

Biomass Availability Analysis – Springfield, Massachusetts

Renewable Biomass from the Forests of Massachusetts



Prepared for the
**Massachusetts Division of Energy Resources
&
Massachusetts Department of Conservation and Recreation**



With Funding Provided by the
Massachusetts Technology Collaborative

January 2007

Prepared By:

Innovative Natural Resource Solutions LLC



107 Elm Street, Suite 100-E
Portland, ME 04101
207/772-5440
www.inrslc.com

This material was prepared with financial support from the Massachusetts Technology Collaborative – Renewable Energy Trust. However, any opinions, findings, conclusions, or recommendations expressed are those of Innovative Natural Resource Solutions LLC, and do not necessarily reflect the views of the Massachusetts Technology Collaborative, the Renewable Energy Trust, the Massachusetts Division of Energy Resources or the Massachusetts Department of Conservation and Recreation, and do not constitute an endorsement of products or services mentioned.

This report is part of a larger project, the Massachusetts Sustainable Forest Bienergy Initiative, that received funding from the U.S. Department of Energy. This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

The analysis contained in this report is based upon our best professional judgement and on sources of information that we believe to be reliable. However, no representation or warranty is made by Innovative Natural Resource Solutions LLC as to the accuracy or completeness of any information contained herein. Nothing in this report is, or should be relied upon as, a promise or representation as to the future.

This analysis was performed for a hypothetical large biomass plant located somewhere in Springfield, MA, and assumes that other new biomass users do not enter the nearby marketplace. A change in this assumption, or specifics of a project, may change the findings of this report.



Table of Contents

Introduction	4
Biomass Resources Near Springfield, MA	5
Wood Residues	9
• Forest Harvest Residues	10
• Sawmill Residue	11
• Urban Wood Residues	12
Biomass Supply Pricing	14
Regional Markets for Low-Grade Wood	17
Endnotes	24

List of Figures

Figure 1. 90 Minute Drive Time and 60 Mile Radius, Springfield, MA	5
Figure 2. Land Classifications within a 60-mile Radius of Springfield, MA	6
Figure 3. Counties Within a 90 Minute Drive Time of Springfield, MA	9
Figure 4. Forest Residues Available by County (estimated)	10
Figure 5. Sawmill Residues Available by County (estimated)	11
Figure 6. Urban Wood Residues Available by County (estimated)	12
Figure 7. Land Clearing in the Region Surrounding Springfield, MA with 90 Minute Drive Time	13
Figure 8. Anticipated Biomass Fuel Supply and Pricing	15
Figure 9. Four Drive Times Around Springfield, MA (30, 60, 90 and 120 Minutes)	18

List of Tables

Table 1. Land Classifications within a 60-mile Radius of Springfield, MA	6
Table 2. Annual Net Growth and Drain, 60-Mile Radius of Springfield, MA	7
Table 3. Annual Growth and Drain (w/ branches), 60-Mile Radius, Springfield, MA	7
Table 4. Anticipated Biomass Fuel Supply and Pricing	14
Table 5. Facilities Using Low-Grade Wood near Springfield, MA	19
Table 6. Facilities within 30 Minute Drive Time of Springfield, MA	20
Table 7. Facilities within 60 Minute Drive Time of Springfield, MA	21
Table 8. Facilities within 90 Minute Drive Time of Springfield, MA	22
Table 9. Facilities within 120 Minute Drive Time of Springfield, MA	23



Introduction

This analysis was prepared for the Massachusetts Division of Energy Resources and the Massachusetts Department of Conservation & Recreation with funding provided by the Massachusetts Technology Collaborative – Renewable Energy Trust. This analysis is part of a larger effort to address many facets of biomass energy development in Massachusetts, the *Massachusetts Sustainable Forest Bioenergy Initiative*. More information on this initiative can be found at <http://mass.gov/doer/programs/renew/bio-initiative.htm>.

This analysis looks at the biomass fuel availability for the area surrounding Springfield, Massachusetts. Similar analyses were also completed for the areas around Pittsfield and Worcester. Additionally, an analysis of biomass availability for the five western counties of Massachusetts (Berkshire, Franklin, Hampshire, Hampden and Worcester) was completed.



