow significantly over the 10-year period of the model. Despite the overall trend of surplus wood, the model indicates signs of stress in Chittenden County, Vermont and Washington County, New York—likely due to the combination of relatively high demand for wood and limited availability due to small parcel sizes.

Increased Biomass & Constant Timber Demand Run



Key Assumptions

- Constant levels of harvesting on public and private timberland
- 60% bole volume classified as low-grade and 50% tops and limbs
- 5% annual increased demand for biomass power and seasonal heating with chips and firewood
- Flat consumption for sawlogs and pulp
- Assumes Berlin and Groveton remain closed

Results

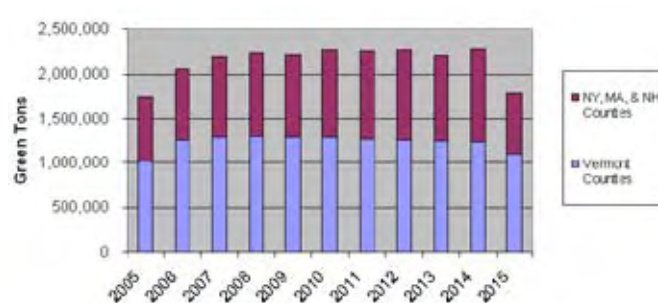
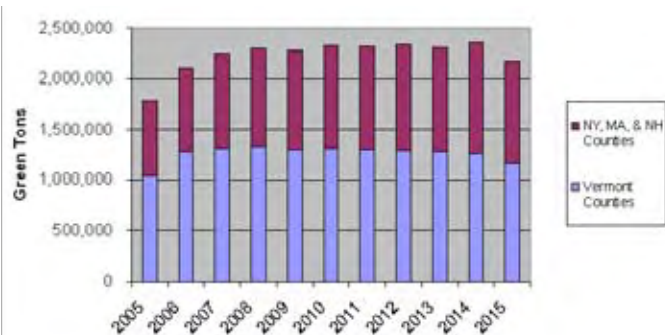
For the Increased Biomass and Constant Timber Demand Run, the biomass demand was increased by 50 percent over the 10-year period (5 percent increase each year). This run begins to show further stress of the NALG inventories. One major reason for this was the assumption of 50 percent increase in residential firewood demand. This run shows a significant drop in the total volumes of NALG inventories in year 2015 when the increased demand for biomass reaches 50 percent.

In addition to the four general model runs, several other specific runs were performed to test the model's spatial allocation functions by placing a 20MW wood-fired power plant in various counties to see its impact on the surrounding wood baskets. Four Vermont counties were tested—Addison, Bennington, Windsor, and Orleans. Of the four, only Orleans showed significant impact on the NALG inventory.

One last model run was conducted to test sensitivity to the forest net annual growth rate. All previous model runs kept forest growth constant at 2.24 percent annually, but when the forest growth was modeled to decline significantly over the 10-year period, NALG inventories are greatly reduced even under the constant demand scenario.

Increased Biomass & Decreased Timber Demand Run

Increased Biomass & Increased Timber Demand Run



Key Assumptions

- Consistant levels of harvesting on public and private timberland
- 60% bole volume classified as low-grade and 50% tops and limbs
- 5% annual increased demand for biomass power and seasonal heating with chips and firewood
- 5% annual reduction of sawlog and pulpwood consumption

Results

Under the Increased Biomass and Decreased Timber Run, relatively few new patterns emerge. The reduction of demand for pulpwood frees up additional volumes for biomass, but the spatial allocation of demand shows the inventory stress on the same counties – Chittenden and Orleans in Vermont and Washington County in New York.

Key Assumptions

- Consistant levels of harvesting on public and private timberland
- 60% bole volume classified as low-grade and 50% tops and limbs
- 5% annual increased demand for biomass power and seasonal heating with chips and firewood
- 5% annual increase in sawlog and pulpwood

Results

Similar patterns were observed under the Increased Biomass and Increased Timber Demand Run. The NALG inventory is not impacted by the increased harvest demand for sawlogs. The additional stress from the modeled increase in pulpwood demand is mostly allocated to the outside regions of the study area.



ECONOMIC ANALYSIS

How much will chips cost if demand increases? To answer this question, it is important to understand that there are two main categories of chips: residue chips derived as a by-product of some other primary activity, and chips produced as a primary fuel.

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.

There are many variables that dictate the economics of wood-fuel supply. Perhaps the most significant variable is the extent to which the economics of harvesting low-grade wood depends on the integrated harvesting of more valuable products that subsidize the low-grade material. Therefore, for the purpose of this study, the economics under several scenarios were explored:

- Current product mix ratios under integrated harvesting
- Increased demand of low-grade wood under integrated harvesting
- Complete independence from integrated harvesting (exclusively low-grade harvesting)

A price range of \$40 to \$64 per green ton for bole chips and \$30 to \$40 per green ton for whole-tree chips was identified using an economic model developed for this study. Chips tend to be on the inexpensive end of the spectrum when there is a strong sawlog market allowing integrated harvesting of low-grade trees at lower costs. If low-grade wood for chips was harvested as a stand-alone practice, prices would reach the high end of the price spectrum.

