

New England Forests: The Path to Sustainability

CHAPTER II • REDUCE USE OF FOREIGN OIL



A TECHNICAL REPORT BY NEW ENGLAND FORESTRY FOUNDATION

INTRODUCTION

This project documents both the existing value and potential of New England's working forest lands: Value – not only in terms of business opportunities, jobs and income – but also nonfinancial values, such as enhanced wildlife populations, recreation opportunities and a healthful environment. This project of the New England Forestry Foundation (NEFF) is aimed at enhancing the contribution the region's forests can make to sustainability, and is intended to complement other efforts aimed at not only conserving New England's forests, but also enhancing New England's agriculture and fisheries.

New England's forests have sustained the six-state region since colonial settlement. They have provided the wood for buildings, fuel to heat them, the fiber for papermaking, the lumber for ships, furniture, boxes and barrels and so much more. As Arizona is defined by its desert landscapes and Iowa by its farms, New England is defined by its forests. These forests provide a wide range of products beyond timber, including maple syrup; balsam fir tips for holiday decorations; paper birch bark for crafts; edibles such as berries, mushrooms and fiddleheads; and curatives made from medicinal plants. They are the home to diverse and abundant wildlife. They are the backdrop for hunting, fishing, hiking, skiing and camping. They also provide other important benefits that we take for granted, including clean air, potable water and carbon storage. In addition to tangible benefits that can be measured in board feet or cords, or miles of hiking trails, forests have been shown to be important to both physical and mental health.

Beyond their existing contributions, New England's forests have unrealized potential. For example, habitats for a wide variety of wildlife species could be enhanced by thoughtful forest management. Likewise, wood quantity could be increased and the quality improved through sustainable forest management. The virtues of improved forest management and buying locally produced goods are widely extolled, but what might that actually look like on the ground? More specifically, how could enhanced forest management make more locally produced forest products available to meet New Englander's own needs, as well as for export, improve the local and regional economies and provide the greatest social and environmental benefits?

The purpose of this project is to document that potential by analyzing what we know about how improved silviculture can enhance wildlife habitat, the quantity and quality of timber, recreational opportunities, and the environment. The best available data from the US Forest Service, state forestry agencies and universities was used to characterize this potential.

The technical reports produced for this project document the potential for:

- Mitigating climate change;
- Increasing timber production to support a more robust forest products industry;
- Restoring important wildlife habitat;
- Replacing fossil fuels with wood to produce thermal energy;
- Reducing greenhouse gas emissions, not only by substituting wood for other fuels, but also wood for other construction materials;
- Enhancing forest recreation opportunities and related tourism;

- Expanding production of nontimber forest products;
- Maintaining other forest values such as their role in providing clean air and potable water – taken for granted but not guaranteed;
- Enhancing the region’s economy by meeting more of our own needs with New England products and retaining more of the region’s wealth within the New England economy; and
- Other related topics.

These technical reports are viewed as “works in progress” because we invite each reader to bring their own contributions to this long term effort of protecting, managing and enhancing New England’s forests. The entire set may be viewed at www.newenglandforestry.org. If you have suggested improvements please contact the New England Forestry Foundation to share your thoughts. These technical reports were used as the background to prepare a summary – *New England Forests: The Path to Sustainability*, which was released on June 5, 2014.

If you are not familiar with NEFF's work please visit www.newenglandforestry.org. Not already a member? Please consider joining NEFF – <https://41820.thankyou4caring.org>.

New England Forestry Foundation
 32 Foster Street, PO Box 1346
 Littleton, MA 01460

The New England Forestry Foundation is a recognized leader in conserving working forests, educating the public about forestry, and assisting landowners in the long-term protection and stewardship of their properties. For almost 70 years, we have demonstrated that well-managed working forests can provide landowners and the community with the prime ingredients for healthy living: clean air and water, sustainable production of an array of forest products, healthy forests for hiking and relaxation, a diversity of wildlife and habitats, periodic income, and renewable natural resources that help support rural economies.

Our Mission is to conserve New England’s working forests through conservation and ecologically sound management of privately owned forestlands in New England, throughout the Americas and beyond.

