How to Cure our Heating Oil Addiction: a roadmap based on the 25x25 Vision

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Woody Biomass Energy Research Symposium for the Northern Forest
April 28 to 30, 2011 at the University of Vermont
Organizations involved in developing the Vision:

- Biomass Thermal Energy Council
- Alliance for Green Heat
- Maine Pellet Fuels Association
- NY Biomass Energy Alliance
- Pellet Fuels Institute

Feedstock Supply and Economic Impact Analysis by FutureMetrics
The northeastern US states are uniquely and overwhelmingly dependent on #2 oil for heat.
Only about 21% of the crude oil refined in the Gulf Coast area is from domestic offshore production in the Gulf of Mexico (48 million barrels per month of a total of 228 million barrels per month entering Gulf coast refineries*).

The rest is imported. About 60% of the imports are from OPEC nations and about 19% are from Mexico.

*EIA, Special Report, Gulf of Mexico Fact Sheet, June 15, 2010.
Natural Gas is not available in the most rural states (which are also the MOST dependent on heating oil).

<table>
<thead>
<tr>
<th>How Homes are Heated</th>
<th>Maine</th>
<th>New Hampshire</th>
<th>Vermont</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Households</td>
<td>Households</td>
<td>Households</td>
</tr>
<tr>
<td>Total:</td>
<td>542,617 100.00%</td>
<td>502,201 100.00%</td>
<td>250,375 100.00%</td>
</tr>
<tr>
<td>Utility natural gas</td>
<td>19,957 3.68%</td>
<td>98,276 19.57%</td>
<td>35,478 14.17%</td>
</tr>
<tr>
<td>Bottled, tank, or LP gas</td>
<td>33,948 6.26%</td>
<td>63,624 12.67%</td>
<td>37,569 15.01%</td>
</tr>
<tr>
<td>Electricity</td>
<td>25,474 4.69%</td>
<td>37,807 7.53%</td>
<td>10,321 4.12%</td>
</tr>
<tr>
<td>Fuel oil, kerosene, etc.</td>
<td>410,296 75.61%</td>
<td>269,329 53.63%</td>
<td>134,100 53.56%</td>
</tr>
<tr>
<td>Coal or coke</td>
<td>1,074 0.20%</td>
<td>735 0.15%</td>
<td>434 0.17%</td>
</tr>
<tr>
<td>Wood</td>
<td>47,475 8.75%</td>
<td>26,098 5.20%</td>
<td>29,603 11.82%</td>
</tr>
<tr>
<td>Solar energy</td>
<td>236 0.04%</td>
<td>99 0.02%</td>
<td>102 0.04%</td>
</tr>
<tr>
<td>Other fuel</td>
<td>3,129 0.58%</td>
<td>4,039 0.80%</td>
<td>1,744 0.70%</td>
</tr>
<tr>
<td>No fuel used</td>
<td>1,028 0.19%</td>
<td>2,194 0.44%</td>
<td>1,024 0.41%</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau, 2005-2009 American Community Survey
The Oil Age
#2 Heating Oil and Crude (one month forward price) 2000 to the present

- Crude (per barrel left scale)
- Heating Oil Average (per gallon right scale)

Correlation = 0.987

source: EIA, May, 2011, Analysis by FutureMetrics
These states will “export” more than $17 BILLION dollars per year*

<table>
<thead>
<tr>
<th></th>
<th>Number of Households that Use #2 Heating Oil</th>
<th>Average Gallons Used per Year by those Homes</th>
<th>Average Total Expenditure Per Year (#2 at $3.80/gal)</th>
<th>Amount that Does not Stay in the States (EXPORTED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>688,000</td>
<td>591,680,000</td>
<td>$2,248,384,000</td>
<td>$1,753,740,000</td>
</tr>
<tr>
<td>Maine</td>
<td>434,000</td>
<td>373,240,000</td>
<td>$1,418,312,000</td>
<td>$1,106,283,000</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>955,000</td>
<td>821,300,000</td>
<td>$3,120,940,000</td>
<td>$2,434,333,000</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>291,000</td>
<td>250,260,000</td>
<td>$950,988,000</td>
<td>$741,771,000</td>
</tr>
<tr>
<td>New York</td>
<td>2,609,000</td>
<td>2,243,740,000</td>
<td>$8,526,212,000</td>
<td>6,650,445,000</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1,415,000</td>
<td>1,216,900,000</td>
<td>$4,624,220,000</td>
<td>3,606,892,000</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>170,000</td>
<td>146,200,000</td>
<td>$555,560,000</td>
<td>433,337,000</td>
</tr>
<tr>
<td>Vermont</td>
<td>148,000</td>
<td>127,280,000</td>
<td>$483,664,000</td>
<td>377,258,000</td>
</tr>
<tr>
<td>Total</td>
<td>6,710,000</td>
<td>5,770,600,000</td>
<td>$21,928,280,000</td>
<td>$17,104,059,000</td>
</tr>
</tbody>
</table>

*The US EIA data shows that 78% of every dollar spent on heating oil leaves the region and much of those dollars leave the country.
More than 950,000 jobs would be added to these states’ economies if all of that money remained in the region.

