

**The New Hampshire Climate Change Policy Task Force**

## **New Hampshire Climate Action Plan**

*A Plan for New Hampshire's Energy, Environmental  
and Economic Development Future*

### **Appendix 7.4:**

#### ***Agriculture, Forestry, and Waste***

#### **Carbon Emissions and Economic Modeling: Approach and Assumptions**

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## **Introduction**

This document details the approach taken and the assumptions made in order to provide emissions and economic analyses of potential Actions proposed by the Working Groups and the Task Force. The results of the analyses are presented separately in the Analysis Results table. Detailed descriptions of the potential Actions are presented in the Action Reports produced by the Working Groups.

### **Carbon Emissions Model:**

#### *Woody Biomass Model*

A model of net carbon emission/sequestration was constructed incorporating data obtained primarily from the Forestry Inventory and Analysis (FIA)<sup>1</sup> National Program, from a Society for the Protection of New Hampshire Forests (SPNHF) study<sup>2</sup>, and from personal communication with experts in the forestry and wood products industry. The basic approach of using FIA data to estimate the potential energy content of New Hampshire wood is described in the supporting document “The Wood Biomass Wedge in New Hampshire.” A more detailed and comprehensive description of the forest and wood products model is in preparation for print in a peer-reviewed journal.

This model estimates exchanges of carbon between terrestrial woody biomass sinks and the atmosphere. Changes in standing woody biomass are modeled by county (10 counties) and by FIA forest classes (4 classes) as a result of primary productivity, mortality, forest conversion, and harvest. Decomposition and storage in the dead wood pool is included in the model. The fate of harvested wood is partitioned into slash and cull, low grade products (pulp, cordwood, or bark), and mill products (rough lumber, chips, sawdust, or bark.) Mill product use is modeled as durable product, non-durable product, or wood for energy (electricity or home heating.)

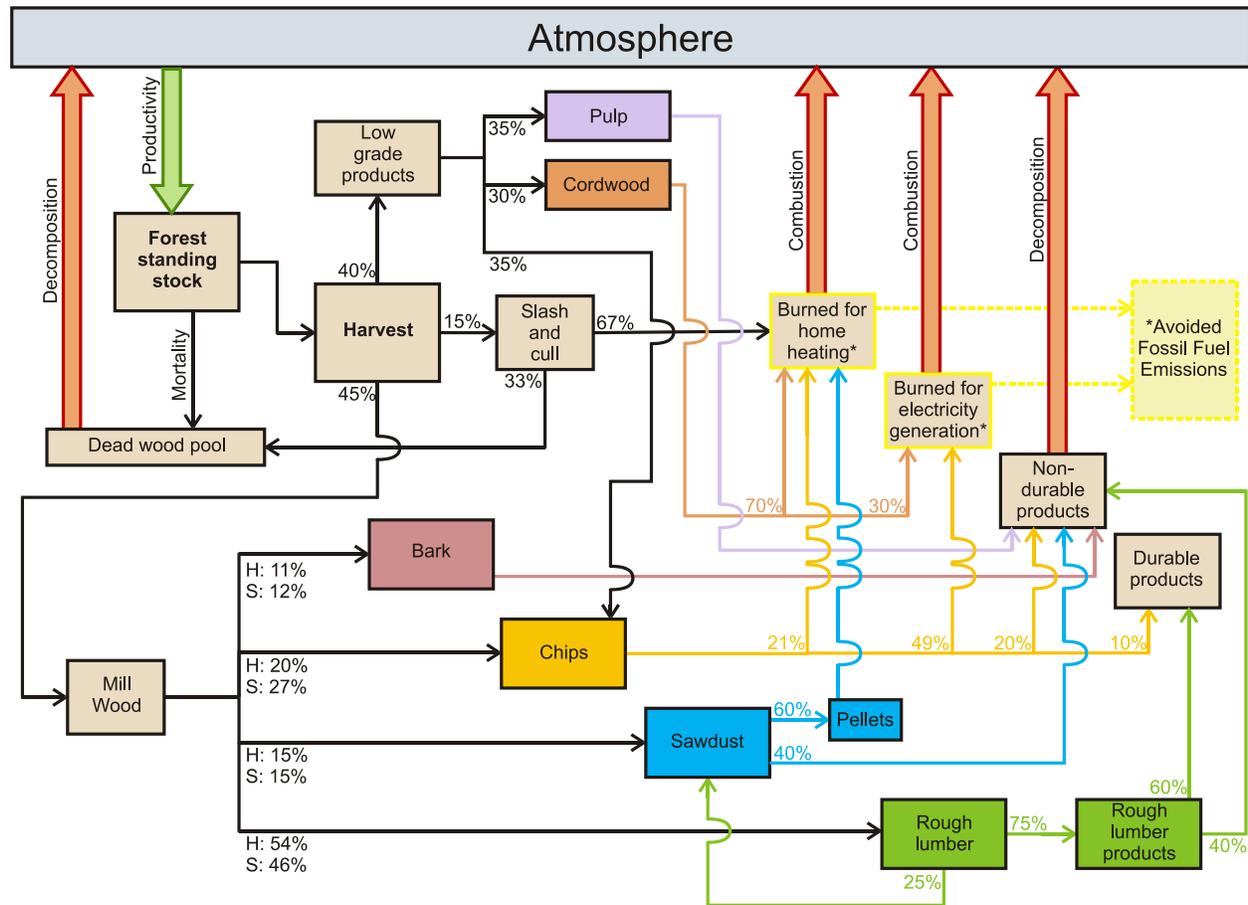
The model projects the future size of the terrestrial woody biomass carbon sink, the annual net sequestration of forests, and the annual avoided fossil fuel emissions. Net avoided emissions from various forest and wood management scenarios are compared against a business-as-usual (BAU) scenario. The basic structure of the model is represented in a schematic in Figure 1.

