REPORT TO STAKEHOLDERS FROM THE AGRICULTURE AND FORESTRY WORKING GROUP

Date: July 23, 2004
To: Agriculture and Forestry Working Group, GHG Stakeholder Advisory Group
From: Tom Peterson
Re: Recommendations regarding Options to reduce GHG emissions from Forestry

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This report is a discussion draft of forest mitigation options that have not yet been fully discussed by the technical working group. It includes the following updates of technical information and technical working group assumptions from the last draft shared with stakeholders at the June 30, 2004 SAG meeting:

- The last option to be analyzed, "Increased Harvest Rotation Length," at a level of 100,000 acres per year, is presented
- The "Active Softwood Increase Option" has been revised to include more acres (33,000 per year vs. 11,333 in the last draft, including 3,000 new acres per year treated with herbicide)
- Two new carbon accounts have been added to the analysis of options
    - Emissions from decay of logging residue left on site after harvest based on a decay function from Turner (1993)
    - Emissions displaced by substituting wood products for other building materials from CORIMM (2004)
- Biomass replacement estimates have been revised upward to include replacement of logging residue based on estimates by Turner (1993)
- The length of biomass grow back is set at 58.2 years for all options, equal to the weighted average age of Maine forest stands in 2003 as measured by FORCARB; timing issues of analysis are discussed more fully in the forest carbon calculator separately available to the technical working group

-- Discussion Draft --

Maine Greenhouse Gas Action Plan Development Process

Forestry Greenhouse Gas Reduction Options

Agriculture and Forestry Technical Working Group Meeting

July 29, 2004 Version

Forestry Mitigation Options

The following options are based on technical working group submissions.

- Early Commercial Thinning
- More Regular, Lighter Harvests
- Active Management To Maintain And Increase The Softwood Component Of Forest Stands
- Increased Harvest Rotation Length
- Increased Biomass Electricity Feedstocks
- Increased Use Of Wood Products

The following sections of this document present information about each of the proposed forestry policy options, including:

- A description of the policy
- A description of some key business as usual policies and programs
- A listing of key data sources, methods and assumptions
- A summary table of estimated greenhouse gas reductions and costs
- A worksheet of calculations
- References and background materials

In developing forestry options the Working Group noted the importance of ancillary issues that are included in decision criteria for the stakeholder advisory group. Specifically, they felt the following considerations should be made:

- All options should be reviewed for potential impacts to biodiversity and the options adopted should do no harm to biodiversity.
- The planting of exotic species of trees should not be precluded as long as impacts to biodiversity have been considered and shown to have no harm.
- All options should create a net benefit to the atmosphere in the form of reduced land use, reduced sulfur emissions, and/or increased carbon sequestration.
- A meaningful and credible dialogue should be created with decision makers in order to give them a better understanding of the options developed by the Working Group.
- Implementation of the options should be in the context of an adaptive management stance, recognizing and providing for new data and understandings of the systems involved.

Summary of Forestry Options Not Yet Discussed

Table 1.

COMBINED FORESTRY PACKAGE GHG SAVINGS	kMTCO2e - 15 yr seq	kMTCO2e – 58.2 yr seq
	Levelized Annual Reductions	Levelized Annual Reductions
Early Commercial Thin	-264.54	783.01
More Light Harvests	-126.56	505.19
Active Softwood Increase	-30.12	48.73
Increased Harvest Rotation Length	1,484.69	13.99
Biomass Electricity Feedstocks	398.91	398.91
Expanded Use Of Wood Products	589.95	217.87

Early Commercial Thinning

Policy Description: Over the next 5 years, treat 50% of the 400,000 acres (40,000 acres per year) estimated to be available for ECT. Apply to all forest types and all landowner classes. Treat an additional 50% of a new subset of 400,000 acres over the subsequent 5-year period. Estimated Forest Product Output: 20% durable wood products; 60% pulp/OSB ("oriented strand board"), and 20% biomass energy. Assume 8 cords per acre per year harvest.

BAU Policy/Program: Early commercial thinnings are not required but are often practiced for silviculture reasons. Costs and undervalued benefits often prohibit broader application of this practice.