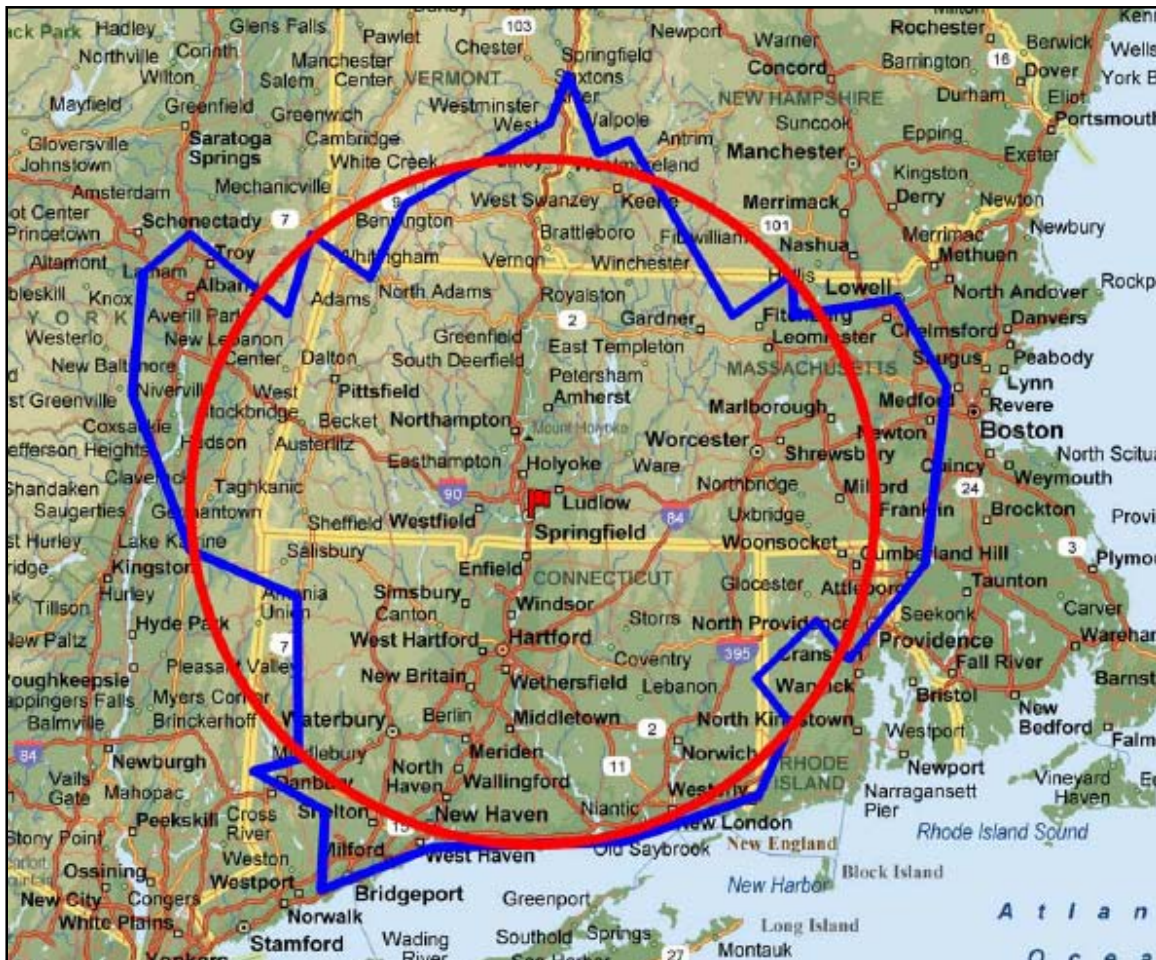
Biomass Resources near Springfield

Forest Resources

Using the USDA Forest Service Forest Inventory & Analysis (FIA) system, an analysis of the area surrounding Springfield, MA was conducted¹. The FIA system permits an understanding of the standing forest inventory, land ownership patterns, timber growth and harvest volumes, and timber mortality volume.

The FIA allows analysis on a radius from a point, in this case Springfield, MA. Analysis was conducted for a 60-mile radius (red) approximates a 90-minute drive time (blue).

Figure 1. 90 Minute Drive Time and 60 Mile Radius, Springfield, MA



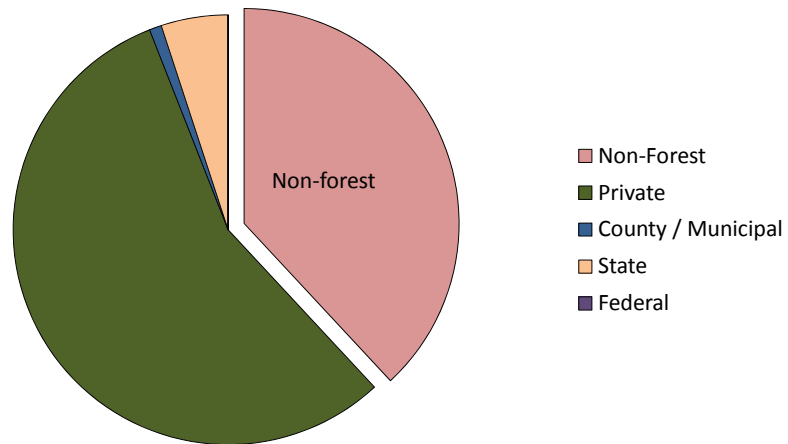
Within a 60-mile radius of Springfield, MA there are 2,814,552 acres of timberland, representing 40% of the land area in the region. Of this timberland, 90% is privately owned, with the remainder under municipal, county, state or federal ownership.

Table 1 and Figure 2 show the distribution of land ownership within the region.

Table 1. Land Classifications within a 60-mile Radius of Springfield, MA

	Acres	% of Timberland	% of All Land
All Land	6,967,398		
Private	2,543,921	90%	37%
Municipal / County	41,842	1%	1%
State	228,789	8%	3%
Federal	-	0%	0%
Timberland	2,814,552		40%

Figure 2. Land Classifications within a 60-mile Radius of Springfield, MA



Within a 60-mile radius of Springfield, MA the standing timber inventory is roughly 79% hardwood and 21% softwood. Annual growth in the region is estimated at over 3.3 million green tons per yearⁱⁱ, with harvest levels under 1 million green tons annually. Growth above current harvest and mortality levels is roughly 2.4 million green tons annually. Table 2 shows the estimated annual standing volume, growth, and removal for timberland within a 60-mile radius of Springfield, MA.