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<sup>1</sup> Forestry Inventory and Analysis (FIA) Program. USDA Forest Service.

<sup>2</sup> “New Hampshire’s Changing Landscape 2005” SPNHF report, supporting data sheets.

**Figure 1:** Simplified conceptual model of the carbon implications of the forestry and wood product business-as-usual scenario.



**Emission Reduction Potential Calculation Assumptions:**

**AFW Action 1.1.1 Increase Cover Crops**

The increases in soil carbon sequestration from cover crops management are not well constrained. However, they are generally characterized as being less than no-till practices (AFW Action 1.1.2). Since the carbon emissions savings of no-till farming are calculated as <0.01, the carbon emissions savings from increases in cover crops as also reported as <0.01.

**AFW Action 1.1.2 Increase Conservation Tillage/No-Till Farming Practices**

Results indicate, on average, that a change from conventional tillage (CT) to no-till (NT) can sequester 57 +/- 14 (g Carbon)/(sq meter \* year).<sup>3</sup> Increased carbon sequestration rates from

<sup>3</sup> "Soil Organic Carbon Sequestration Rates by Tillage and Crop Rotation: A Global Data Analysis." Tristram O. West and Wilfred M. Post. 2002.

no-till practices applied to silage corn acreage (Table 1). Assumed that 50% of silage corn acreage already conducts no-till practices.<sup>4</sup>

**Table 1: Agricultural acreage by type (Personal comm. with working group)**

|  | Farm Area [arces] | Farm Area (% of NH land) |
|--|-------------------|--------------------------|
| USDA "Land in Farms"                           | 444,000           | 7.70%                    |
| NH Current Use (Enrolled in Farmland Category) | 210,000           | 3.60%                    |
| USDA "Harvested Acreage"                       | 96,000            | 1.70%                    |
| - Forage crops (hay and pasture)               | 71,000            |                          |
| - Silage corn                                  | 14,000            |                          |
| - Vegetables                                   | 3,500             |                          |

**AFW Action 1.1.3 Protect Agricultural Land**

Supporting mechanism for Smart Growth. Agricultural land sequesters 20-30% less carbon than forests or grasslands.<sup>5</sup> Since rural developed land incorporates a significant fraction of these land types, it is not known whether the conversion of agricultural land to developed land in NH would result in net carbon storage. Analysis requires a systems approach; consult TLU Smart Growth analysis for potential savings.