A number of existing programs support improved management of private non-industrial forests in Maine. The Maine Forest Service, with some financial support from the USDA Forest Service, provides technical and financial assistance to encourage non-industrial private forest landowners to keep their lands and natural resources productive and healthy. Qualifying land includes rural lands with existing tree cover or land suitable for growing trees and which is owned by a private individual, group, association, corporation, Indian tribe, or other legal private entity. Eligible landowners must have an approved Forest Management Plan and own 1,000 or fewer acres of qualifying land. Authorization may be obtained for exceptions of up to 5,000 acres.

The Tree Growth Tax Law provides for the valuation of enrolled forestlands according to the land's productivity instead of its just value (ad valorem). This provides an incentive for forest landowners to hold and manage their lands for long term. Substantial withdrawal penalties ensure the program's credibility. Enrolled acreage has remained relatively stable at around 11.7 million acres for many years.

Data Sources, Methods and Assumptions:

Analysis of this proposal (and others) is based on baseline data from the modified USFS FORCARB as described in an earlier discussion of the forestry baseline. Forest carbon measurements for average and specific stands are based on 2003 FORCARB data (average collection date of 2001). Specific proposed action levels, timing, acreages, and the Maine Forest Service and Environment Northeast provided yields per acre. Specific coefficients for emissions and storage from wood products are based on USFS HARVCARB data. Electricity emissions are based on HARVCARB allocations of biomass energy use from durable wood products and pulp, and emissions factors for marginal displaced power provided by Synapse, Inc. (ISO New England rates of 950 pounds CO_2 per Mwh). All HARVCARB data are for the Northeast.

Analysis of these assumptions was conducted by spreadsheet analysis (static model) that assumed changes in biomass from policy would not be offset by demand responses (dynamic model). Cost figures were not available.

Greenhouse gas savings numbers were calculated by creating levelized annual actions assuming all 15 years (2005-2020) undergo equal actions and no ramp up period is involved. Savings numbers are not discounted. The levelized calculation is based on a stylized stand of all 15 years worth of acres grown in the average year (7.5 years from 2005), divided by the 15 year budget period (2005-2020) to simplify timing issues associated with biomass growth.

Calculations for net effects of biomass energy emissions and storage were made under two scenarios: 1) carbon sequestration of 15 years (the 2005-2020-target period), and 2) carbon sequestration of 95 years (2005-2100). The latter scenario is generally consistent with full life cycle analysis of growth of biomass supplies to replace current biomass combustion. Both scenarios were calculated using a simple levelized annual number based on total years of carbon sequestered (7.5 or 87.5) divided by 15. Unless otherwise noted sequestration levels are based on statewide biomass growth rates for a mixture of stand types. Carbon sequestration rates for specific tree species were provided by the USFS (Jim Smith, appendix 4). Wood products and landfill emissions and storage are based on the HARVCARB model. Biomass conversions from cords per acre to carbon and dry tons wood biomass were calculated using coefficients provided by the Maine Forest Service.

Other details are noted in the worksheet below.

Estimated GHG Savings and Costs:

The tables below summarize results of analysis for the proposed option using two time horizons:

Table 2.

Option Summary - Early Commercial Thinning	Levelized Annual GHG savings 2005-2020 (kMTCO2e)	$/MTCO2e
15 Yr Seq	**-264.54**	L-M
95 Yr Seq	**783.01**	L-M

Table 3.

Early Commercial Thin		kMTCO2e			
		2010	2020	2010+	2020+
Acres treated per year (avg forest)	80,000				
Cords removed per acre	8				
Cft removed per acre	1,024				
Pounds removed per acre (5000 short pounds/cord)	40,000				
Wet Tons removed per acre (2.5 short tons/cord)	20				
Dry Tons removed per acre (.5)	10				
MT removed per acre	9.07				
MTC removed per acre (.50 conversion)	4.54				
MTCO2e removed per acre (2.079 MT CO2e/cord)	16.632				
Total KMTCO2e removed yr 0-15	19,958				
% to durable wood	20%				
kMTCO2 to Durable wood (sum yrs 0-15)	3,992				
kMTCO2 Products in use - storage (avg yr 7.5)		63.25	63.25	14.64	14.64
kMTCO2 Landfill - storage (avg yr 7.5)		13.47	13.47	29.41	29.41
kMTCO2 Biomass energy - annual emission		-114.96	-114.96	-118.42	-118.42
Mbtus Biomass Energy (17.0 Mbtus per dry ton)	17,625,600				
Mwh Biomass Energy (11550 btu per Kwh)	1,526,026				
kMTCO2 Displaced (950 lbs CO2 per Mwh) annual	658	43.88	43.88	43.88	43.88
kMTCO2 Other WP - Emission (avg yr 7.5)		-81.03	-81.03	-103.65	-103.65
kMTCO2 Forest Sequestration (stand replacement) (avg yr 7.5)		52.81	52.81	409.81	409.81
kMTCO2 Logging residue (avg yr 7.5)		-45.85	-45.85	-142.09	-142.09
kMTCO2 Building materials substitution (avg yr 7.5)		20.93	20.93	20.93	20.93