Table 2. Annual Net Growth and Drain, 60-Mile Radius of Springfield, MAⁱⁱⁱ

	Softwood	Hardwood Green Tons ^{iv}	Total
Standing Volume	27,354,145	100,495,936	127,850,081
Annual Net Growth	752,332	2,591,295	3,343,627
Annual Removals	154,904	746,034	900,938
Net Growth Less Removals	597,428	1,845,262	2,442,690

The USDA Forest Inventory and Analysis, used to develop the data in Table 2, accounts for only the merchantable stem of the tree – wood that could go to traditional roundwood markets like lumber, veneer, pulp or engineered wood products. While this wood, particularly the lower grades, is available for biomass, the branches and tops of a tree are potentially available as well. In the Northeastern U.S., it is estimated that for every ton of biomass contained in the stem of a tree, another 0.29 tons of biomass are contained in the branches and tops.^v Table 3 uses the assumption that for every green ton of biomass in the stem, another 0.29 green tons is available in the tops and branches.

Table 3. Annual Growth and Drain (w/ branches), 60-Mile Radius, Springfield, MA

	Softwood	Hardwood Green Tons ^{vi}	Total
Standing Volume	35,286,847	129,639,758	164,926,605
Annual Net Growth	970,508	3,342,771	4,313,279
Annual Removals	199,826	962,384	1,162,210
Net Growth Less Removals	770,682	2,380,387	3,151,070



It is important to note that a considerable amount of the nutrients contained in a tree are in the tops (particularly when leaves are on), and removal of high volumes of this material from a logging job can raise concerns about long-term sustainability. For this reason, as well as practical availability, INRS recommends that availability of tops and branches be considered at no more than 50% of reported availability^{vii}.

This means that nearly 2.8 million green tons of wood could be available before harvest and mortality exceeds growth. This volume of wood, enough to support almost 210 megawatts of electric power capacity operating at industry standard efficiency and capacity factors.

In practical terms, it is highly unlikely that this volume of wood could be harvested in an economic or environmentally responsible manner to supply biomass fuel. Further, some of this wood is sawlogs or other high-value material, and as such would be sent to other markets.



Wood Residues

Using data from the USDA Forest Service, the US Environmental Protection Agency, the National Renewable Energy Laboratory / US Department of Energy and the U.S. Census Bureau, INRS has developed a national database of biomass residues available by county. For this analysis, counties that are largely within a 90-minute drive time of Springfield include the following, shown in Figure 3:

Massachusetts: Hampshire, Berkshire, Franklin, Worcester, Hampden, Middlesex, Norfolk

New York: Columbia

Conecticut: Windham, New London, Middlesex, Tolland, Litchfield, Hartford, New Haven

Vermont: Windham

New Hampshire: Cheshire

Rhode Island: Providence

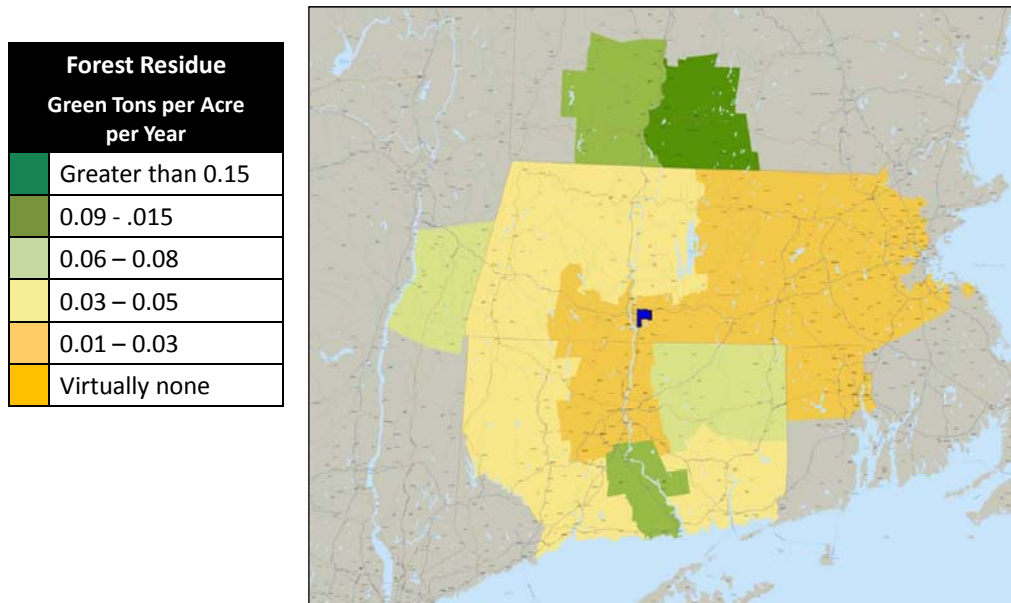
Figure 3. Counties Within a 90 Minute Drive Time of Springfield, MA



Forest Harvest Residues

Forest harvest residue is wood that is left in the forest due to lack of market conditions. In most areas, this is tops, branches and pieces of tree that do not meet local specifications for sawlogs and pulpwood. Forest harvest residue is estimated to be roughly 980,000 green tons a year in the counties surrounding Springfield, MA^{viii}. This is largely a function of existing harvesting activity – in locations with high volumes of existing logging activity, volumes of forest harvest residue tend to be higher. Figure 4 shows annual harvest residue density by county.