The “Vision” is to convert 25% of northeastern homes’ THERMAL needs to renewable energy by 2025.
What is Achievable? It Starts with Sustainable Feedstock Supply

- Forest and agricultural sources
- Estimate annual forest growth across seven states
- Subtract % not available for harvest (≈30%)
- Subtract current and future consumption for all forest products
- Remaining % available for biomass energy
- Then reduce this % in half to be conservative
- Repeat exercise for agricultural sources
The Northeast is heavily Forested

Maine alone sustainably harvests more than 16 million tons per year of wood*.

*Maine Forest Service data, 2010
Flow Diagram of Sustainable Biomass for New England and New York (in green tons)
Analysis by FutureMetrics

Potential Annual Sustainable Forest Harvest
55,400,000 Green Tons

Potential Annual Dedicated Energy Crops Harvest
23,304,000 Green Tons

Not Available for Harvest
16,939,000 Tons

Sawlogs
8,391,000 Tons

Pulpwood
14,935,000 Tons

half of remaining potential removed to keep estimate conservative
7,440,000 Tons

Potential Forest Biomass for Energy: 7,440,000 Tons

Total Potential Annual Biomass for Energy Applications
19,092,000 Green Tons

Potential Crop Biomass for Energy: 11,652,000 Tons

half of potential energy crops removed to keep estimate conservative
11,652,000 Tons
Pulpwood demand is shrinking!

Maine Pulpwood Harvest 1984 - 2010 (green tons)

Source: Maine Forest Service, 2011, analysis by FutureMetrics
The “Vision” is about:

- A transformation to thermal renewable energy, to start in the Northeast
- 25% of all thermal energy in Northeast from renewable energy by 2025
- 75% of renewable thermal energy from biomass by 2025 (balance from solar thermal and geothermal)
New England and NY Thermal Energy is Currently from:

- Natural Gas, 54.93%
- Heating Oil, 29.23%
- Biomass, 4.16%
- LPG, 3.75%
- Residual Fuel Oil, 4.82%
- Kerosene, 0.94%
- Solar Thermal, 0.14%
- Geothermal, 0.06%

Source: EIA, 2010
New England and NY Thermal Energy in 2025 from:

- Natural Gas, 47.00%
- Heating Oil, 19.00%
- Kerosene, 0.50%
- LPG, 2.50%
- Residual Fuel Oil, 4.50%
- Biomass, 18.50%
- Coal, 1.50%
- Geothermal, 1.50%
- Solar Thermal, 5.00%

source: EIA, 2010, forecast by FutureMetrics
Potential Economic Benefits

- Conversion to biomass thermal will **displace over 1.14 billion gallons of oil annually by 2025**.

- Conversion of 1.39 million homes and businesses will enable the **retention of more than $1.6 billion in annual income in our economy** instead of exporting to other economies.

- By 2025, the Northeast would have more than **$4.5 billion new dollars per year injected into the regional economy**.

- This retention of wealth and the expansion of the biomass thermal industry will result in a total of **140,000 new or sustained permanent jobs**.

- The increase in jobs and commerce will result in huge increases in tax revenues (more than **$960 million per year** by 2025).
Replacing oil (a high carbon fuel) with biomass (a low carbon fuel) reduces greenhouse gas emissions that contribute to climate change.

The enhanced value of biomass will contribute to healthy rural communities through improved economics and viability of forest and farm ownership because Working forests are healthy forests.
Key Strategies

- Research & development
- High efficiency & ultra-clean emissions technology that is fully automatic and convenient
- Investment in fuel collection, storage, transportation, and delivery systems
- Investment in pellet & chip manufacturing and refining
- District-heating and CHP

Education & Promotion
Maine Energy Systems has the only ASME approved European state-of-the-art pellet fueled boiler in the US. ÖkoFEN systems from Austria are in more than 40,000 homes in Europe.
Total Pounds of Particulate per Year
normalized to the equivalent of the BTU from 1000 gallons of heating oil per year

- Fireplace: 3920.0
- Uncertified Wood Stove: 644.0
- EPA Certified Wood Stove: 196.0
- Pellet Stove: 68.6
  - Old Oil Boiler (pre-1990s): 10.08
- Maine Energy Systems Pellet Fuel Boiler: 2.94
  - Modern Oil Boiler: 2.52
- Gas Boiler: 1.16

Source: USEPA, Swedish National Testing and Research Institute, Typenprüfberichte BLT Wieselburg, 2009
The European experience can help the northeast...