This mission encompasses:

- Educating landowners, foresters, forest products industries, and the general public about the benefits of forest stewardship and multi-generational forestland planning.
- Permanently protecting forests through gifts and acquisitions of land for the benefit of future generations.
- Actively managing Foundation lands as demonstration and educational forests.
- Conservation, through sustainable yield forestry, of a working landscape that supports economic welfare and quality of life.
- Supporting the development and implementation of forest policy and forest practices that encourage and sustain private ownership.

THE PATH TO SUSTAINABILITY



YOU ARE HERE
SUSTAINABILITY

New England's forests have tremendous potential to provide economic, environmental, and social benefits to the citizens of the region. Right now, we're letting some of that potential slip away. Through 12 new research reports, New England Forestry Foundation has defined the benefits our region's forests could provide, and those benefits are summarized here along the Path to Sustainability, starting with the premise that we Keep New England Forested.

NEW ENGLAND FORESTRY FOUNDATION

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REDUCE USE OF FOREIGN OIL: The Potential for Wood to Displace Fossil Fuels in New England

Prepared by Innovative Natural Resource Solutions, LLC

Part of a larger project on the potential of New England's forest lands coordinated by R. Alec Giffen for the New England Forestry Foundation. Component parts include the following of the larger effort:

1. **KEEP NEW ENGLAND FORESTED:** Assessing the Current Conservation Status of New England's Forests by Jerry A Bley
2. **GIVE WILDLIFE HOMES:** Potential of New England's Working Forests as Wildlife Habitat by Jerry A. Bley
3. **PROVIDE MORE RECREATION:** Forest Recreation Trends and Opportunities in New England: Implications for Recreationists, Outdoor Recreation Businesses, Forest Land Owners and Policy Makers by Craig Ten Broeck and Aaron Paul
4. **PROTECT US FROM CLIMATE CHANGE** by R. Alec Giffen and Frank Lowenstein
5. **CLEAN AND COOL THE AIR:** Forest Influence on Air Quality in New England: Present and Potential Value by Aaron Paul
6. **PURIFY OUR WATER:** The Potential for Clean Water from New England Forests by Aaron Paul
7. **GROW MORE WOOD:** The Potential of New England's Working Forests to Produce Wood by R. Alec Giffen, Craig Ten Broeck and Lloyd Irland
8. **CREATE LOCAL JOBS:** Vision for New England's Wood-Based Industries in 2060 by Innovative Natural Resource Solutions, LLC and The Irland Group
9. **CULTIVATE NEW BUSINESSES:** New England's Nontimber Forest Products: Practices and Prospects by Craig Ten Broeck
10. **PROVIDE MORE WOOD FOR BUILDINGS:** The Greenhouse Gas Benefits of Substituting Wood for Other Construction Materials in New England by Ann Gosline
11. **REDUCE USE OF FOREIGN OIL:** The Potential for Wood to Displace Fossil Fuels in New England by Innovative Natural Resource Solutions, LLC
12. **GROW AS MUCH AS WE USE:** Production versus Consumption of Wood Products in New England by Craig Ten Broeck

A. The Opportunity – An Overview

Wood fuels provide an opportunity to displace fossil fuels in a variety of different ways. When burned directly to displace fossil fuels, green and dry wood displace fossil fuels in varying amounts as shown below:

Table 1. Displacement of various fossil fuels by wood in producing heat¹

| One unit of wood equals... | Oil (gallons) | Natural gas (1,000 ft ³) | Propane (gallons) |
|----------------------------|---------------|--------------------------------------|-------------------|
| • Green wood (ton, 50% MC) | 50 | 7 | 89 |
| • Dry wood (ton, 20% MC) | 92 | 13 | 163 |
| • Wood pellets (ton) | 118 | 17 | 210 |

