Woody Biomass Demand & Regional Timber Markets: A Case Study of New England & New York

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1. Overview

2. Methods

3. Results

4. Conclusions

Acknowledgements:

    Bob Abt, Jesse Henderson, Ray Sheffield
Overview

New England and New York forested lands have a great potential as a renewable energy feedstock.

72% of the land is forest cover and nearly 81% of this forestland privately owned.
Overview

Policy instruments promoting wood bioenergy use


**State level:** Renewable Portfolio Standards (RPS) and Renewable Energy Certificates (RECs)
Overview & Objectives

Ecological and Environmental Concerns

Carbon balances
Biodiversity
Nutrient cycling
Long-term productivity

Economic Concerns

Supply and demand for woody biomass
Management opportunity with low grade market
Impacts on traditional wood markets

Objective: How will changing woody biomass consumption affect New England and New York timber markets?
Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont
Methods

Existing and proposed wood biomass energy facilities in Northeast
Northeast Sub-Regional Timber Supply Model (NE-SRTS)

Model structure and data flows

- **FIA Plot Data**
  - Inventory proportion by DBH class (2") by region (NE+NY), species group, type, owner, age class

- **Product Definitions**
  - product by species, DBH

- **Goal Program**
  - harvest by type, age class

- **Growth Regression**

- **Inventory Accounting**
  - \( I_t = I_{t-1} + G - H \)
  - harvest by unit, owner, type, age class

- **Starting Acres Inventory Growth Harvest**
  - by species group, unit, type, owner, age class (10 year)

- **Market Module**
  - harvest by product-unit-owner

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Supply:

\[ Q_{it}^S = V_{it} \cdot P_t^\beta \cdot I_{it}^Y \] (1)

Demand:

\[ Q_t^D = Z_t \cdot P_t^\alpha \]

Equilibrium:

\[ Q_t^D = \sum_i Q_{it}^S \]
Inventory, Growth and Removals are tracked by:

- **Region** – 24 FIA survey units; non-disclosure issues
- **Ownerships** – public and corporate and & other private
- **Product classes** - softwood pulpwood, softwood sawtimber, hardwood pulpwood and hardwood sawtimber
- **Management types** – 9 management types (1.4 % dropped)
- **Age class** - eleven 10-year age classes (with aggregated upper end to include 100+ year old forests
- **Partial harvests**
## Methods

### Area of timberland by SRTS management type and ownership class (thousand acres)

<table>
<thead>
<tr>
<th>Management type</th>
<th>All</th>
<th>National Forest</th>
<th>Other public</th>
<th>Private-individual</th>
<th>Corporate</th>
</tr>
</thead>
<tbody>
<tr>
<td>White/Red/Jack pine</td>
<td>3471.67</td>
<td>31.63</td>
<td>456.68</td>
<td>2405.43</td>
<td>577.92</td>
</tr>
<tr>
<td>Spruce-fir</td>
<td>6740.64</td>
<td>148.72</td>
<td>403.74</td>
<td>1838.49</td>
<td>4349.68</td>
</tr>
<tr>
<td>Other softwoods</td>
<td>464.08</td>
<td>–</td>
<td>131.71</td>
<td>286.14</td>
<td>46.23</td>
</tr>
<tr>
<td>Oak-pine</td>
<td>1804.03</td>
<td>5.45</td>
<td>312.83</td>
<td>1269.56</td>
<td>216.19</td>
</tr>
<tr>
<td>Oak Hickory</td>
<td>6477.64</td>
<td>26.95</td>
<td>1077.21</td>
<td>4446.66</td>
<td>926.82</td>
</tr>
<tr>
<td>Elm/ash/cottonwood</td>
<td>2105.82</td>
<td>1.64</td>
<td>302.64</td>
<td>1535.49</td>
<td>266.05</td>
</tr>
<tr>
<td>Maple/beech/birch</td>
<td>21515.23</td>
<td>693.08</td>
<td>1815.58</td>
<td>12004.58</td>
<td>7001.99</td>
</tr>
<tr>
<td>Aspen/birch</td>
<td>3039.68</td>
<td>87.89</td>
<td>165.58</td>
<td>1435.12</td>
<td>1351.09</td>
</tr>
<tr>
<td>Other hardwoods</td>
<td>1000.63</td>
<td>3.52</td>
<td>153.16</td>
<td>665.37</td>
<td>178.58</td>
</tr>
<tr>
<td><strong>All</strong></td>
<td><strong>46619.42</strong></td>
<td><strong>998.9</strong></td>
<td><strong>4819.13</strong></td>
<td><strong>25886.84</strong></td>
<td><strong>14914.56</strong></td>
</tr>
</tbody>
</table>