**AFW Action 1.2 Avoid Forest Land Conversion**

Projected statewide loss of forested land (which is less than projected development of forested land) is projected be approximately 5,010 acres/year.<sup>6</sup> This projected loss of forested land, partitioned by county, is set to zero in the model under this scenario. This affects carbon emissions and storage in two ways. First, the wood harvests associated with the clearing of developed lands under the BAU scenario do not occur in this scenario. Second, the acreage of forested lands, a proportional factor in calculating total forest productivity, does not decrease in this scenario. Therefore, total productivity is higher under this scenario.

**AFW Action 1.3 – Promote Durable Wood Products**

Modeled as a rise in the percentage of post-mill rough lumber that becomes durable product (from 60% to 90%).

**AFW Goal 2 - Fuel and Electricity Generation**

The effects of the Actions supporting this goal are aggregated in the outputs of the integrated forest and wood product model. These outputs also include the effects of avoiding forested land losses (AFW Action 1.2) and the promotion of durable wood products (AFW Action 1.3).

<sup>4</sup> The application of no-till to silage corn only and the assumed percentage that already conducts no-till practices from AFW Working Group feedback.

<sup>5</sup> "Soil Organic Carbon Sequestration Rates by Tillage and Crop Rotation: A Global Data Analysis." Tristram O. West and Wilfred M. Post. 2002.

<sup>6</sup> "New Hampshire's Changing Landscape 2005" SPNH report, supporting data sheets.

The integrated output, reported under AFW Action 2.2, represents a balance between the use of wood for electricity generation and residential heating.

**AFW Action 2.2 – Maximize Availability of Biomass for Electricity and Heating within Sustainable Limits**

All suitable non-durable wood products are used for energy, with a balance of wood for electricity generation and residential heating. The energy implications of this model are presented below in Table 2.

**Table 2:** Energy implications of integrated forest management scenario (AFW Action 2.2). Note that the current wood electric generation capacity of 89 MW includes wood from out of state, while the scenario estimate of wood electric generation capacity of 87 MW includes only wood from New Hampshire. Therefore, wood electric generation capacity could potentially be higher if importation of wood into the state continues.

| <b>Wood electricity generation</b><br>(MW capacity, wood/total) | <b>2002</b>      | <b>2009</b>      |
|---|------------------|------------------|
| Current   | <b>89 / 1821</b> |                  |
| Scenario estimate   |                  | <b>87 / 2733</b> |

| <b>Wood home heating</b><br>(trillion BTU, wood/total) | <b>2005</b>     | <b>2009</b>      |
|--|-----------------|------------------|
| Current  | <b>2.7 / 54</b> |                  |
| Scenario estimate                                      |                 | <b>19.5 / 54</b> |

**AFW Action 2.1 Encourage the Use of Bioreactors for Landfills**

Not individually quantified, supports AFW Goal 2.

**AFW Action 2.2 Maximize Availability of Biomass for Electricity and Heating within Sustainable Limits**

Not individually quantified, supports AFW Goal 2.

**AFW Action 2.2.1 Maintain Infrastructure for Biomass Production and Support Regulatory and Business Efficiencies**

Not individually quantified, supports AFW Goal 2.

**AFW Action 2.2.2 Ensure Biomass Consumption is within Sustainable Limits**

Not individually quantified, supports AFW Goal 2.

**AFW Action 2.2.3 Ensure the Most Efficient Use of Energy/Biomass Stock**

Not individually quantified, supports AFW Goal 2.

#### AFW Action 4.1 Strengthen Local Food Systems

Considerable uncertainty remains in determining the amount of greenhouse gas reduction associated with local food production. Research does show that food choices are critical for determining greenhouse gas emissions.<sup>7</sup>

Calculated by analogy with Iowa<sup>8</sup>, with NH growing and transporting an additional 10% of food locally. Assumed savings are proportional to population.

### **Economic Model:**

The CSNE economic modeling team took an “efficient analysis” approach to estimating the economic impacts of different actions proposed by the working groups, given the many different policy options considered. The modeling assumptions used in estimating economic costs and benefits are provided below.