Figure 4. Forest Residues Available by County (estimated)



Of note, the region surrounding Springfield, MA has relatively low concentrations of harvest residues. This is largely a reflection of forest harvesting activity in the region, which is active but modest. This region does not currently have the level of forest harvesting seen in neighboring New Hampshire or Maine, states with relatively large biomass energy industries.

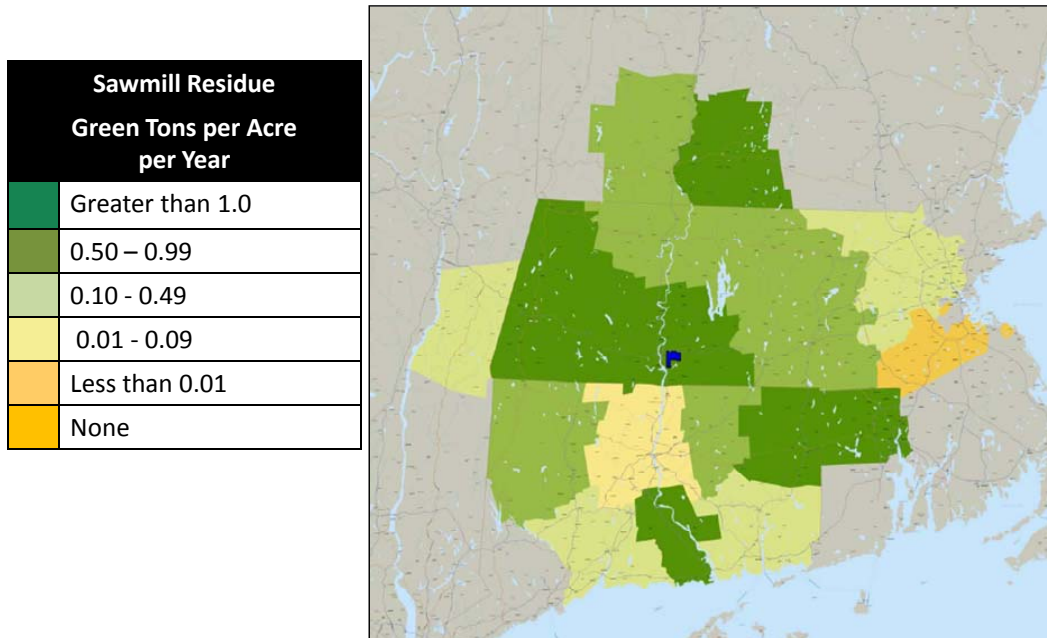


Sawmill Residue

When sawmills cut cylindrical logs into rectangular boards, residue is produced - including bark, sawdust and mill chips. Actual residue generation varies by species and mill equipment, but a general rule of thumb is that a log in a sawmill produces 60 to 70% of useful timber as boards, 20 to 30% as wood chips, and 10% as sawdust^{ix}.

Based upon the latest USDA Forest Service Timber Product Output information, sawmill residue (chips, bark and sawdust) in the region is roughly 700,000 green tons in the counties surrounding Springfield, MA.

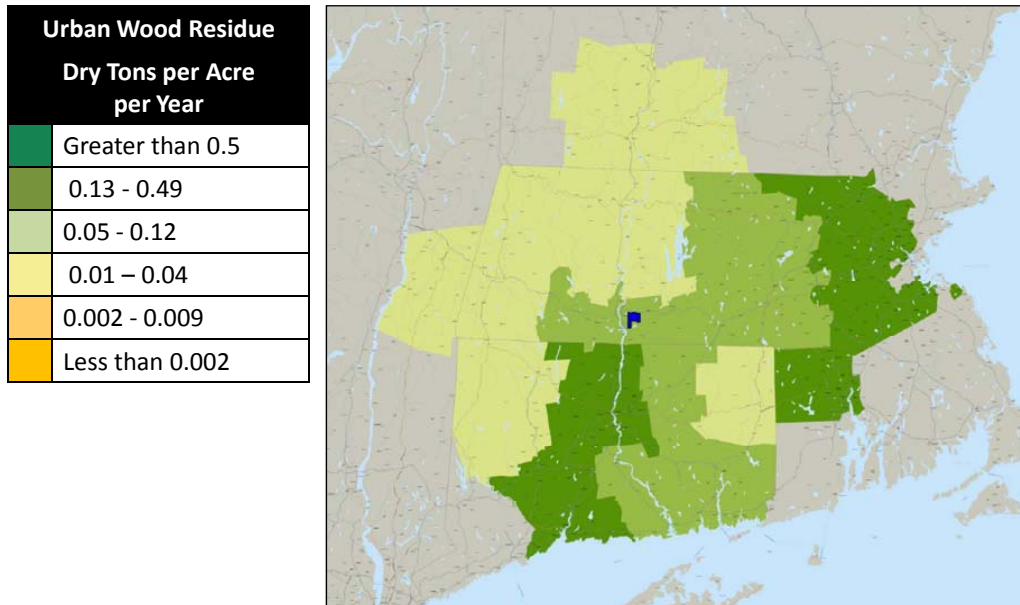
Figure 5. Sawmill Residues Available by County (estimated)



Urban Wood Residues

Urban wood residues include most wood generated as a result of activity in and around urban and suburban areas, and include tree trimmings, utility right-of-way clearing, ground pallets, and the clean woody fraction of construction and demolition debris.

