Why should we care about renewable energy?

[Graph showing oil production (billions of barrels per year) over time, with a peak around the year 2000. Source: Various forecasts aggregated by FutureMetrics.]
United States’ “Energy Policy”
At current heating oil prices, the NE states “export” more than **20 BILLION** dollars per year*

<table>
<thead>
<tr>
<th>State</th>
<th>Number of Households that use Heating Oil</th>
<th>Average Gallons Used per Year by all Users</th>
<th>Average Total Expenditure Per Year (#2 at $3.65/gal)</th>
<th>Amount that Does not Stay in the State (EXPORTED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>873,000</td>
<td>720,225,000</td>
<td>$ 2,628,821,250</td>
<td>$ 2,050,481,000</td>
</tr>
<tr>
<td>Maine</td>
<td>418,000</td>
<td>376,200,000</td>
<td>$ 1,373,130,000</td>
<td>$ 1,071,041,000</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>1,110,000</td>
<td>915,750,000</td>
<td>$ 3,342,487,500</td>
<td>$ 2,607,140,000</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>409,000</td>
<td>368,100,000</td>
<td>$ 1,343,565,000</td>
<td>$ 1,047,981,000</td>
</tr>
<tr>
<td>New York</td>
<td>3,275,000</td>
<td>2,947,500,000</td>
<td>$ 10,758,375,000</td>
<td>8,391,533,000</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1,837,000</td>
<td>1,377,750,000</td>
<td>$ 5,028,787,500</td>
<td>3,922,454,000</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>208,000</td>
<td>166,400,000</td>
<td>$ 607,360,000</td>
<td>473,741,000</td>
</tr>
<tr>
<td>Vermont</td>
<td>201,000</td>
<td>180,900,000</td>
<td>$ 660,285,000</td>
<td>$ 515,022,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8,331,000</strong></td>
<td><strong>7,052,825,000</strong></td>
<td><strong>$ 25,742,811,250</strong></td>
<td><strong>$ 20,079,393,000</strong></td>
</tr>
</tbody>
</table>


*The US EIA data shows that 78% of every dollar spent on heating oil leaves the region and most of those dollars leave the country.
At current heating oil prices, **about ONE MILLION jobs are destroyed** as money is drained from those states’ economies and sent to other places.

<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 $3.65/gal</th>
<th>Permanent Job Destruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>720,225,000</td>
<td>($2,050,480,575)</td>
<td>-98,300</td>
</tr>
<tr>
<td>Maine</td>
<td>376,200,000</td>
<td>($1,071,041,400)</td>
<td>-64,189</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>915,750,000</td>
<td>($2,607,140,250)</td>
<td>-133,194</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>368,100,000</td>
<td>($1,047,980,700)</td>
<td>-58,773</td>
</tr>
<tr>
<td>New York</td>
<td>2,947,500,000</td>
<td>($8,391,532,500)</td>
<td>-415,023</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1,377,750,000</td>
<td>($3,922,454,250)</td>
<td>-198,084</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>166,400,000</td>
<td>($473,740,800)</td>
<td>-23,575</td>
</tr>
<tr>
<td>Vermont</td>
<td>180,900,000</td>
<td>($515,022,300)</td>
<td>-30,219</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7,052,825,000</strong></td>
<td><strong>($20,079,392,775)</strong></td>
<td><strong>-1,021,357</strong></td>
</tr>
</tbody>
</table>

Analysis by FutureMetrics
MAINE: WINTER BALANCE OF TRADE

MIDDLE EAST TREASURY

IMPORT

EXPORTS

JOBS

FOREIGN OIL
Biomass Thermal

- Using wood to meet space heat and process heat needs a highly efficient use of wood fuels
- Long established practice in forest products industry; is cordwood and chips – now moving beyond (pellets, densified wood, torrefaction)
- Residential, commercial, institutional, industrial
- National “Fuels for Schools” Program
- New business models emerging
- An area with major growth potential
- Real issues with emissions, particularly PM
- Fuel specifications / delivery requirements often more restrictive than biomass electric (no secondary screening)
Biomass Thermal Fuels

• Tend to be modest volumes
  – Price takers, not market makers
  – Can utilize infrastructure built to serve others (e.g. pulp mills or biomass electric)

• Can have specialized delivery requirements
  – Self-unloading trucks, high fuel spec

• No “single source” for biomass fuel information – developing industry

• Can be forest-derived, sawmill residue, urban wood, processed fuel (e.g., pellets), etc.
Biomass Thermal Beats Oil...