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## Elasticities and sensitivity analysis

<table>
<thead>
<tr>
<th>Case/Product</th>
<th>Demand</th>
<th></th>
<th></th>
<th></th>
<th>Supply</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HW P</td>
<td>HW S</td>
<td>SW P</td>
<td>SW S</td>
<td>HW P</td>
<td>HW S</td>
<td>SW P</td>
<td>SW S</td>
</tr>
<tr>
<td><strong>Initial Analysis</strong></td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.70</td>
<td>0.45</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Case 1</strong></td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.75</td>
<td>0.50</td>
<td>0.55</td>
<td>0.55</td>
</tr>
<tr>
<td><strong>Case 2</strong></td>
<td>0.55</td>
<td>0.55</td>
<td>0.55</td>
<td>0.55</td>
<td>0.65</td>
<td>0.4</td>
<td>0.45</td>
<td>0.45</td>
</tr>
</tbody>
</table>

**Case 1:** *conditions favorable to more wood use* - uniform decrease in demand elasticity values for all products by 0.05 and simultaneous uniform increase of all supply elasticity values by 0.05

**Case 2:** *less favorable conditions for the wood market* - uniform decrease in supply elasticity values for all products by 0.05 and simultaneous uniform increase of all demand elasticity values by 0.05
Modeling scenarios

Traditional forest products demand

Demand from traditional forest industries (e.g. pulp and paper, lumber and veneer) assumed to slowly grow at the following annual rates:

- **Hardwood Pulpwood**: average rate of 0.47%
- **Softwood Pulpwood**: average rate of 0.25%
- **Hardwood Sawtimber**: average rate of 0.63%
- **Softwood Sawtimber**: average rate of 0.48%

**Wood bioenergy** demand is constant throughout the projection period at 8.25 million green tons in the Reference Case.
## Wood bioenergy consumption scenarios

<table>
<thead>
<tr>
<th>Case</th>
<th>No supply restriction</th>
<th>Massachusetts-like supply restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steady growth wood bioenergy consumption</td>
<td>A1</td>
<td>B1</td>
</tr>
<tr>
<td>Rapid development wood bioenergy consumption</td>
<td>A2</td>
<td>B2</td>
</tr>
<tr>
<td>Wood bioenergy plus Hydropower</td>
<td>A3</td>
<td>B3</td>
</tr>
</tbody>
</table>
Criteria for evaluation

Mean rate of change of **price**:

\[ \overline{\% \delta_P} = \frac{1}{50} \left( \frac{P_{t=50} - P_{t=0}}{P_{t=0}} \right) \cdot 100\% \]

Mean rate of change of **inventory**:

\[ \overline{\% \delta_I} = \frac{1}{50} \left( \frac{I_{t=50} - I_{t=0}}{I_{t=0}} \right) \cdot 100\% \]

Mean rate of change of **removals**:

\[ \overline{\% \delta_Q} = \frac{1}{50} \left( \frac{Q_{t=50} - Q_{t=0}}{Q_{t=0}} \right) \cdot 100\% \]
(a) HW pulpwood, (b) HW sawtimber, (c) SW pulpwood, (d) SW sawtimber
## Typical Sawtimber Projections (e.g. Scenario A2)