Figure 6. Urban Wood Residues Available by County (estimated)

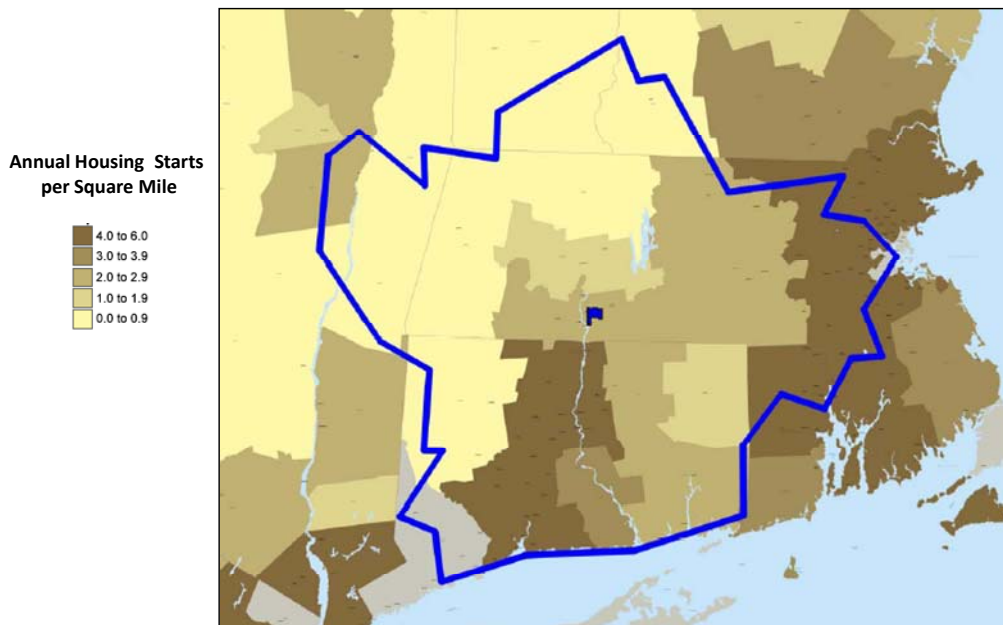


In the counties surrounding Springfield, MA there is roughly 840,000 green tons of urban wood available. This includes an estimated 410,000 green tons of wood from land clearing in the region.



Figure 7 shows the concentration of housing starts in the counties proximate to Springfield, MA. Housing starts are a very good indication of the volume of land clearing expected in an area. It is important to note that land clearing activity is heavily tied to new construction activity; when construction activity slows, lower volumes of land clearing wood can be expected.

Figure 7. Land Clearing in the Region Surrounding Springfield, MA with 90 Minute Drive Time



Biomass Supply Pricing

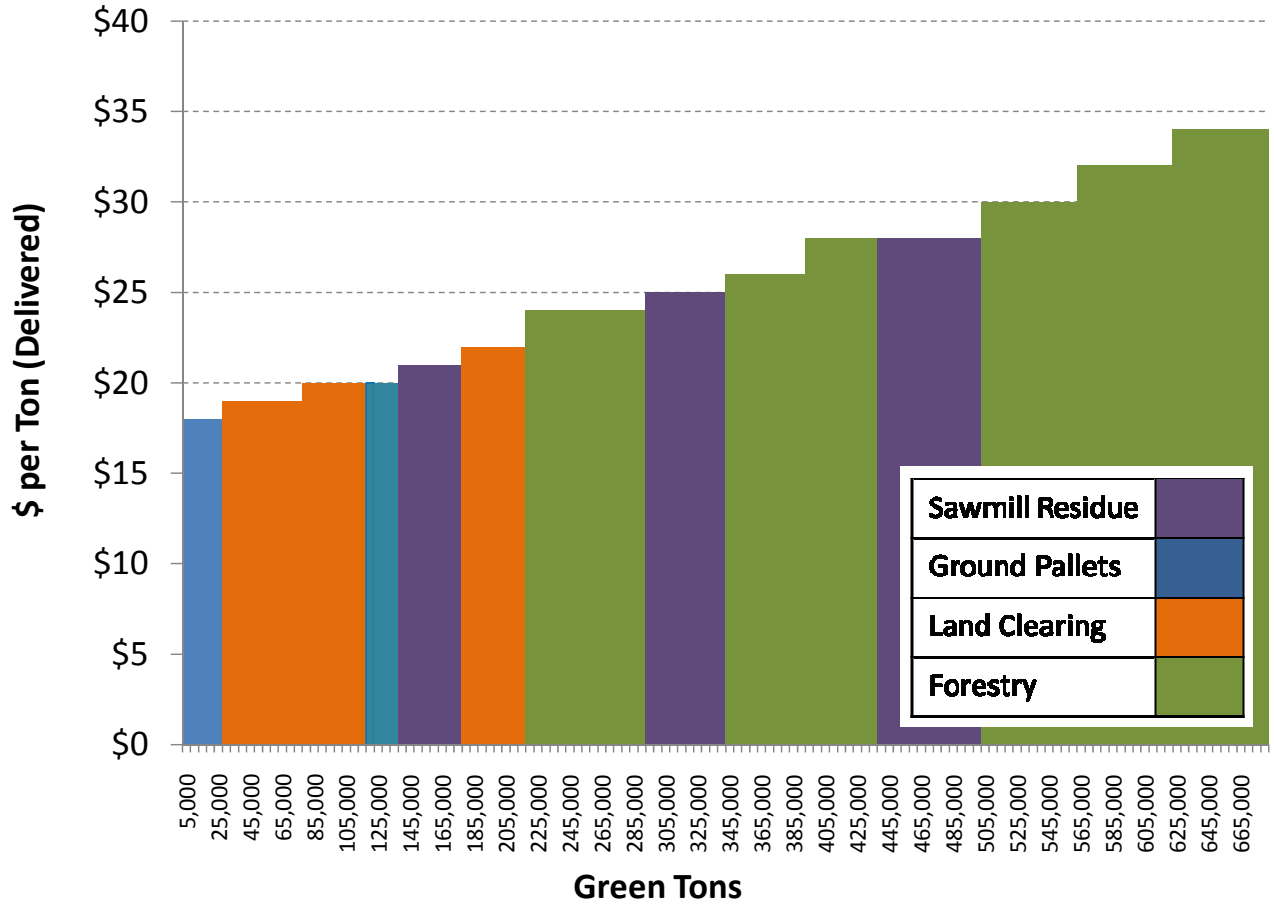
The following table shows *anticipated* biomass supply pricing, by source, for a hypothetical large biomass facility in Springfield, MA. This table shows the incremental volume and delivered pricing^x by fuel source, the weighted average price, and the total tons.