Total GHG Savings		**-22.58**	**-22.58**	**275.66**	**275.66**
% to pulp	60%				
kMTCO2 to Durable wood (sum yrs 0-15)	11,975				
kMTCO2 Products in use - storage (avg yr 7.5)		188.09	188.09	19.56	19.56
kMTCO2 Landfill - storage (avg yr 7.5)		63.07	63.07	83.43	83.43
kMTCO2 Biomass energy - annual emission		-333.46	-333.46	-345.28	-345.28
Mbtus Biomass Energy (17.0 Mbtus per dry ton)	51,126,480				
Mwh Biomass Energy (11550 btu per Kwh)	4,426,535				
kMTCO2 Displaced (950 lbs CO2 per Mwh) annual	1,909	127.28	127.28	127.28	127.28
kMTCO2 Other WP - Emission (avg yr 7.5)		-245.25	-245.25	-350.07	-350.07
kMTCO2 Forest Sequestration (stand replacement) (avg yr 7.5)		158.43	158.43	1229.44	1229.44
kMTCO2 Logging residue (avg yr 7.5)		-137.56	-137.56	-426.27	-426.27
kMTCO2 Building materials substitution (avg yr 7.5)		67.71	67.71	67.71	67.71
Total GHG Savings		**-111.71**	**-111.71**	**405.78**	**405.78**
% to elec gen	20%				
kMTCO2 Biomass energy - annual emission	3991.68	-266.11	-266.11	-266.11	-266.11
Mbtus Biomass energy (17.0 Mbtus per dry ton)	40,800,000				
Mwh Biomass energy (11550 btu per Kwh)	3,532,468				
kMTCO2 Displaced (950 lbs CO2 per Mwh) annual	1,524	101.57	101.57	101.57	101.57
kMTCO2 Forest Sequestration (stand replacement) (yr 7.5)	1,089	34.29	34.29	266.11	266.11
kMTCO2 Logging residue (avg yr 7.5)		-45.85	-45.85	-426.27	-426.27
Total GHG Savings		**-130.25**	**-130.25**	**101.57**	**101.57**
Option Total GHG Savings		**-264.54**	**-264.54**	**783.01**	**783.01**

Key Uncertainties:

- Feasibility of treating 40,000 acres per year (a potentially aggressive goal)
- Growth rates of restocked species following thinning; growth rates may be not be the same following thins as for restocking following clear cut harvest (assumed in this analysis)
- Emissions factors for electricity supplies displaced by biomass power
- Sequestration rates for average forest stands
- The volume of non merchantable harvest residue left on site
- Waste emissions (biomass not used for energy recapture) from biomass conversion during processing
- The percentage of biomass used for heat versus power production, and the relevant displacement rates for direct heat
- Time periods of analysis

More Regular, Lighter Harvests

Policy Description: This option is intended to remove standing biomass from the forest with minimal impact on the forest floor and soils, and to apply biomass to energy saving uses to reduce carbon dioxide emissions. Apply to all forest types and all landowner classes on 1,700,000 total acres over a 15-year period (113,333 acres per year). Goal: within 10 years capture 50% of biomass that otherwise is thinned by natural mortality and becomes decay on forest floors. This would yield approximately 4,000 cords of wood annually, or 3 cubic feet of wood per acre per year. Estimated Forest Product Output: 45% saw logs; 48% pulpwood and 7% biomass chips (the average mix of the reported harvest of forest products over the past 7 years).