The objective of the economic analysis was to estimate approximate “levels of magnitude” of the economic impacts of each proposed action item. Given the short time frame of analysis and large number of action items under consideration, this economic analysis is not as detailed as previous UNH economic studies of RPS and RGGI. It is instead meant to provide economic context to assist in the decision making process for the task force.

The analysis provided for the task force is limited to direct New Hampshire costs/benefits and does not include assessment of society wide impacts. As much as possible, direct employment impacts are estimated along with costs and benefits. The analysis does not consider potential benefits associated with actions such as reduced health costs due to reduced air pollution emissions and also does not include avoided costs in calculating economic impacts.

However where appropriate, an economic multiplier was used to estimate the broader state-wide economic impacts of cost savings, such as for reduced fuel consumption. An economic multiplier is used to estimate economy-wide impacts of specific economic changes. The UNH Economic team—based on its significant knowledge of the NH economy and to be conservative—chose a \$1 economic multiplier for each \$1 of savings attributed to an action. The assumptions section discusses whether the economic multiplier was applied to any given action. The 1:1 multiplier is considered conservative.<sup>9</sup>

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<sup>7</sup> <http://pubs.acs.org/cgi-bin/asap.cgi/esthag/asap/pdf/es702969f.pdf?isMac=902618>  
[http://www.associatedcontent.com/article/407798/cornell\\_study\\_assesses\\_food\\_print\\_related.html?cat=22](http://www.associatedcontent.com/article/407798/cornell_study_assesses_food_print_related.html?cat=22)  
<sup>8</sup> <http://www.leopold.iastate.edu/pubs/staff/ppp/index.htm>

<sup>9</sup> Federal Reserve Bank, 2002.

The economic analysis does not discount costs and benefits of climate change policies to reflect timing or uncertainty. This is consistent with the approach used for NH RGGI and RPS analysis and used in the Stern Report. Ken Arrow, Nobel Laureate Economist, reviewed the Stern Report<sup>10</sup> and concluded that discounting for time and uncertainty did not change conclusions.<sup>11</sup>

In the analysis spreadsheet summarizing the carbon and economic impacts of each action item, levels of magnitude and qualitative information are provided, not precise figures for costs and benefits or the exact timing of those costs and benefits. The economic analysis section below provides an overview of the approach and assumptions use to model the economic costs and benefits of each action.

To help provide some context for the expected costs and benefits, the New England Economic Partnership forecasts that New Hampshire's Gross Domestic Product (GDP) will be \$58 billion dollars in 2012. The NH GDP is the most comprehensive measure of NH economic activity and is calculated for all states by the U.S. Bureau of Economic Analysis.

#### Implementation Costs

- Low 0-\$2.5 million
  - Moderately Low \$2.5 million to \$25
  - Moderate \$25 million to \$125 million
  - Moderately high \$125 million to \$500 million
  - High \$500 million to \$1 billion
  - Very high Greater than \$1 billion
- 
- Uncertain: Economic implementation costs were not easily determined without significant research beyond the scope of this part of the analysis.
  - Study: Means that the action proposed by the working group is a study to further look at issue, this is meant to avoid confusion in comparison of the costs of different actions.

#### Potential economic benefits

- Low 0-\$2.5 million
  - Moderately Low \$2.5 million to \$25
  - Moderate \$25 million to \$125 million
  - Moderately high \$125 million to \$500 million
  - High \$500 million to \$1 billion
  - Very high Greater than \$1 billion
- 
- Uncertain: Economic implementation costs were not easily determined without significant research beyond the scope of this part of the analysis.

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<sup>10</sup> Stern Review on the economics of climate change. 2006.

[http://www.hm-treasury.gov.uk/independent\\_reviews/stern\\_review\\_economics\\_climate\\_change/stern\\_review\\_report.cfm](http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm)

<sup>11</sup> "The case for cutting emissions," Ken Arrow, 2007.