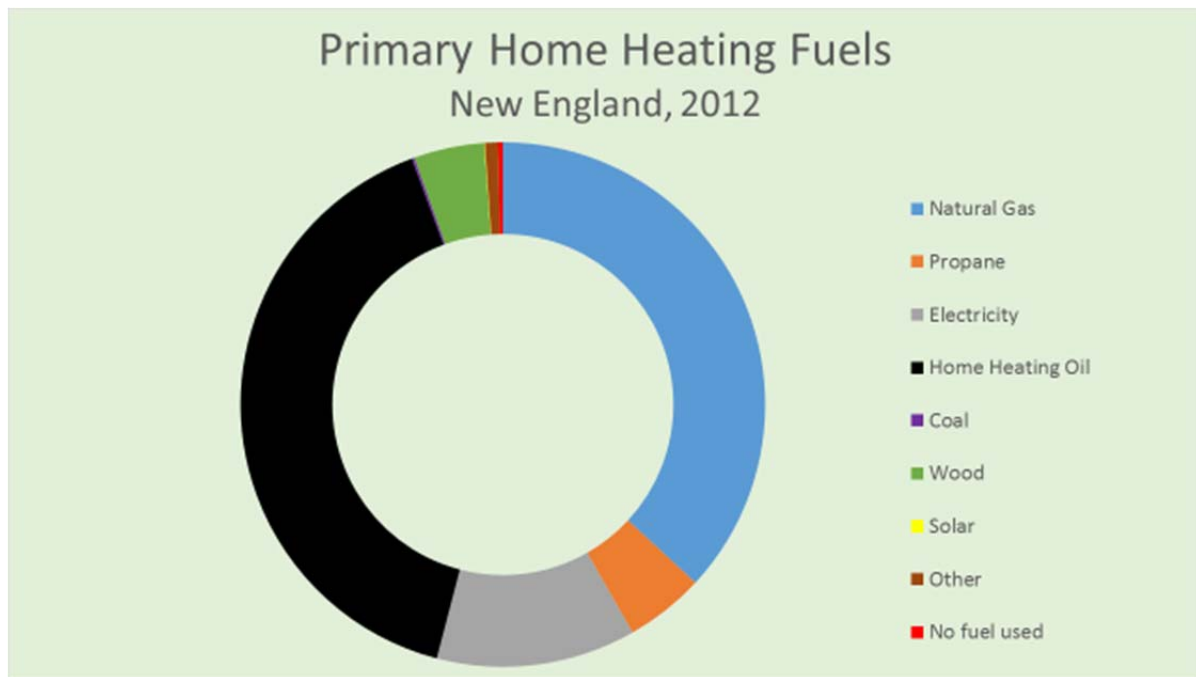
As is shown by the table above, the amount of various fossil fuels displaced depends not only on the fossil fuel itself, but also whether or not the wood displacing it is green or dry.

New England has significant dependence upon oil for heating, more than any other region of the United States. Forty percent (40%) of the homes in the region use oil as their primary heating fuel, 37% use natural gas, 12% use electricity, another five percent (5%) use propane as the primary heating fuel. Four percent (4%) of homes - 245,000 household in New England – use wood as their primary heating fuel. Another +/- 700,000 homes in New England use wood for secondary or supplemental heat.

¹ Using gross fuel values and efficiencies from US Forest Service, *Fuel Value Calculator*, published by the Technology Marketing Unit, Forest Products Laboratory, 2008. Fuel values and efficiency include:

- Green wood (50% MC), 8,600 mmbtu/ton, 67% efficiency
- Dry wood (20% MC), 13,760 mmbtu/ton, 77% efficiency
- Wood pellets, 16,400 mmbtu/ton, 83% efficiency
- Home heating oil (No. 2), 138.8 mmbtu/gallon, 83% efficiency
- Natural gas, 1,025 mmbtu per 1000 cubic feet, 80% efficiency
- Propane, 91.3 mmbtu/gallon, 79% efficiency