BAU Policy/Program: A number of existing programs support improved management of private non-industrial forests in Maine. The Maine Forest Service, with some financial support from the USDA Forest Service, provides technical and financial assistance to encourage non-industrial private forest landowners to keep their lands and natural resources productive and healthy. Qualifying land includes rural lands with existing tree cover or land suitable for growing trees and which is owned by a private individual, group, association, corporation, Indian tribe, or other legal private entity. Eligible landowners must have an approved Forest Management Plan and own 1,000 or fewer acres of qualifying land. Authorization may be obtained for exceptions of up to 5,000 acres.

The Tree Growth Tax Law provides for the valuation of enrolled forestlands according to the land's productivity instead of its just value (ad valorem). This provides an incentive for forest landowners to hold and manage their lands for long term. Substantial withdrawal penalties ensure the program's credibility. Enrolled acreage has remained relatively stable at around 11.7 million acres for many years.

Data Sources, Methods and Assumptions:

Same as other options; other details are noted in the worksheet below.

Estimated GHG Savings and Costs:

The tables below summarize results of analysis for the proposed option using two time horizons:

Table 4.

Option Summary – More Regular Light Harvest	**Levelized Annual GHG savings 2005-2020 (kMTCO2e)**	**$/MTCO2e**
15 Yr Seq	**-126.56**	L-M
95 Yr Seq	**505.19**	L-M

Table 5.

More Light Harvest		kMTCO2e			
		2010	2020	2010+	2020+
Acres treated per year (avg forest)	170,000				
Cords removed per acre	2				
Cft removed per acre	256				
Pounds removed per acre (5000 short pounds/cord)	10,000				
Wet Tons removed per acre (2.5 short tons/cord)	5				
Dry Tons removed per acre (.5)	2.5				
MT removed per acre	2.27				
MTC removed per acre (.50 conversion)	1.13				
MTCO2e removed per acre (2.079 CO2e/cord)	4.158				
Total KMTCO2e removed yr 0-15	10,603				
% to durable wood	45%				
kMTCO2 to durable wood (yr 0-15)	4,771				
kMTCO2 Products in use - storage (yr 7.5)		75.61	75.61	17.49	17.49
kMTCO2 Landfill - storage (yr 7.5)		16.10	16.10	35.15	35.15
kMTCO2 Biomass energy - annual emission		-136.62	-136.62	-141.07	-141.07
Mbtus biomass energy (17.0 Mbtus per dry ton)	11,592,332				
Mwh biomass energy (11550 btu per Kwh)	1,003,665				
kMTCO2 displaced (950 lbs CO2 per Mwh) annual	433	28.86	28.86	28.86	28.86
kMTCO2 Other WP - emission (yr 7.5)		-96.86	-96.86	-116.74	-116.74
kMTCO2 Forest Sequestration (stand		63.13	63.13	489.85	489.85

replacement) (yr 7.5)					
kMTCO2 from logging residue		-54.81	-54.81	-169.84	-169.84
kMTCO2 from building materials substitution		25.01	25.01	25.01	25.01
Total GHG Savings		**-49.79**	**-49.79**	**313.55**	**313.55**
% to pulp	48%				
kMTCO2 to pulp (yr 0-15)	5,089				
kMTCO2 Products in use - storage (yr 7.5)		79.94	79.94	8.31	8.31
kMTCO2 Landfill - storage (yr 7.5)		26.80	26.80	35.46	35.46
kMTCO2 Biomass energy - annual emission		-141.72	-141.72	-146.74	-146.74
Mbtus biomass energy (17.0 Mbtus per dry ton)	21,728,754				
Mwh biomass energy (11550 btu per Kwh)	1,881,277				
kMTCO2 displaced (950 lbs CO2 per Mwh) annual	811	54.09	54.09	54.09	54.09
kMTCO2 Other WP - emission (yr 7.5)		-104.23	-104.23	-148.78	-148.78
kMTCO2 Forest Sequestration (stand replacement) (yr 7.5)		67.33	67.33	522.51	522.51
kMTCO2 from logging residue		-58.46	-58.46	-181.17	-181.17
kMTCO2 from building materials substitution		28.77	28.77	28.77	28.77
Total GHG Savings		**-47.47**	**-47.47**	**172.46**	**172.46**
% to elec gen	7%				
kMTCO2 Biomass energy - annual emission	742	-49.48	-49.48	-49.48	-49.48
Mbtus Biomass energy (17.0 Mbtus per dry ton)	7,586,250				
Mwh Biomass energy (11550 btu per Kwh)	656,818				
kMTCO2 Displaced (950 lbs CO2 per Mwh) annual	283	18.89	18.89	18.89	18.89
kMTCO2 Forest Sequestration (stand replacement) (yr 7.5)		9.82	9.82	76.20	76.20
kMTCO2 Logging residue (avg yr 7.5)		-8.53	-8.53	-26.42	-26.42
Total GHG Savings		**-29.30**	**-29.30**	**19.18**	**19.18**
Option Total GHG Savings		**-126.56**	**-126.56**	**505.19**	**505.19**