• On a BTU basis, biomass thermal competes well with oil (and propane and even reesidential natural gas!)
• The following charts show wood pellets as a cost-effective alternative to traditional fuels; the savings can be even greater for chips
• Often the barrier to biomass thermal use is capital – the expense associated with putting in a new boiler or other heating system
Wood Pellets Provide Cost Savings Compared to Home Heating Oil
Cost Savings per MMBTU
Modern Wood Pellet Boilers are CLEAN and completely automatic.

**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
- **Modern European Pellet Fuel Boiler**: 2.94
- **Gas Boiler**: 1.16
- **Old Oil Boiler (pre-1990s)**: 10.08
- **Modern Oil Boiler**: 2.52

To put this into perspective, let’s compare using one cord of wood in a fireplace and one cord of wood’s worth of energy from wood pellets in a modern pellet boiler.

375 pounds

Particulate emissions (SMOKE!)

0.28 pound
Biomass Thermal Geography

• The following maps show
  – Percent of homes using oil as a primary heating source
  – Homes with oil or propane as primary heat per square mile (for bulk delivery economics)
Percent of Homes Using Oil as a Primary Heat Source
Homes with Oil or Propane as Primary Heat Source
Units per Square Mile
Pellets are Simple Way to Access and Use Biomass Fuel

• Heating options include boilers (whole home) and stoves (supplemental heat)
• Moving from residential to commercial and larger applications
• Provides a refined fuel with modest consumer involvement
• Potential for bulk delivery (or bagged for small scale consumers)
Using very conservative estimates for the quantity of sustainable biomass, if we assume that each state provides biomass for its own needs, the table below shows the conversion rates.

Maine is highest proportionally with 32.33% of its homes and businesses converting.

New York is highest in absolute numbers with 756,000 homes and businesses converting.

<table>
<thead>
<tr>
<th>State</th>
<th>Occupied Households</th>
<th>Number of Businesses</th>
<th>Total Number of Households and Businesses</th>
<th>Total Biomass Production per Year (green tons)</th>
<th>Total Number Converting in each State if there is NO Interstate Transport of Pellets (based on 8 tons per user per year average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>1,323,000</td>
<td>394,651</td>
<td>1,717,651</td>
<td>454,000</td>
<td>1.65% 28,400</td>
</tr>
<tr>
<td>Maine</td>
<td>542,000</td>
<td>161,679</td>
<td>703,679</td>
<td>3,640,000</td>
<td>32.33% 227,500</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>2,449,000</td>
<td>730,537</td>
<td>3,179,537</td>
<td>608,000</td>
<td>1.20% 38,000</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>501,000</td>
<td>149,448</td>
<td>650,448</td>
<td>694,000</td>
<td>6.67% 43,400</td>
</tr>
<tr>
<td>New York</td>
<td>7,907,420</td>
<td>2,358,783</td>
<td>10,266,203</td>
<td>12,096,000</td>
<td>7.36% 756,000</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>4,877,735</td>
<td>1,455,028</td>
<td>6,332,763</td>
<td>6,694,000</td>
<td>6.61% 418,400</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>405,000</td>
<td>120,812</td>
<td>525,812</td>
<td>166,000</td>
<td>1.97% 10,400</td>
</tr>
<tr>
<td>Vermont</td>
<td>251,000</td>
<td>74,873</td>
<td>325,873</td>
<td>1,434,000</td>
<td>27.50% 89,600</td>
</tr>
<tr>
<td></td>
<td>18,256,155</td>
<td>5,445,811</td>
<td>23,701,966</td>
<td>25,786,000</td>
<td>27.50% 89,600</td>
</tr>
</tbody>
</table>

analysis by FutureMetrics
The biomass for fuel harvest already is more than 3 million tons per year in Maine.
Maine Pulpwood Harvest is Declining