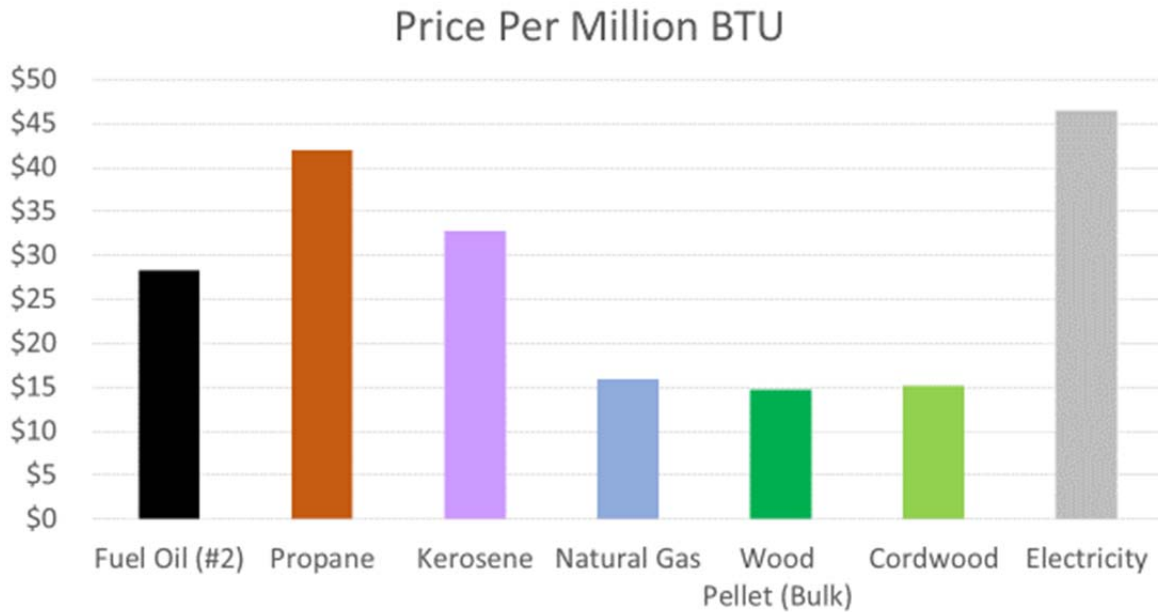
Figure 1. Primary home heating fuels in New England, 2012



Source: US Census Bureau (2012).

Oil and propane are specifically identified because they are relatively expensive when compared with wood fuels, such as cordwood or wood pellets. The following figure shows cost per million BTUs for a range of heating fuels used in New England.

Figure 2. Comparative cost of fuels



Source: New Hampshire Office of Energy Planning (2014).

Significant potential exists for wood to displace oil or propane used in heating, particularly in rural areas not served by natural gas pipelines. Maine, New Hampshire and Vermont have the highest percentage of homes heated by oil or propane. However, given the larger populations in Massachusetts and Connecticut, the absolute opportunity may be even greater in those states.

Figure 3. Percent of homes using oil and propane, 2012 by state

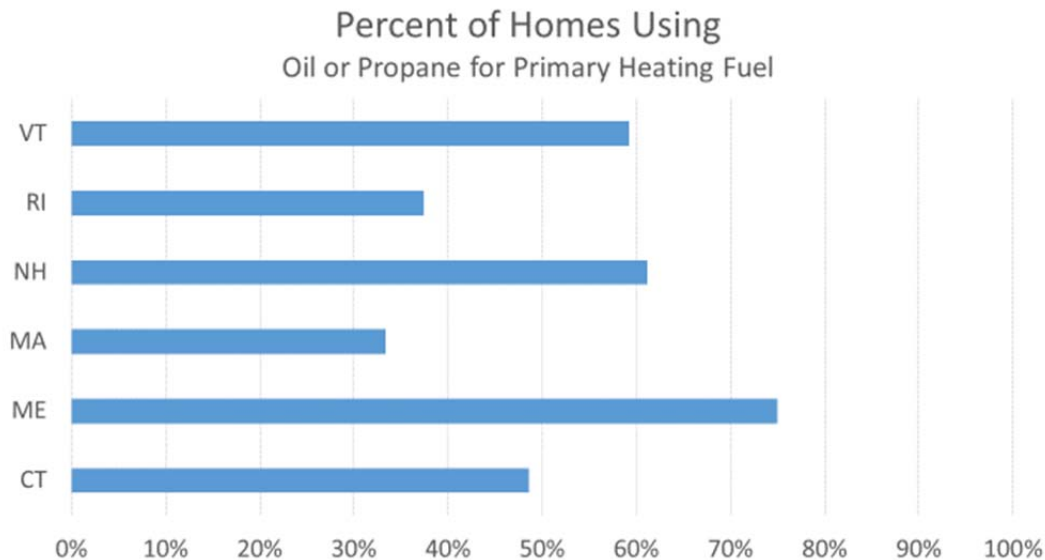
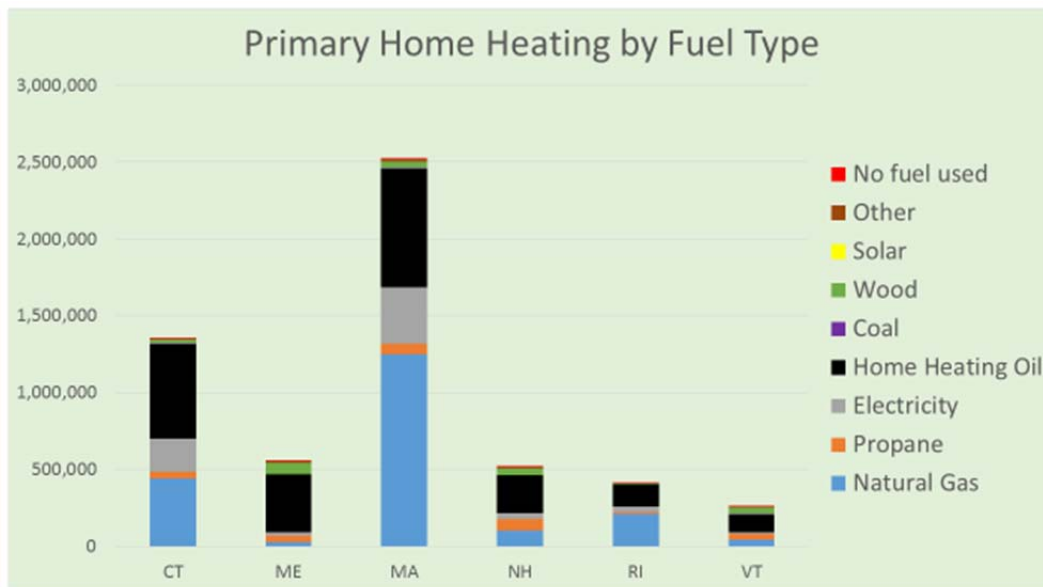