### Timing of Costs

- Immediate/higher upfront: The majority of economic cost is experienced in the relative short term with the longer term economic cost being less significant
- Constant/even: The economic cost tends to be relatively constant on an annual basis
- Low short-term/Mostly long-term: The majority of economic cost is experienced in the relative long term with the shorter term economic cost being less significant
- Uncertain: Economic implementation costs were not easily determined without significant research beyond the scope of this part of the analysis

### Timing of Economic Benefits

- Immediate/higher upfront: The majority of economic benefit is experienced in the relative short term with the longer term economic benefit being less significant
- Constant/even: The economic benefit tends to be relatively constant on an annual basis
- Low short-term/Mostly long-term: The majority of economic benefit is experienced in the relative long term with the shorter term economic benefit being less significant
- Uncertain: Economic benefits were not easily determined without significant research beyond the scope of this part of the analysis

### Who Experiences the Significant Portion of the Costs

- Consumer (Evenly Distributed, Concentrated on particular groups)
- Government (State, Local)
- Business (Evenly Distributed, Concentrated on particular groups)

### Who Experiences the Significant Portion of the Benefits

- Consumer (Evenly Distributed, Concentrated on particular groups)
- Government (State, Local)
- Business (Evenly Distributed, Small, Medium, Large)

In the above, “Evenly distributed” means that costs and/or benefits are shared relatively equally across the respective group. “Concentrated on particular groups” means that costs and/or benefits are disproportionately borne by, for example, upper or lower income groups.

Economic analysis uses latest (2008) US-DOE EIA (Energy Information Administration) Energy Outlook in constant \$2008. The EIA fuel forecast only goes out to 2030, the assumption was made that the 2030 price continues through 2050 in constant dollars. The only exception is the electricity price which was taken from the Independent Service Operator New England (ISO-NE) CELT (Capacity, Energy, Loads, and Transmission) forecast. The report projects prices specifically for NH out to 2017. The 2017 price was assumed to continue through 2050 in constant dollars.

If current prices are indicative the EIA forecasts are low, however the same fuel forecasts are applied consistently across all sectors for fuel savings. Therefore economic benefits based on fuel savings are appropriate as a comparative tool in the decision making process. It is also important to note that all dollars reported in the economic sections including fuel costs are in constant 2008 dollars. This allows for the reporting of costs and benefits in a dollar value in today's values.

**CSNE Fuel Forecast (\$2008)**

|                                   | Units  | 2012    | 2025   | 2050    |
|-----------------------------------|--------|---------|--------|---------|
| LPG                               | Gallon | \$ 1.87 | \$1.89 | \$ 1.97 |
| Residual Oil                      | Gallon | \$ 1.48 | \$1.44 | \$ 1.57 |
| Distillate Oil                    | Gallon | \$ 2.59 | \$2.61 | \$ 2.78 |
| Natural Gas                       | Therm  | \$ 0.87 | \$0.90 | \$ 0.99 |
| Electricity- NH Specific          | kWh    | \$ 0.15 | \$0.15 | \$ 0.15 |
| Motor Gasoline                    | Gallon | \$ 2.76 | \$2.71 | \$ 2.80 |
| Diesel Fuel (distillate fuel oil) | Gallon | \$ 2.75 | \$2.75 | \$ 2.91 |

Source: EIA Annual Energy Outlook for 2008

**Economic Calculation Assumptions:**

**AFW Action 1.1.1 Increase Cover Crops**

Assumed 100% of available farmland planted with 100,000 acres of land in NH actively used for crop planting.<sup>12</sup> The cost of planting cover crops was assumed to be \$28 per acre.<sup>13</sup> For an annual cost to farmers of approximately \$2.8 million. \$100,000 for administrative costs to establish the program. Economic value of cover crop was assumed to be \$95 per acre for annual revenue of \$9.5 million.<sup>14</sup>

**AFW Action 1.1.2 Increase Conservation Tillage/No-Till Farming Practices**

<sup>12</sup> State Fact Sheets: New Hampshire, USDA Economic Research Service, Available online at <http://www.ers.usda.gov/StateFacts/NH.HTM>

<sup>13</sup> Winter Cover Crop Program: Progress Update, Maryland Department of Agriculture, Microsoft PowerPoint Presentation, August 2005, Available online at <http://www.mde.state.md.us/assets/document/BRF-CoverCropProgramUpdate083105.pdf>

<sup>14</sup> Overview of Cover Crops and Green Manures, Appropriate Technology Transfer for Rural Areas, July 2003, Available online at <http://attra.ncat.org/attra-pub/PDF/covercrop.pdf>

Assumed 100,000 acres of land for crop planting (see Action 1.1.1). Assumed \$100,000 for administrative cost to establish program, no additional cost from farmers and savings of \$13 per acre<sup>15</sup>, yielding savings of \$1.3 million.