Table 4. Anticipated Biomass Fuel Supply and Pricing

Source	Volume (green tons equivalent)	Price (green tons equivalent)	Extended	Weighted Average Price	Total Tons
pallets	25,000	\$ 18.00	\$ 450,000	\$ 18.00	25,000
land clearing	50,000	\$ 19.00	\$ 950,000	\$ 18.67	75,000
land clearing	40,000	\$ 20.00	\$ 800,000	\$ 19.13	115,000
pallets	15,000	\$ 20.00	\$ 300,000	\$ 19.23	130,000
sawmill	40,000	\$ 21.00	\$ 840,000	\$ 19.65	170,000
forestry	40,000	\$ 22.00	\$ 880,000	\$ 20.10	210,000
forestry	75,000	\$ 24.00	\$ 1,800,000	\$ 21.12	285,000
sawmill	50,000	\$ 25.00	\$ 1,250,000	\$ 21.70	335,000
forestry	50,000	\$ 26.00	\$ 1,300,000	\$ 22.26	385,000
forestry	50,000	\$ 28.00	\$ 1,400,000	\$ 22.92	435,000
sawmill	60,000	\$ 28.00	\$ 1,680,000	\$ 23.54	495,000
forestry	60,000	\$ 30.00	\$ 1,800,000	\$ 24.23	555,000
forestry	60,000	\$ 32.00	\$ 1,920,000	\$ 24.99	615,000
forestry	60,000	\$ 34.00	\$ 2,040,000	\$ 25.79	675,000



Figure 8. Anticipated Biomass Fuel Supply and Pricing



This pricing assumes a facility with fast unloading capabilities (including truck dumps), the ability to unload and handle a variety of fuels, a screening and processing system for fuel not meeting the facility's specifications, professional management of fuel procurement, and purchase of at least 200,000 green tons annually. Prices during the first year of start-up would be higher than listed above, as regional supply capacity is built.

Each price grouping above includes a number of suppliers, with price reflecting an average price within that grouping. For example, some land clearing chips may be available at less than \$19 per green ton, but this reflects an average price for the first 50,000 green tons. Price increases within like supplier groupings reflect increased distance to Springfield, need for companies to add processing equipment to existing operations (a significant need in the area around Springfield, MA), and the need to compete directly with other markets as distance increases.

Pricing expectations were established based upon interviews with potential suppliers, INRS knowledge of operating costs of various types of biomass fuel suppliers, knowledge of the existing and potential supply infrastructure, and historic pricing for biomass supply in New England.

Regional Markets for Low-Grade Wood

A number of markets exist or are proposed for low-grade wood, including but not limited to biomass fuel, in the region surrounding Springfield, MA. Figure 8 shows the areas within a 30, 60, 90 and 120 minute drive time of Springfield, MA.

In a 120 mile drive time of Springfield, MA there are nine active, idle or proposed facilities that use biomass, or low-grade wood that competes with biomass energy production.

- Two operating facilities, with combined annual wood use of up to 890,000 green tons;
- One idle facility, with potential annual wood use of a 50,000 green tons;
- Six publicly proposed facilities, in various stages of development, with total combined wood use of up to 2.15 million green tons.

These figures do not account for the many projects that are in the early stages of development, but have not made public announcements or taken obvious steps to begin development activities. These figures, and accompanying table, show only markets big enough to exert their own market influence. Small facilities, such as seen at schools and hospitals, present excellent opportunities for biomass development, but these small units do not individually influence that overall market for and pricing of biomass fuel.