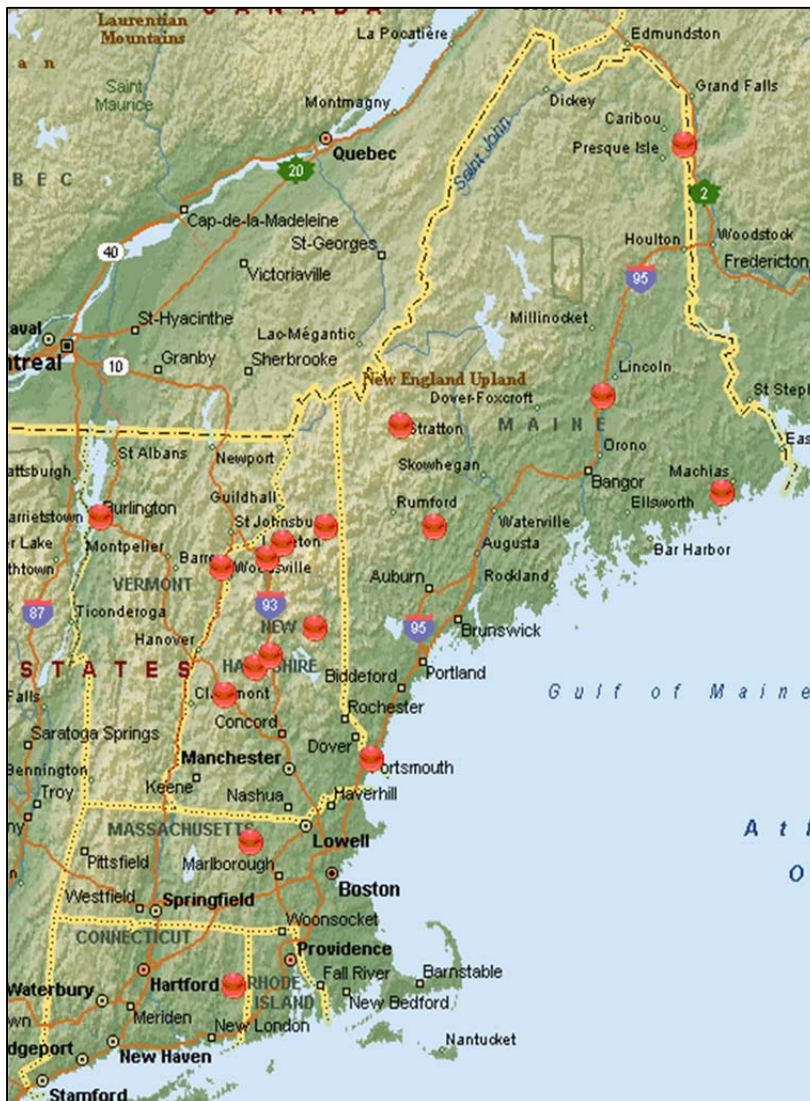
Figure 4. Primary home heating fuel by type, 2012