**AFW Action 1.1.3 Protect Agricultural Land**

Assumed an annual conversion of 1,460 acres lost per year.<sup>16</sup> Conservation costs considered include acquisition and transaction costs. Average acquisition cost per acre of \$7,000 was assumed.<sup>17</sup> The average transaction acreage size was assumed to be 50.<sup>18</sup> Average conservation easement costs assumed to be \$20,000 per project<sup>19</sup> for a \$350 per acre transaction fee. Total cost for protecting all acreage is estimated at \$10.7 million per year. Tax benefits are a financial benefit of easements, estimated at \$1000 per acre (based on example at [privatelandownernetwork.org](http://privatelandownernetwork.org))<sup>20</sup> or \$1.5 million. Agricultural output per average acre of NH farmland estimated at \$365<sup>21</sup> for an annual average output of \$525 thousand for the potentially converted acres. Additional benefits include supporting smart growth.

Estimated Economic Benefits (Agricultural Output Preserved and Personal Tax benefits) assuming 100% of farmland was protected at a rate of 1,460 acres per year:

| 2012        | 2025         | 2050         |
|-------------|--------------|--------------|
| \$4 million | \$10 million | \$24 million |

**AFW Action 1.2 Avoid Forest Land Conversion**

Current forested cover is estimated at 4.2 million acres and assumed an annual conversion of 17,500 acres lost per year.<sup>22</sup> (Note: conversion refers to change in land use. It does not refer to loss of forested land which is projected to occur at ~5,010 acres per year [see carbon emissions analysis AFW Action 1.2 above.]) Conservation costs considered include acquisition and transaction costs. Costs per acre were same as action 1.1.3. Total costs for protecting all acreage is estimated at ~\$129 million per year. Tax benefits per acre were assumed the same as

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<sup>15</sup> University of California: Davis, Available online at <http://safs.ucdavis.edu/newsletter/v05n3/page1.htm>  
<sup>16</sup> National Resources Inventory: New Hampshire Statistics Sheet, Farmland Information Center, Available online at [http://www.farmlandinfo.org/agricultural\\_statistics/index.cfm?function=statistics\\_view&stateID=NH](http://www.farmlandinfo.org/agricultural_statistics/index.cfm?function=statistics_view&stateID=NH)  
<sup>17</sup> Email correspondence from Will Abbott, NH Society for Protection of NH Forests, Derived from LCHIP data for average cost per acre for LCHIP transactions that had an assessed value.  
<sup>18</sup> City of Dover Open Lands Committee and Conservation Commission Land Protection Project Completion Report, City of Dover, NH, January 2007, Available online at <http://www.ci.dover.nh.us/boards/conservation/Project%20Completion%20Report.pdf>  
<sup>19</sup> Criteria for acceptance and selection of conservation easements, Aspen Valley Land Trust, Available online at [http://www.avlt.org/docs/AVLT\\_Criteria\\_Checklist\\_FinancialRequirements.pdf](http://www.avlt.org/docs/AVLT_Criteria_Checklist_FinancialRequirements.pdf)  
<sup>20</sup> Hypothetical Examples of the Tax Benefits of Donating Conservation Land, Private Landowner Network, Available online at <http://www.privatelandownernetwork.org/plnlo/taxbenefitexamples.asp>  
<sup>21</sup> State Fact Sheets: New Hampshire, USDA Economic Research Service, Available online at <http://www.ers.usda.gov/StateFacts/NH.HTM>  
<sup>22</sup> New Hampshire's Changing Landscape 2005, Society for the Protection of New Hampshire Forests, Available online at <http://www.spnhf.org/research/papers/nhcl2005es.pdf>

1.1.3 and timberland economic benefits were assumed to be \$1.5 billion annually.<sup>23</sup> Economic output per acre of NH timberland was estimated at \$340 per acre.