Trend in the Maine Pulpwood Harvest

(source: Maine Forest Service, 2011, analysis by FutureMetrics)
New Solutions Coming to Market
This “Energy Box” from Maine Energy Systems can House Multiple Boilers and Bulk Pellet Storage, Providing a New Product for Schools, Mid-Size Commercial, etc.
Pneumatic Tankers Deliver Wood Pellets

Sealed dry bulk tankers deliver the equivalent of 4,000 gallons of heating oil.
Pellet Handling at Jackson Lab (Bar Harbor, Maine)
Largest Single User of Wood Pellets in the United States

Fuel Unloading

Site mounted blower pressurizes tanker driving pellets through a flexible hose and up into the storage silo
Biomass – for electric and thermal – is an important part of the New England forest economy
Energy Wood Use in Maine, New Hampshire, New York and Vermont 2010

- Biomass: 9,470,000 Green Tons
- Wood Pellets: 4,410,000 Green Tons
- Firewood: 1,000,000 Green Tons
Energy Wood Use/Production in Maine, New Hampshire, New York and Vermont  2010

The chart above represents the annual energy wood use/production in Maine, New Hampshire, New York, and Vermont from 1994 to 2010. The categories include biomass, wood pellets, firewood, and total. The data indicates a steady increase in total energy wood use/production from 1994 to 2010.
Biomass Chips are an Important Source of Fuel for Thermal Applications
Biomass Facilities in Vermont
A Success Story for Community-Scale Projects
A case study – Sweden

Fossil Fuel Energy Consumption (% of total)

Biomass as % of Total Energy

source: World Bank, 2011, Analysis by FutureMetrics
The smoothed trend in GDP per capita is virtually identical.
And as an added benefit....
What is the Future for Renewable Energy?

Europe is more than a decade ahead.

Note the role of biomass in the European renewable energy portfolio.

Solar and wind are less than 10% while biomass makes up 67% in the most recent year’s data.

| Total Renewable Energy Production in Europe in 1000's of tons of oil equivalent (TOE) |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Year                            | 1998            | 1999            | 2000            | 2001            | 2002            | 2003            | 2004            | 2005            | 2006            | 2007            | 2008            | 2009            |
| Solar energy                    | 0.4%            | 0.4%            | 0.4%            | 0.5%            | 0.5%            | 0.6%            | 0.6%            | 0.7%            | 0.8%            | 0.9%            | 1.2%            | 1.6%            |
| Biomass                         | 60.7%           | 60.5%           | 60.1%           | 59.2%           | 62.3%           | 64.1%           | 63.8%           | 65.4%           | 66.0%           | 66.8%           | 66.6%           | 66.8%           |
| Geothermal Energy               | 4.5%            | 4.7%            | 4.8%            | 4.5%            | 4.8%            | 5.0%            | 4.8%            | 4.6%            | 4.5%            | 4.3%            | 4.0%            | 3.9%            |
| Hydro power                     | 31.3%           | 30.9%           | 30.8%           | 31.5%           | 27.2%           | 24.8%           | 24.5%           | 22.4%           | 21.4%           | 19.8%           | 19.6%           | 18.7%           |
| Wind power                      | 1.0%            | 1.3%            | 1.9%            | 2.3%            | 3.1%            | 3.6%            | 4.5%            | 5.2%            | 5.7%            | 6.7%            | 7.2%            | 7.6%            |

WHAT IF IT'S A BIG HOAX AND WE CREATE A BETTER WORLD FOR NOTHING?

- Energy Independence
- Preserve Rainforests
- Sustainability
- Green Jobs
- Livable Cities
- Renewables
- Clean Water, Air
- Healthy Children
- Etc. Etc.