In addition to heating applications, wood is used in power generation at a number of biomass electric facilities around the region. The facilities in this region can each use up to (and perhaps over) 750,000 green tons of biomass fuel annually, making them among the largest wood users (by volume) in a number of regions in New England. These facilities sell electricity to the grid, either through long-term price agreements or through spot sales. These facilities often rely upon public policy – usually a state-based Renewable Portfolio Standard – to operate economically.

Biomass electric facilities in New England have a combined capacity of over 450 MW, representing a market for over six million green tons of low-grade wood annually. Actual wood use depends upon electric generation, which can change with market conditions and other factors.

Figure 5. Biomass electric facilities in New England (operating)



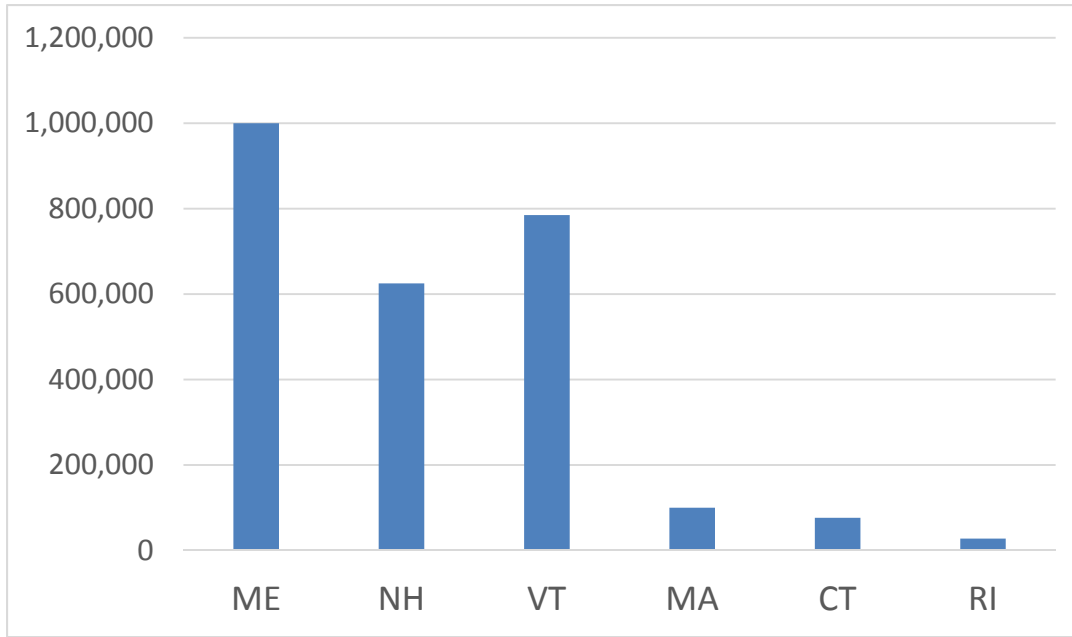
Wood can also be used as a feedstock for the production of liquid biofuels; however, the technologies for accomplishing this conversion are still being developed and this use is not widespread. Even if they were fully commercialized, the economic and environmental benefits (reduction in greenhouse gas levels) is likely to continue to favor using biomass to displace oil in heating over other uses.

B. Existing Use of Wood Fuels

Wood can be used in energy applications to displace fossil fuels in a number of ways. Firewood is used in wood stoves and boilers for heating, and accounts for a significant portion of harvest in the region. A recent analysis of the Northern Forest Region – Maine, New Hampshire, Vermont and New York – suggests that over eight percent (8%) of total harvest volume is used as

firewood (Hushaw 2014). It is important to note that firewood use is very difficult to track, and remains one area where statistics on use of forest products are not fully reliable; in part because of the fragmented micro-business and cash nature of the industry. That noted, regional estimates suggest that roughly 2.6 million green tons of firewood is used annually; about 1 million cords.

Figure 6. Estimates of annual firewood use by state in green tons, 2011



Source: INRS (2011).