Estimated Economic Benefits (Forest Product Output Preserved and Personal Tax benefits) assuming 100% of timberland was protected at a rate of 17,500 acres per year:

| 2012         | 2025          | 2050          |
|--------------|---------------|---------------|
| \$41 million | \$119 million | \$270 million |

AFW Action 1.3 – Promote Durable Wood Products

Assumed an annual marketing and administrative budget of \$500,000 for program promotion and a 2% increase in economic activity due to marketing outreach was assumed.<sup>24</sup> Economic benefits of forest industry to NH were assumed to be \$1.5 billion annually (see Action 1.2.1). The marketing program would be expected to result in an annual incremental activity of \$30 million.

AFW Goal 2 - Fuel and Electricity Generation

Wood for residential heat

13,300,000 MMBTU sustainable biomass available. Wood stove heat rate per cord, 13.475 MMBTU per cord, average price per cord of seasoned wood wood – \$300.<sup>25</sup> For a total cost of \$296 million.

Cost assumed to displace 150 gallons of No. 2 fuel oil per cord. 987,000 cords of wood are sustainable, avoided oil cost of \$387 million, yielding \$90 million in annual savings, \$1 multiplier for dollars invested locally, total economic benefits \$477 million.<sup>26</sup>

Wood for electricity

There is not expected to be a change in the price of electricity as the whole sale power price is set by marginal producers- biomass would not be a marginal producer and would be expected to meet its required rate of return through wholesale power sales and Renewable Energy Credits.

CSNE heat rate assumptions 12,687 BTU/kWh, benefits are power generated locally, heat rate at a whole sale power price of \$0.08 per kWh. ~ 1 Million MWH, for total economic benefits of \$83 million annually.<sup>27</sup>

<sup>23</sup> NH Timberland Owner’s Association, Available online at <http://www.nhtoa.org/education.html>

<sup>24</sup> Assumptions by UNH Economic team

<sup>25</sup> <http://www.tulsamastergardeners.org/blackbox/enrgcalc.htm>

<sup>26</sup> <http://www.cdc.gov/nasd/docs/d001201-d001300/d001235/d001235.html>

[http://www.newstimes.com/ci\\_10158299](http://www.newstimes.com/ci_10158299)

<sup>27</sup> <http://answers.google.com/answers/threadview/id/271700.html>

### AFW Action 2.1 Encourage the Use of Bioreactors for Landfills

Total market potential for new landfill power generation assumed to be 4 MW.<sup>28</sup> Landfill gas is expected to have a negative cost per kWh that is less \$0.0134 less than the wholesale price of power<sup>29</sup>, however given the small amount of generation it is expected to have no perceptible impact on electricity costs. Additional support may be necessary for projects that require significantly higher development costs than average but that would be site specific and not possible to model. Total Construction costs are estimated to be \$2 million per MW for a total of \$8 million, which would be a one-time benefit to the local economy.<sup>30</sup> Jobs associated with LFG are ~6 per MW for a total of 24.<sup>31</sup> Current average wage per alternative energy job is ~\$57,000 per year<sup>32</sup> for total annual wages paid of about \$1.4 million. Property taxes from the facilities would be another benefit.

### AFW Action 2.2.1 Maintain Infrastructure to Support Biomass Production and Support Regulatory and Business Efficiencies

The AFW action report discusses many different policies, many are advocacy or training related that would be expected to have low costs relative to other policies under consideration. The maintenance and upgrading of e-2 bridge infrastructure was focused on for this analysis. There are currently 329 E-2 or greater bridges in NH. An informal review of costs listed for redlisted bridges in NH showed costs in the range of \$1 million to \$10 million for rehabbing.<sup>33</sup> Assuming an average cost of \$5 million per repair and 2 repairs per year.<sup>34</sup> Average cost would be \$10 million. Assuming that good bridge conditions prevents 2% of economic activity related to timber from being lost<sup>35</sup>, it would save at least \$30 million per year (see action 1.2.1 for economic activity discussion).