Key Uncertainties:

- Emissions factors for electricity supplies displaced by biomass power
- Sequestration rates for average forest stands
- The volume of non merchantable harvest waste left on site
- Waste emissions (biomass not used for energy recapture) from biomass conversion during processing
- The percentage of biomass used for heat versus power production, and the relevant displacement rates for direct heat
- Time periods of analysis

Active Management To Maintain And Increase The Softwood Component Of Forest Stands

Policy Description: Significant percentages of Maine's original softwood forests have shifted to hardwoods as a result of forest practices. With long-term forest succession they are likely to return to softwoods in the very long term, but this process can be accelerated with practices that remove hardwood stocks by thinning or harvest and replace them with longer-lived softwoods. In the process significant biomass could be generated for wood products and energy use, carbon sequestration rates may be improved by stimulating biomass growth response in the forest, and spruce budworm risks may be reduced along with emissions associated with decomposition of dead or dying wood.

Two million acres of spruce-fir forests, predominately located in northern Maine, transitioned from a softwood forest type to a hardwood forest type as a combined result of the spruce budworm epidemic in the 1970's and 1980's and subsequent salvage harvesting.

The working group proposed implementing a structured conversion process back to an assignment as a softwood forest type will increase the soil sequestration values of a substantial portion of Maine timberlands. Goal: transition 33,333 acres per year over 15 years currently classified as a hardwood forest type to a softwood forest type by 2020. This includes removal of two cords of harvested biomass per acre through one-time removals over the 15-year period from ten percent of these stands, with restocking of softwood species. It also includes application of herbicides to 3,000 acres of hardwood to promote natural stand release and regeneration of softwoods.

BAU Policy/Program: A number of existing programs support improved management of private non-industrial forests in Maine. The Maine Forest Service, with some financial support from the USDA Forest Service, provides technical and financial assistance to encourage non-industrial private forest landowners to keep their lands and natural resources productive and healthy. Qualifying land includes rural lands with existing tree cover or land suitable for growing trees and which is owned by a private individual, group, association, corporation, Indian tribe, or other legal private entity. Eligible landowners must have an approved Forest Management Plan and own 1,000 or fewer acres of qualifying land. Authorization may be obtained for exceptions of up to 5,000 acres.

The Tree Growth Tax Law provides for the valuation of enrolled forest lands according to the land's productivity instead of its just value (ad valorem). This provides an incentive for forest landowners to hold and manage their lands for long term. Substantial withdrawal penalties ensure the program's credibility. Enrolled acreage has remained relatively stable at around 11.7 million acres for many years.

Data Sources, Methods and Assumptions:

Same as for other options; other details are noted in the worksheet below.

Estimated GHG Savings and Costs:

The tables below summarize results of analysis for the proposed option using two time horizons:

Table 6.

Option Summary – Active Softwood Increase	Levelized Annual GHG savings 2005-2020 (kMTCO2e)	$/MTCO2e
15 Yr Seq	**-2.37**	L-H
95 Yr Seq	**0.14**	L-H

Table 7.

Active Softwood Increase		**kMTCO2e**			
		2010	2020	2010+	2020+
Acres treated per year (avg forest)	36,000				
Cords removed per acre	2				
Cft removed per acre	256				
Pounds removed per acre (5000 short pounds/cord)	10,000				
Wet Tons removed per acre (2.5 short tons/cord)	5				
Dry Tons removed per acre (.5)	2.5				
MT removed per acre	2.27				
MTC removed per acre (.50 conversion)	1.13				
MTCO2e removed per acre (2.079 CO2e/cord)	4.158				
Total kMTCO2e removed yr 0-15	2,245				
% to durable wood	**41.3%**				
kMTCO2 to durable wood (yr 0-15)	926				
kMTCO2 Products in use - storage (yr 7.5)		14.68	14.68	3.40	3.40
kMTCO2 Landfill - storage (yr 7.5)		3.46	3.46	6.82	6.82