Wood fuel can also be chips – either from the bole of a tree (bole chips) or from low-grade stems and logging residue (tops and branches) on a timber harvest. These chips, depending upon quality, can be used in community scale thermal applications (e.g. a boiler at a school or hospital) or for large industrial boilers, such as found at a biomass electric facility or the power island at a pulp and paper mill.

Biomass chips represent a significant market in the region. In New Hampshire in 2011, over one third of all wood harvested was used as a biomass fuel – either for electric generation or at smaller community-scale facilities. Given



Wood sorted for chipping on a landing

New Hampshire's large number of biomass electric facilities and a lack of a pulp mill (which would compete for low-grade roundwood) this may represent the largest percentage of harvest of any of the New England states.

Wood for energy can also be derived from mill residues – the byproduct of other forest products manufacturing. For example, when cylindrical logs are sawn into rectangular boards, the chips and sawdust are considered residues. The region is estimated to produce over 3 million green tons of mill residues annually (US Forest Service 2012), though this fluctuates with lumber product and other wood use.

Importantly, virtually all mill residues have a market. Sawdust and chips are used for energy uses (either in biomass boilers or wood pellet production), as well as a feedstock for pulp and paper mills. Bark can be used as a fuel at some industrial boilers; it is also sold for mulch. Any increased use of mill residue would come at the expense of some other incumbent user.



Sawmill residue

1. Wood Pellets

Wood pellets are a dried and refined biomass fuel. In New England, there are wood pellet manufacturing facilities in Maine (4), New Hampshire (1) and Vermont (1). These existing facilities produce wood pellet used in regional thermal applications – either as supplemental heat (e.g. a pellet stove) or whole building heating (e.g. a residential boiler, or a larger institutional heating system).

Figure 7. Wood pellet manufacturing in New England



In other parts of the country (and in Canada) wood pellets are manufactured specifically for export to Europe or other regions for use in electric generation. To date, regional producers of wood pellets have preferred to concentrate on the domestic heating market.

C. Potential to Increase Heating

Using data developed from the USDA Forest Inventory and Analysis², INRS estimates that the total unutilized forest biomass opportunities in the region provide for slightly over 10 million green tons of biomass annually.³

Table 2. Rough estimate of total biomass available

| | Green tons | |
|----------------------|----------------------|-----------------------|
| | Unutilized low grade | Harvest residue (50%) |
| Connecticut | 1,028,935 | 79,530 |
| Maine | 2,176,668 | 2,137,281 |
| Massachusetts | 1,583,011 | 151,838 |
| New Hampshire | 1,073,198 | 450,695 |
| Rhode Island | 227,520 | 8,683 |
| Vermont | 1,171,401 | 379,008 |
| Total | 7,260,734 | 3,207,035 |

Many of the trees in New England forests are considered “low-grade”, not meeting the specifications for higher value products such as sawlogs or veneer due to form, health or species. Harvest residue consists of limbs and tops normally left in the woods – note only 50% of these are proposed to be included as available, recognizing other operational and ecological limitations on removal of residues during a harvest.