### AFW Action 2.2.2 Ensure Biomass Consumption is within Sustainable Limits

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<sup>28</sup> Landfill Methane Outreach Program (LMOP), US EPA, Available online at <http://www.epa.gov/landfill/proj/index.htm#1>

<sup>29</sup> Gittell and Magnusson, Economic Impact of a New Hampshire Renewable Portfolio Standard, February 2007, Available online at [http://www.des.state.nh.us/ard/climatechange/pdf/UNH\\_rps\\_report.pdf](http://www.des.state.nh.us/ard/climatechange/pdf/UNH_rps_report.pdf)

<sup>30</sup> Gittell and Magnusson, Economic Impact of a New Hampshire Renewable Portfolio Standard, February 2007, Available online at [http://www.des.state.nh.us/ard/climatechange/pdf/UNH\\_rps\\_report.pdf](http://www.des.state.nh.us/ard/climatechange/pdf/UNH_rps_report.pdf)

<sup>31</sup> Gittell and Magnusson, Economic Impact of a New Hampshire Renewable Portfolio Standard, February 2007, Available online at [http://www.des.state.nh.us/ard/climatechange/pdf/UNH\\_rps\\_report.pdf](http://www.des.state.nh.us/ard/climatechange/pdf/UNH_rps_report.pdf)

<sup>32</sup> Bureau of Labor Statistics, 2007

<sup>33</sup> NH DOT Bureau of Bridge Design, Available online at <http://www.nh.gov/dot/bureaus/bridgedesign/BridgeInspection.htm>

<sup>34</sup> Assumption by UNH Economic team

<sup>35</sup> Assumption by UNH Economic team

Assumed study of \$100,000 to establish sustainable biomass levels and ongoing administrative costs related to this action of \$100,000.<sup>36</sup> A supporting mechanism for renewable power generation in the region.

AFW Action 2.2.3 Ensure the Most Efficient Use of Energy/Biomass Stock

Similar costs expected as for action 2.2.2. A supporting mechanism for a combined heat and power portfolio standard.

AFW Action 3.1 Implement a Pay-As-You-Throw Initiative (PAYT)

In 2004, NH generated 1.7 million tons of trash (1.3 tons per capita) with approximately a 25% recycling rate.<sup>37</sup> Residential makes up 55% of the waste stream. Paper makes up 34% of the waste stream by weight, plastics 12%, metals 8% and glass 5% - for a total of ~60% of waste stream.<sup>38</sup> Therefore approximately 560,000 tons of residential recyclables are recyclable each year, at a 25% recycling rate 420,000 tons of residential recyclables are disposed of. Assuming that current disposal cost is \$70 per ton and average value of recycled material is \$100 per ton<sup>39</sup> and that the program captures an additional 35% of recyclable material<sup>40</sup>, the avoided disposal cost and total recovered value would be ~\$25 million per year. Implementation costs are expected to be low at the town level, but an additional recycling material recovery facility would be required to process this level of material for the State volume, cost of facility estimated at \$6 million.<sup>41</sup>

AFW Action 4.1 Strengthen Local Food Systems

Action implementation plan focuses on education, outreach and developing state government resources to support stronger local food systems, these development costs are expected to be low relative to other actions under consideration. Local agriculture had \$144 million in market value in 2002.<sup>42</sup> A 2% increase<sup>43</sup> in this number due to outreach efforts would increase agricultural output by ~\$3 million.

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<sup>36</sup> Assumption by UNH Economic team

<sup>37</sup> State of Garbage, Biocycle, Available online at [http://www.jgpress.com/archives/\\_free/000848.html](http://www.jgpress.com/archives/_free/000848.html)

<sup>38</sup> Municipal Solid Waste Generation, Recycling, and Disposal in the United States:

Facts and Figures for 2005, US EPA, Available online at

<http://www.epa.gov/epaoswer/osw/conserves/resources/msw-2005.pdf>

<sup>39</sup> Conversation with Waste Management, 2008

<sup>40</sup> Assumption by AFW working group

<sup>41</sup> Conversation with Waste Management, 2008

<sup>42</sup> National Resources Inventory: New Hampshire Statistics Sheet, Farmland Information Center, Available online at [http://www.farmlandinfo.org/agricultural\\_statistics/index.cfm?function=statistics\\_view&stateID=NH](http://www.farmlandinfo.org/agricultural_statistics/index.cfm?function=statistics_view&stateID=NH)

<sup>43</sup> Assumption by UNH Economic team