SURVEY

Surveys were used to gather further general information; test and fine tune key assumptions used in the supply calculation, the 10-year supply/demand model, and the economic analysis; and explore potential strategies to increase low-grade wood supply. Six main groups of stakeholders were identified within the forestry profession, the forest products industry, and the biomass energy industry. Mail-back surveys were developed and distributed to these six key groups.



CONCLUSIONS

Much was learned from the current wood fuel supply analysis, from in-forest NALG calculation, from 10-year supply and demand modeling, from the economic analysis, and from the surveys:

- A majority of Vermont's current supply of biomass fuel is produced as a by-product of commercial harvesting or primary processing of forest products
- Vermont's forests have the capacity to supply additional amounts of wood fuel for biomass energy
- Some counties have greater capacity to expand the use of biomass energy than others
- The ability of Vermont's forests to sustain increased harvesting for biomass energy will depend to a certain extent on the future of the pulp and paper industry in the region
- Higher market prices paid for wood fuel will stimulate mobilization of the in-forest NALG inventory and result in greater availability and reliability of the wood fuel supply
- Bole chips and whole-tree chips have potential for becoming commodity wood fuel products
- Loggers and mills are surviving—but just barely

How stable is the supply infrastructure that supplies wood energy? The bad news is that the harvesting, processing, and transport infrastructure that supplies wood energy in Vermont is almost entirely supported by the primary activities of the forest products industry. The average age of loggers in the region is 45 years. There are no new sawmills in Vermont. Two of the major pulpmills in the region ceased operations in 2006. The good news is that greater supply independence from the forest products industry can be achieved at higher prices and increased volumes. If the tipping points for volume of demand and price can be met, the growth of biomass energy can stimulate the necessary investment to strengthen the supply infrastructure .

Currently most of the chips produced and sold in the region for energy are sourced as a by-product stream of some other activities. The historic and current pricing of these chips have been directly tied to their status as by-products. If new volumes of wood are to be accessed for expanding the supply of fuel for biomass energy, market prices and strategies will need to be adopted that treat wood fuel as a commodity rather than as a by-product.

RECOMMENDED STRATEGIES

This study and the modeling tools developed for it, present the opportunity to take a fresh look at possible strategies and actions that can advance the goal of sustainably utilizing low-grade forest resources for biomass energy production in Vermont. The study itself has not developed new strategies – instead it has explored the details of wood fuel supply to improve our understanding of wood fuel availability and reliability so that, as policy decisions are made, we can ensure that growing demand for wood fuel is maintained within the capacity of the forest resource and is consistent with ecological and environmental values and management objectives, for years to come.



- Expand existing initiatives, such as the Current Use (or Use Value Appraisal) taxation program, and develop new incentives that help reduce property tax burdens on private landowners.
- Develop programs and initiatives that facilitate the coordination among the increasing number of small private timberland owners to achieve their forest management objectives and reach the scale necessary to keep small woodlots as “working forests”.
- Increase public outreach and education on the benefits of managed forests and highlight examples of well-managed forests.
- Expand public relations efforts to promote the forestry and logging professions as the stewards of Vermont’s working forests.
- Work with public and private partners to develop strategies to reduce the parcelization and fragmentation of large forest parcels.
- Work to maintain and enhance the forest harvesting infrastructure – equipment and personnel. Keep existing forest products markets in Vermont strong as their demand is the backbone of the existing harvesting infrastructure.
- Create a business development assistance program for parties interested in starting wood fuel supply businesses.
- Develop a portfolio of commercial lending programs and small grant programs that will make capital available to the forest products industry.
- Develop loan guarantee programs to help wood supply businesses without sufficient collateral to secure commercial financing.

- Support strong markets for high-grade and mid-grade forest products as a vehicle for enabling low-grade wood harvesting.
- Promote and make investments in distributed storage and processing sites.
- Encourage investment in fuel supply and transport infrastructure.
- Encourage the private development of year-round chipping yards.
- Explore with Vermont Agency of Transportation increasing Vermont's interstate truck weight limit from 80,000 lbs to 99,000 lbs to conform to limits of neighboring states.
- Educate and develop consumer acceptance toward more equitable pricing for wood fuel as a necessary element toward achieving greater fuel supply availability and reliability.
- Purchase chips made from low-value species such as white birch, beech, and poplar.
- Encourage the procurement of bole chips and whole-tree chips from entire trees as a mechanism to transition toward a commodity fuel supply market.
- Build roundwood inventory in accessible chipping yards to reduce exposure to risk from poor weather and "just-in-time" inventory management.
- Develop the wood energy market in Vermont with consideration to the need to aggregate sufficient regional demand to achieve a critical volume sufficient to prompt new investment in fuel supply infrastructure.
- Use the NALG inventory information from this study to help plan county build out of biomass facilities for the future.
- Encourage the use of unique wood fuel purchasing contract mechanisms, such as pre-buys, 12-month spreads of payments, and diesel fuel price adjustments to attract new chip vendors into the market.
- Encourage longer-term contract commitments for greater market stability.
- Increase funding for state and federal programs to provide up-to-date and on-going data on: forest inventory, growth and harvest volumes, and harvested land area. Also improve data regarding the residential use of firewood.
- Continue, expand and fine-tune use of the methods and tools created as part of this study to re-examine the question answered over time and to enhance the model's capabilities to address remaining unanswered questions.