<table>
<thead>
<tr>
<th>Year</th>
<th>HW Sawtimber</th>
<th>SW Sawtimber</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2025</td>
<td>110</td>
<td>110</td>
</tr>
<tr>
<td>2035</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>2045</td>
<td>130</td>
<td>130</td>
</tr>
<tr>
<td>2055</td>
<td>140</td>
<td>140</td>
</tr>
<tr>
<td>2065</td>
<td>150</td>
<td>150</td>
</tr>
</tbody>
</table>

### Graphs

- **Inventory**
- **Removals**
- **Price**

In the graphs, the percent of inventory, removals, and price are plotted over the years from 2015 to 2065 for both HW and SW sawtimber.
Scenario A1

Inventory

Removals

Price

HW Pulpwood

2015  2025  2035  2045  2055  2065

Year

SW Pulpwood

2015  2025  2035  2045  2055  2065

Year
Scenario A3

Inventory vs. Removals and Price for HW Pulpwood and SW Pulpwood over the years 2015 to 2065.
Scenario B2

Inventory
Removals
Price

HW Pulpwood

SW Pulpwood
Conclusions

- in all scenarios involving increased consumption of wood biomass for energy (A1-A3, B1-B3), prices as well as removals increase for SW and HW pulpwood;

- Scenario A1 results in the greatest increase in price and removals of HW pulpwood compared to other scenarios;

- Scenario B1 leads to the greatest increase in price and removals of SW pulpwood;

- Woody biomass consumption for energy had no significant effect on SW and HW sawtimber inventory, removals or prices;

- Case studies of elasticities performed as expected.
Next Steps

- Policy changes
  - Efficiency requirements (MA)
  - Changes in Renewable Energy Standards (NH, ME)
- Impacts of pulpmill closures
- Carbon balances
- Land use change
Coming Soon: Heat Wave Relief in New Hampshire
## Summary of the projection results

<table>
<thead>
<tr>
<th>Scenario/Mean rate of change, %</th>
<th>HW pulpwood</th>
<th>HW sawtimber</th>
<th>SW pulpwood</th>
<th>SW sawtimber</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%Δp</td>
<td>%ΔI</td>
<td>%ΔQ</td>
<td>%Δp</td>
</tr>
<tr>
<td>Reference</td>
<td>-0.50</td>
<td>1.30</td>
<td>0.53</td>
<td>-0.68</td>
</tr>
<tr>
<td>A1</td>
<td>0.39</td>
<td>1.24</td>
<td>1.10</td>
<td>-0.67</td>
</tr>
<tr>
<td>A2</td>
<td>0.07</td>
<td>1.22</td>
<td>0.87</td>
<td>-0.65</td>
</tr>
<tr>
<td>A3</td>
<td>0.02</td>
<td>1.26</td>
<td>0.87</td>
<td>-0.67</td>
</tr>
<tr>
<td>B1</td>
<td>0.52</td>
<td>1.24</td>
<td>1.18</td>
<td>-0.66</td>
</tr>
<tr>
<td>B2</td>
<td>0.16</td>
<td>1.22</td>
<td>0.92</td>
<td>-0.65</td>
</tr>
<tr>
<td>B3</td>
<td>0.13</td>
<td>1.26</td>
<td>0.95</td>
<td>-0.67</td>
</tr>
</tbody>
</table>
Scenario A1

(a) HW pulpwood, (b) HW sawtimber, (c) SW pulpwood, (d) SW sawtimber
Scenario A2

(a) HW pulpwood, (b) HW sawtimber, (c) SW pulpwood, (d) SW sawtimber
Scenario A3

(a) HW pulpwood, (b) HW sawtimber, (c) SW pulpwood, (d) SW sawtimber
Scenario B1

(a) HW pulpwood, (b) HW sawtimber, (c) SW pulpwood, (d) SW sawtimber
Scenario B2

(a) HW pulpwood, (b) HW sawtimber, (c) SW pulpwood, (d) SW sawtimber
Scenario B3

(a) HW pulpwood, (b) HW sawtimber, (c) SW pulpwood, (d) SW sawtimber