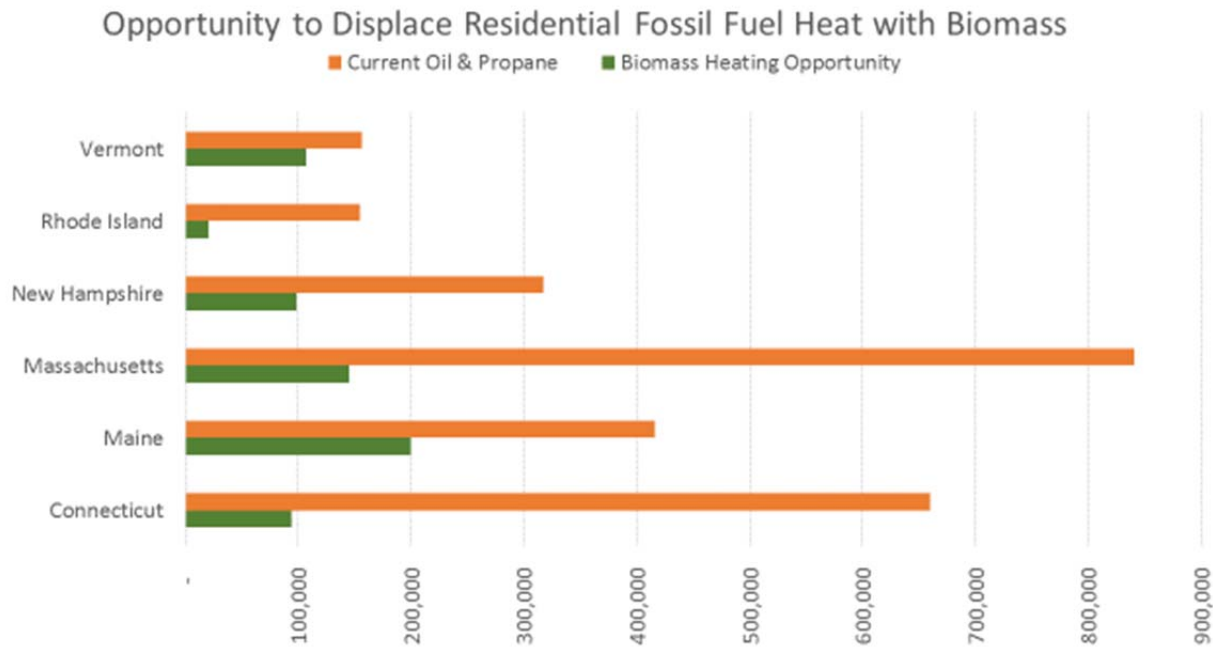
It is important to note that this estimate does not include limitations based upon landowner attitudes, terrain (e.g. slope, wetlands, and proximity to water bodies), parcel size or other considerations. As such, this should be considered a theoretical maximum.

If all of the unutilized low-grade roundwood in the region was used exclusively for domestic heating application, we have the potential to displace about 26% of the heating currently served by oil or propane. The following figure shows this opportunity, by state – with the wood from each state serving that state’s heating market exclusively. This is obviously for illustration purposes only; the region is interconnected, and wood from one state has the potential to serve markets elsewhere in New England, the nation and the world.

² INRS used the most recent Forest Inventory & Analysis data, from survey years 2008 – 2012, and accessed using the tool EVALIDator, version 1.5.1.06. FIA data is presented in cubic feet; INRS converted this to green tons assuming 85 cubic feet of solid wood per cord, with a green cord of softwood weighing 2.3 tons and a green cord of hardwood weighing 2.6 tons. INRS assumed that low-grade represents 43% of all unutilized growth. Forest residue was estimated assuming a 50% capture rate, with 0.22 green tons of residue generated per ton of softwood roundwood harvested, and 0.31 tons of residue generated per ton of hardwood roundwood harvested.

³ This quick analysis is in no way meant to serve as a wood supply evaluation, but is provided simply to provide a way to estimate the magnitude of the opportunity that biomass heating represents in the region.

Figure 8. Opportunity to displace residential fossil fuel heat with biomass, by state



Assuming that all of the displaced fossil fuel was home heating oil, nearly 666,000 homes in New England would purchase \$1.85 billion less oil. Instead, these homes would purchase roughly \$970 million in wood fuels from local sources, and this money would stay in the New England economy.

D. Conclusion

Wood fuels offer very significant opportunities for displacing fossil fuels and improving the economy of the region. Biomass from forestry activities can and is used in a variety of energy applications, including thermal (firewood, institutional heating, wood pellet heating, etc.) and electric generation.

While there are a number of ways that wood energy use could be increased in the region – each with its benefits and challenges – if all unutilized low-grade roundwood in New England was dedicated to home heating applications, the region could reduce the number of homes heated with oil and propane by roughly a quarter – helping keep money and industry in the region.

E. References

Hushaw, J. 2014. Biomass availability: What do the data tell us? Presentation at the Northeast Biomass Heating Expo 2014, Portland, Maine. April 11.

Innovative Natural Resource Solutions LLC. 2011. Internal working documents (accessed April 2011).

New Hampshire Office of Energy Planning. 2014. Fuel prices. www.nh.gov/oep/energy/energy-nh/fuel-prices/index.htm (accessed March 17, 2014).

US Census Bureau. 2012. American community survey. factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_1YR_B25040&prodType=table (accessed May 3, 2014).

US Forest Service. 2012. Timber product output (TPO) reports. Knoxville, TN: US Forest Service, Southern Research Station. srsfia2.fs.fed.us/php/tpo_2009/tpo_rpa_int1.php (accessed May 3, 2014).