<table>
<thead>
<tr>
<th></th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro (excl. pumping)</td>
<td>30,613</td>
<td>25,551</td>
<td>24,932</td>
<td>26,135</td>
<td>24,284</td>
<td>24,572</td>
</tr>
<tr>
<td>Wind</td>
<td>2,320</td>
<td>3,071</td>
<td>3,815</td>
<td>5,057</td>
<td>6,060</td>
<td>7,045</td>
</tr>
<tr>
<td>Solar</td>
<td>483</td>
<td>532</td>
<td>594</td>
<td>675</td>
<td>800</td>
<td>987</td>
</tr>
<tr>
<td>Geothermal</td>
<td>3,616</td>
<td>3,946</td>
<td>5,287</td>
<td>5,384</td>
<td>5,280</td>
<td>5,526</td>
</tr>
<tr>
<td><strong>Biomass (wood)</strong></td>
<td><strong>49,081</strong></td>
<td><strong>49,837</strong></td>
<td><strong>54,638</strong></td>
<td><strong>57,588</strong></td>
<td><strong>58,922</strong></td>
<td><strong>61,905</strong></td>
</tr>
<tr>
<td>Municipal Solid Waste</td>
<td>7,947</td>
<td>8,120</td>
<td>8,588</td>
<td>8,964</td>
<td>9,854</td>
<td>10,399</td>
</tr>
<tr>
<td>Biogas</td>
<td>2,670</td>
<td>3,292</td>
<td>3,274</td>
<td>3,747</td>
<td>4,267</td>
<td>4,750</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>96,730</strong></td>
<td><strong>94,349</strong></td>
<td><strong>101,128</strong></td>
<td><strong>107,550</strong></td>
<td><strong>109,478</strong></td>
<td><strong>115,184</strong></td>
</tr>
</tbody>
</table>


In Europe, using wood for energy is a mature and well-established market. Energy from wood makes up more than half of all of the energy from renewables in Europe.

Although wind and solar get most of the attention, the “workhorse” of renewable energy is wood fuels (pellets and chips).

Renewable electricity sources are important; but heating homes is not done with electricity!
The penalty for failure is dire!

When heating oil prices rise from the current $3.00/gallon to $4.50/gallon, hundreds of thousands of jobs will be lost if the northeast does not end its heating oil addiction.

<table>
<thead>
<tr>
<th>#2 Distillate Fuel use in Residential, Commercial, and Industrial (not Transportation)</th>
<th>Average Gallons per Year</th>
<th>Money Exported from Regional Economy at $3.00/gal</th>
<th>Money Exported from Regional Economy at $4.50/gal</th>
<th>Annual Increased Loss of Money if Heating Oil goes to $4.50/gal</th>
<th>Permanent Increase in Jobs Lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maine</td>
<td>414,493,000</td>
<td>$969,913,620</td>
<td>$1,454,870,430</td>
<td>($484,956,810)</td>
<td>-31,966</td>
</tr>
<tr>
<td>Vermont</td>
<td>130,435,000</td>
<td>$305,217,900</td>
<td>$457,826,850</td>
<td>($152,608,950)</td>
<td>-11,191</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>242,029,000</td>
<td>$566,347,860</td>
<td>$849,521,790</td>
<td>($283,173,930)</td>
<td>-17,405</td>
</tr>
<tr>
<td>Connecticut</td>
<td>672,464,000</td>
<td>$1,573,565,760</td>
<td>$2,360,348,640</td>
<td>($786,782,880)</td>
<td>-44,896</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>148,551,000</td>
<td>$347,609,340</td>
<td>$521,414,010</td>
<td>($173,804,670)</td>
<td>-12,216</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>818,841,000</td>
<td>$1,916,087,940</td>
<td>$2,874,131,910</td>
<td>($958,043,970)</td>
<td>-59,939</td>
</tr>
<tr>
<td>New York</td>
<td>1,818,841,000</td>
<td>$4,256,087,940</td>
<td>$6,384,131,910</td>
<td>($2,128,043,970)</td>
<td>-126,728</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>840,580,000</td>
<td>$1,966,957,200</td>
<td>$2,950,435,800</td>
<td>($983,478,600)</td>
<td>-55,075</td>
</tr>
<tr>
<td>New Jersey</td>
<td>459,420,000</td>
<td>$1,075,042,800</td>
<td>$1,612,564,200</td>
<td>($537,521,400)</td>
<td>-29,026</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5,545,654,000</strong></td>
<td><strong>$12,976,830,360</strong></td>
<td><strong>$19,465,245,540</strong></td>
<td><strong>($6,488,415,180)</strong></td>
<td><strong>-388,443</strong></td>
</tr>
</tbody>
</table>
The poorest households suffer the most.

The lowest decile in the Maine income distribution will spend more than 50% of their income on heating oil at $4.50/gallon!
Fully automatic pellet fueled central heating systems are HERE NOW. The fuel is about ½ the price of heating oil. This is a solution that can make a difference NOW.

Thank You

William Strauss, PhD

Papers on the economic impacts of the Northeast's addiction to heating oil can be downloaded from the FutureMetrics’ website: www.FutureMetrics.com