kMTCO2 Biomass energy - annual emission		-26.67	-26.67	-27.48	-27.48
Mbtus biomass energy (17.0 Mbtus per dry ton)	4,089,690				
Mwh biomass energy (11550 btu per Kwh)	354,086				
kMTCO2 displaced (950 lbs CO2 per Mwh) annual	153	10.18	10.18	10.18	10.18
kMTCO2 Other WP - emission (yr 7.5)		-18.80	-18.80	-24.05	-24.05
kMTCO2 Forest Sequestration (stand replacement) (yr 7.5)		12.25	12.25	95.09	95.09
kMTCO2 from logging residue		-10.64	-10.64	-32.97	-32.97
kMTCO2 from building materials substitution		4.86	4.86	4.86	4.86
Total GHG Savings		**-10.69**	**-10.69**	**35.85**	**35.85**
% to pulp	**44.0%**				
kMTCO2 to pulp (yr 0-15)	988				
kMTCO2 Products in use - storage (yr 7.5)		15.52	15.52	1.61	1.61
kMTCO2 Landfill - storage (yr 7.5)		5.20	5.20	6.88	6.88
kMTCO2 Biomass energy - annual emission		-27.51	-27.51	-28.49	-28.49
Mbtus biomass energy (17.0 Mbtus per dry ton)	4,217,935				
Mwh biomass energy (11550 btu per Kwh)	365,189				
kMTCO2 displaced (950 lbs CO2 per Mwh) annual	158	10.50	10.50	10.50	10.50
kMTCO2 Other WP - emission (yr 7.5)		-20.23	-20.23	-28.88	-28.88
kMTCO2 Forest Sequestration (stand replacement) (yr 7.5)		13.07	13.07	101.43	101.43
kMTCO2 from logging residue		-11.35	-11.35	-35.17	-35.17
kMTCO2 from building materials substitution		5.59	5.59	5.59	5.59
Total GHG Savings		**-9.22**	**-9.22**	**33.48**	**33.48**
% to elec gen	**6.4%**				
kMTCO2 Biomass energy - annual emission	144	-9.60	-9.60	-9.60	-9.60
Mbtus biomass energy (17.0 Mbtus per dry ton)	1,472,625				
Mwh biomass energy (11550	127,500				

btu per Kwh)					
kMTCO2 displaced (950 lbs CO2 per Mwh) annual	55	3.67	3.67	3.67	3.67
kMTCO2 Forest Sequestration (stand replacement) (yr 7.5)	-39	-1.91	-1.91	-14.79	-14.79
kMTCO2 Logging residue (avg yr 7.5)		-1.66	-1.66	-5.13	-5.13
Total GHG Savings		**-7.85**	**-7.85**	**-20.73**	**-20.73**
% herbicide treatment	8.3%				
kMTCO2 Biomass herbicide removal	187	-3.98	-3.98	-12.33	-12.33
kMTCO2 Forest Sequestration (stand replacement) (yr 7.5)		1.61	1.61	12.47	12.47
Total GHG Savings		**-2.37**	**-2.37**	**0.14**	**0.14**

Key Uncertainties:

- Emissions factors for electricity supplies displaced by biomass power
- The capacity of industry to produce and plant softwood seedlings
- Sequestration rates for average forest stands
- The volume of non merchantable harvest residue left on site
- Waste emissions (biomass not used for energy recapture) from biomass conversion during processing
- The percentage of biomass used for heat versus power production, and the relevant displacement rates for direct heat
- Time periods of analysis

Increased Harvest Rotation Length

Policy Description: Over the next 15 years, postpone harvest on 100,000 acres of forestland in Maine for an average of ten years, with a focus on the maple/beech/birch and spruce/fir systems. Expected potential benefits include increased sequestration and reduced emissions associated with harvest and wood products processing.

BAU Policy/Program: Harvest rotation lengths are largely determined by public policy for public lands, and generally determined by market forces on private lands, subject to environmental and economic constraints as well as other landowner values. They vary by species, location and time period.