- Facility name (commonly used name, may not be legal name)
- Location (town, state)
- Status (operating, idle, proposed, etc.)
- Owner (or operator)
- Product (electricity, paper, wood pellets, etc.)
- Size (MW capacity)
- Fuel type(s) used
- Annual wood use (green tons, *estimated*)
- Distance to Springfield, MA (road miles and time)



Figure 9. Four Drive Times Around Springfield, MA (30, 60, 90 and 120 Minutes)

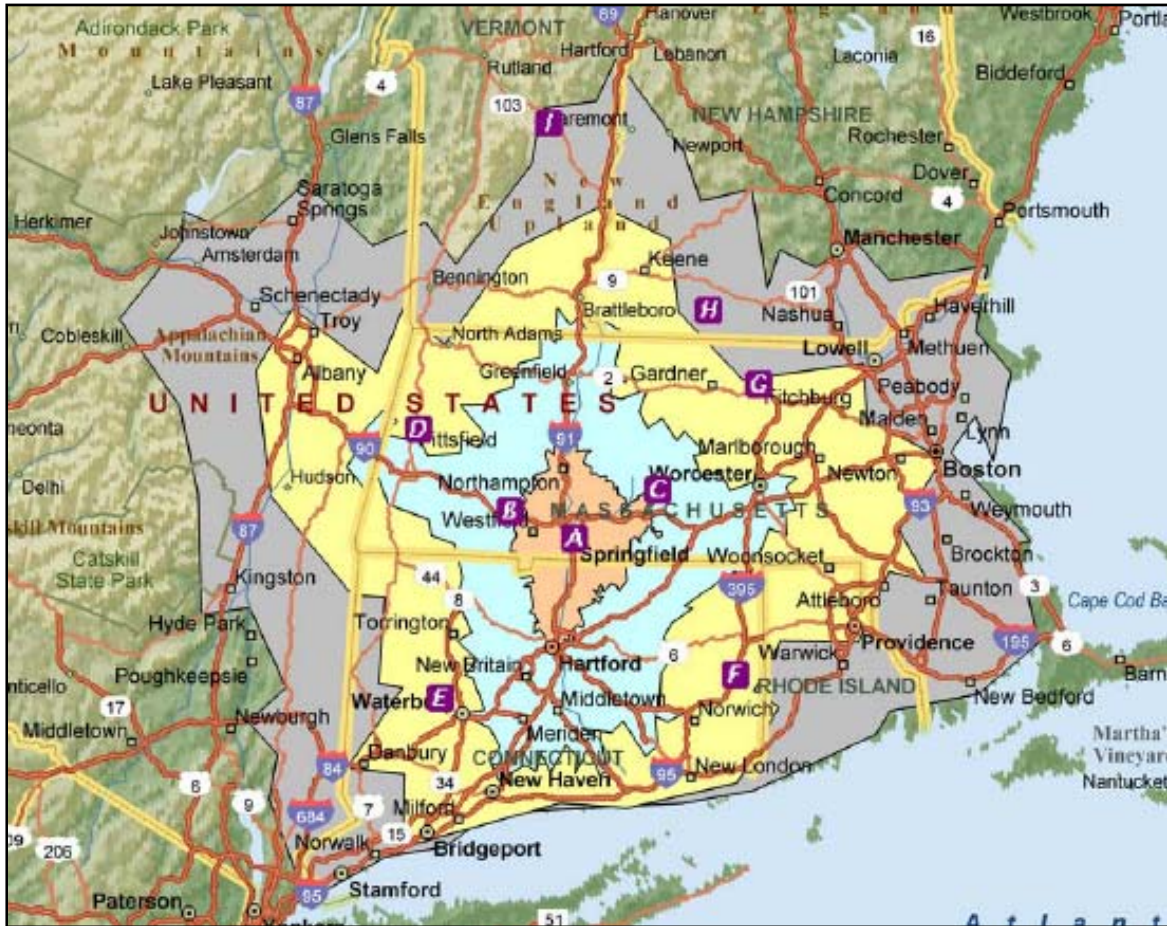


Table 5. Facilities Using Low-Grade Wood near Springfield, MA

Drive Time (Minutes)	Facility	Current	Potential
30	Palmer Renewable Energy	-	235,000
	Russell Biomass	-	630,000
	<i>Subtotal</i>	-	<i>865,000</i>
60	Ware Co-Gen	-	50,000
	Berkshire Renewable Power	-	600,000
	<i>Subtotal</i>	-	<i>650,000</i>
	<i>Running Total</i>	-	<i>1,515,000</i>
90	Watertown Renewable Power	-	400,000
	Plainfield Renewable Energy	-	400,000
	Pinetree - Fitchburg	225,000	225,000
	<i>Subtotal</i>	<i>225,000</i>	<i>1,025,000</i>
	<i>Running Total</i>	<i>225,000</i>	<i>2,540,000</i>
120	New England Wood Pellet	160,000	160,000
	Access Energy - Ludlow	-	315,000
	<i>Subtotal</i>	<i>160,000</i>	<i>475,000</i>
	<i>Running Total</i>	<i>385,000</i>	<i>3,015,000</i>



Table 6. Facilities within 30 Minute Drive Time of Springfield, MA

Facility A	Palmer Renewable Energy
Location	Springfield, MA
Status	Proposed
Product	Electricity
Owner	Palmer Renewable Energy
Size	30 MW
Fuel	Wood, from a variety of sources
Annual Wood Use (est.)	235,000 tons
Springfield – road miles	0 miles
Springfield - minutes	0 minutes

Facility B	Russell Biomass
Location	Russell, MA
Status	Proposed, in permitting
Product	Electricity
Owner	Russell Biomass LLC
Size	50 MW
Fuel	Whole tree chips, sawmill residue, pallets
Annual Wood Use (est.)	630,000 tons (estimate)
Springfield – road miles	17 miles
Springfield - minutes	27 minutes



Table 7. Facilities within 60 Minute Drive Time of Springfield, MA

Facility C	Ware Co-Gen
Location	Ware, MA
Status	Idle, approved for MA RECs
Product	Electricity
Owner	Ware Energy Company
Size	8.6 MW (2 units)
Fuel	Construction and demolition
Annual Wood Use (est.)	50,000 tons (estimate)
Springfield – road miles	26.6 miles
Springfield - minutes	36 minutes

Facility D	Berkshire Renewable Power
Location	Pittsfield, MA
Status	Proposed
Product	Electricity
Owner	Tamarack Energy
Size	30 – 50 MW
Fuel	Whole tree chips, sawmill residue, pallets
Annual Wood Use (est.)	Up to 600,000 tons
Springfield – road miles	54 miles
Springfield - minutes	55 minutes



Table 8. Facilities within 90 Minute Drive Time of Springfield, MA

Facility E	Watertown Renewable Power
Location	Watertown, CT
Status	Proposed, in permitting
Product	Electricity
Owner	Tamarack Energy
Size	30 MW
Fuel	Whole tree chips, pallets, sawmill residue
Annual Wood Use (est.)	400,000 tons
Springfield – road miles	58 miles
Springfield - minutes	1 hour, 7 minutes

Facility F	Plainfield Renewable Energy
Location	Plainfield, CT
Status	Proposed, in permitting
Product	Electricity
Owner	Decker Energy International and NuPower
Size	30 MW
Fuel	Whole tree chips, pallets, sawmill residue, woody fraction of construction and demolition debris
Annual Wood Use (est.)	400,000 tons
Springfield – road miles	73 miles
Springfield - minutes	1 hour, 23 minutes

Facility G	Pinetree – Fitchburg
Location	Westminster, MA
Status	Operating
Product	Electricity
Owner	Suez Energy North America
Size	17 MW (14 MW wood boiler, 3 MW landfill gas)
Fuel	Whole-tree chips, sawmill residue, ground pallets, paper cubes and landfill gas
Annual Wood Use (est.)	180,000 tons
Springfield – road miles	63 miles
Springfield - minutes	1 hour, 19 minutes



Table 9. Facilities within 120 Minute Drive Time of Springfield, MA

Facility H	New England Wood Pellet
Location	Jaffrey, NH
Status	Operating
Product	Wood pellets
Owner	New England Wood Pellet, www.pelletheat.com
Feedstock	Sawmill residue, sawdust, pulp quality chips
Annual Wood Use (est.)	120,000 tons (equivalent of roughly 160,000 green tons)
Springfield – road miles	73 miles
Springfield - minutes	1 hour, 33minutes

Facility I	Access Ludlow Clean Energy Project, LLC
Location	Ludlow, VT
Status	Proposed
Product	Electricity
Owner	Access Energy
Size	25 MW
Fuel	Whole-tree chips, sawmill residue
Annual Wood Use (est.)	315,000 tons
Springfield – road miles	106 miles
Springfield - minutes	2 hours



Endnotes

ⁱ Data developed using latest publicly available complete USDA Forest Service Forest Inventory & Analysis information – Massachusetts 1998, Connecticut 1998, New Hampshire 1997, New York 1993, Rhode Island 1998 and Vermont 1997.

ⁱⁱ All USDA Forest Service Forest Inventory & Analysis is presented in cubic feet; converted to green tons assuming 85 cubic feet of solid wood in a cord, a cord of hardwood weighing 2.6 tons, and a cord of softwood weighing 2.3 tons.

ⁱⁱⁱ Data developed using latest publicly available complete USDA Forest Service Forest Inventory & Analysis information – Massachusetts 1998, Connecticut 1998, New Hampshire 1997, New York 1993, Rhode Island 1998 and Vermont 1997.

^{iv} All USDA Forest Service Forest Inventory & Analysis is presented in cubic feet.; converted to green tons assuming 85 cubic feet of solid wood in a cord, a cord of hardwood weighing 2.6 tons, and a cord of softwood weighing 2.3 tons.

^v North East State Foresters Association. *Carbon Sequestration and Its Impacts on Forest Management in the Northeast*. December 19, 2002. www.nefainfo.org

^{vi} All USDA Forest Service Forest Inventory & Analysis is presented in cubic feet.; converted to green tons assuming 85 cubic feet of solid wood in a cord, a cord of hardwood weighing 2.6 tons, and a cord of softwood weighing 2.3 tons.

^{vii} The issue of forest sustainability standards for biomass fuel is beyond the scope of this report, and is a complex and controversial subject matter. However, at least one state, Minnesota, has developed draft biomass harvesting standards. *Draft Biomass Harvesting on Forest Management Sites in Minnesota*. Prepared by the Minnesota Forest Resources Council Biomass Harvesting Guideline Development Committee. May 1, 2007. www.forestrycenter.org

^{viii} This figure includes a remarkably high volume of logging residue in Cheshire County, NH. This information could be incorrect or could be the result of unique local conditions. INRS has confirmed the data with the USDA Forest Service and the US Department of Energy / National Renewable Laboratory, and both parties indicate that the baseline data as reported is correctly listed.

^{ix} Wakefield, Emily. “PyNe Workshop Report.” *ThermalNet*. Issue 04. June 2007.

^x These prices assume 2007 dollars and oil at \$75 per barrel.