Data Sources, Methods and Assumptions:

Analysis of this proposal is based on a baseline harvest scenario (that represents the likely harvest that would occur without postponement), compared to the sequestration benefits of postponing harvest for an additional ten years. The baseline harvest analysis uses the same data sources, methods and assumptions as are used in other forestry options involving biomass removal, and assume removal of eight cords per acre.

Other details are noted in the worksheet below.

Estimated GHG Savings and Costs:

The table below summarizes results of analysis for the proposed option using two time horizons:

Table 8.

Option Summary - Increased Harvest Rotation Length	Levelized Annual GHG savings 2005-2020 (kMTCO2e)	$/MTCO2e
15 Yr Seq	**1484.69**	M-H
95 Yr Seq	**13.99**	M-H

Table 9.

Increased Harvest Rotation Length		**kMTCO2e**			
		2010	2020	2010+	2020+
Acres treated per year (avg Maple/Spruce forest)	100,000				
Cords removed per acre	8				
Cft removed per acre	1,024				
Pounds removed per acre (5000 short pounds/cord)	40,000				
Wet Tons removed per acre (2.5 short tons/cord)	20				
Dry Tons removed per acre (.5)	10				
MT removed per acre	9.07				
MTC removed per acre (.50 conversion)	4.54				
MTCO2e removed per acre (2.079 CO2e/cord)	16.632				
Total kMTCO2e removed yr 0-15	24,948				
Postponed Baseline Harvest:					
% to durable wood	**20%**				
kMTCO2 to durable wood (yr 0-15)	4,990				
kMTCO2 Products in use - storage (yr 7.5)		78.74	78.74	17.63	17.63
kMTCO2 Landfill - storage (yr 7.5)		21.56	21.56	35.76	35.76
kMTCO2 Biomass energy - annual emission		-141.31	-141.31	-145.96	-145.96
Mbtus biomass energy (17.0 Mbtus per dry ton)	21,664,800				
Mwh biomass energy (11550 btu per Kwh)	1,875,740				
kMTCO2 displaced (950 lbs CO2 per Mwh) annual	809	53.93	53.93	53.93	53.93
kMTCO2 Other WP - emission (yr 7.5)		-101.72	-101.72	-137.71	-137.71
kMTCO2 Forest Sequestration (stand replacement) (yr 7.5)		66.01	66.01	512.27	512.27
kMTCO2 from logging residue		-57.32	-57.32	-177.61	-177.61
kMTCO2 from building materials substitution		27.19	27.19	27.19	27.19
Total GHG Savings		**-52.92**	**-52.92**	**185.49**	**185.49**
% to pulp	**20%**				
kMTCO2 to pulp (yr 0-15)	4,990				
kMTCO2 Products in use - storage (yr 7.5)		78.37	78.37	8.15	8.15

kMTCO2 Landfill - storage (yr 7.5)		26.28	26.28	34.76	34.76
kMTCO2 Biomass energy - annual emission		-138.94	-138.94	-143.87	-143.87
Mbtus biomass energy (17.0 Mbtus per dry ton)	21,302,700				
Mwh biomass energy (11550 btu per Kwh)	1,844,390				
kMTCO2 displaced (950 lbs CO2 per Mwh) annual	795	53.03	53.03	53.03	53.03
kMTCO2 Other WP - emission (yr 7.5)		-102.19	-102.19	-145.86	-145.86
kMTCO2 Forest Sequestration (stand replacement) (yr 7.5)		66.01	66.01	512.27	512.27
kMTCO2 from logging residue		-57.32	-57.32	-177.61	-177.61
kMTCO2 from building materials substitution		28.21	28.21	28.21	28.21
Total GHG Savings		**-46.54**	**-46.54**	**169.08**	**169.08**
% to electricity generation	**60.0%**				
kMTCO2 Biomass energy - annual emission	14969	-997.92	-997.92	-997.92	-997.92
Mbtus biomass energy (17.0 Mbtus per dry ton)	153,000,000				
Mwh biomass energy (11550 btu per Kwh)	13,246,753				
kMTCO2 displaced (950 lbs CO2 per Mwh) annual	5,713	380.89	380.89	380.89	380.89
kMTCO2 Forest Sequestration (stand replacement) (yr 7.5)	-4,082	198.04	198.04	1536.80	1536.80
kMTCO2 Logging residue (avg yr 7.5)		-148.19	-148.19	-526.27	-526.27
Total GHG Savings		**-418.99**	**-418.99**	**919.77**	**919.77**
Baseline Harvest Total		**-518.45**	**-518.45**	**1274.33**	**1274.33**
Increased Rotation Length:					
kMTCO2 Ten yr growth increment per acre mature Maple/Spruce	0.0129				
kMTCO2 Ten yr growth increment for 100,000 acres per yr	1,288	966.24	966.24	1288.32	1288.32
Extended Rotation Total		**966.24**	**966.24**	**1288.32**	**1288.32**
Option Total GHG Savings (Net of Option - Baseline)		**1484.69**	**1484.69**	**13.99**	**13.99**

Biomass Electricity Feedstocks

Policy Description: This option is the simple addition of biomass energy sub options evaluated under forest management options, including: early commercial thins, more lighter harvests, and active management of stands for softwood reestablishment.

Incentives to make greater use forest products or forest waste as a fuel (in solid or gas form) or for co-firing with fossil fuels may reduce net emissions from power supply if it replaces higher emissions supply sources. In addition, removals of overstocked trees may improve forest health and reduce emissions from dead and dying trees.

BAU Policy/Program: Presently biomass is used for about 24 percent of the state's power generation, and is also a significant source of combined heat and power for wood products manufacturing facilities. Biomass is heavily used for home heating with wood stoves. (Reference Energy Supply and Waste Working Group for Updated Heat and Electric Power Demand for Biomass.)

Data Sources, Methods and Assumptions:

Same assumptions as used in forest management options that include biomass energy recapture. No dynamic effects of markets, all new supplies assumed to be additive to the market and not lost to export.

Other details are noted in the worksheet below.

Estimated GHG Savings and Costs:

The tables below summarize results of analysis for the proposed option using two time horizons:

Table 10.

Option Summary – Biomass Electricity Feedstocks	Levelized Annual GHG savings 2005-2020 (kMTCO2e)	$/MTCO2e
15 Yr Seq	**398.91**	L-H
95 Yr Seq	**398.91**	L-H

Table 11.

Biomass Electricity Feedstocks (Displacement Only)	**kMTCO2e**			
	2010	**2020**	**2010+**	**2020+**
Early commercial thin	272.73	272.73	272.73	272.73
More light harvests	101.84	101.84	101.84	101.84
Active softwood increase	24.35	24.35	24.35	24.35
Option Total GHG Savings	**398.91**	**398.91**	**398.91**	**398.91**

Key Uncertainties:

- Emissions displacement factors
- Forest sequestration rates
- Supply responses from competing fuel sources
- Demand responses from expanded supply options
- Price requirements for biomass to effectively enter the power market
- Future subsidies for biomass, including production tax credits, portfolio standards and other incentives

Increase Wood Products Use

Policy Description: This option is the simple addition of biomass to wood products sub options evaluated under forest management options, including: early commercial thins, more lighter harvests, and active management of stands for softwood reestablishment.

Durable wood products in construction of furnishings and buildings can sequester carbon for long periods of time depending on the type of harvesting practices and end use of the wood products. Wood products may be less energy-intensive in production and use than other materials.

BAU Policy/Program: None to date.

Data Sources, Methods and Assumptions:

Same assumptions as used in forest management options that include biomass to wood products. No dynamic effects of markets, all new supplies assumed to be additive to the market and not lost to export.

Other details are noted in the worksheet below.

Estimated GHG Savings and Costs:

The tables below summarize results of analysis for the proposed option using two time horizons:

Table 12.

Option Summary – Increased Wood Products Use	Levelized Annual GHG savings 2005-2020 (kMTCO2e)	$/MTCO2e
15 Yr Seq	**589.95**	L-H
95 Yr Seq	**217.87**	L-H

Table 13.

Expanded Use of Wood Products (Storage and Displacement)	**kMTCO2e**			
	2010	**2020**	**2010+**	**2020+**
Early commercial thin	339.97	339.97	122.83	122.83
Regular light harvests	209.34	209.34	79.60	79.60
Active softwood increase	40.64	40.64	15.45	15.45
Option Total GHG Savings	**589.95**	**589.95**	**217.87**	**217.87**

Key Uncertainties:

- Dynamic effects of wood product markets, including imports and exports
- Potential variation in Maine versus the Northeast