

MAINE FORESTRY CARBON CALCULATOR



The table below describes important components of full life cycle carbon accounting for forestry mitigation options and is followed by an accounting template for analysis of greenhouse gas reductions.

Variable	Description
Acres Treated	Specified by technical work group proposals as cumulative acreage, by forest type, over 15 years, and also translated into an average annual number
Harvest Method And Intensity	Specified by technical work group proposals
Regeneration Method And Intensity	Specified by technical work group proposals, or by default with biomass replacement assumed to occur completely over 58.2 years (the average age of forested stands in Maine as measured by FORCARB)
Percent Harvested Biomass Directed To/From Energy Recapture Vs. Wood Products	Specified by technical work group proposals or by default using HARVCARB averages based on a weighted average of Maine hardwood vs. softwood as measured

	by FORCARB
Percent Biomass Directed To/From Pulp Vs. Saw Timber	Specified by technical work group proposals or by default using HARVCARB averages based on a weighted average of Maine hardwood vs. softwood as measured by FORCARB
Disposition Rates Of Harvested Biomass To/From: <ul style="list-style-type: none"> • Wood Products • Landfill Storage • Waste Emissions • Energy Emissions 	HARVCARB regional data applied to Maine FORCARB data Specific rates vary by hardwood vs. softwood, and by saw timber vs. pulp A weighted average based on FORCARB results is used for average stands
Estimated Forest Carbon In Biomass	FORCARB as revised with Maine biomass equations from Wharton and Griffith (1998), component equations from Jenkins and others (2003) Soil carbon data from Amichev and Galbraith (2004) Species specific equation are used for restocking programs (e.g. Spruce) Carbon replacement of natural stands uses 2002 Maine FORCARB data
Volume And Decay Of Logging Residue	Estimates of non merchantable biomass volume from Turner (1993) as reported in Sampson and Hair (1995); intermediate harvest rates used Hardwoods: 36.4 percent of total harvested biomass left on site Softwoods: 35.4 percent of total harvested biomass left on site
Carbon Decay Rate Of Forest Floor And Coarse Woody Debris	Currently not quantified, but can be increased by intensive harvest levels and certain harvest methods – see Yanai (2003)
Mortality Rate Of Undisturbed Stands	Currently not quantified, but can be reduced by density management (thinning)

<p>Electric Power Displacement From Biomass Feedstocks</p>	<p>Marginal displacement rate of 950 pounds per MWh provided by Tellus (2004) using NEMS, roughly equal to natural gas combined cycle</p>
<p>GHG Displacement From Wood Products That Substitute For Building Materials</p>	<p>Data from Bowyer (2003) from CORIMM using case studies from Minneapolis and Atlanta</p> <p>Combined effect of steel and concrete energy displacement = 28.7 percent of biomass carbon in wood products that substitute</p>
<p>Sustainability Constraints</p>	<p>Long term biomass growth estimates assume sustained acreage levels, no unnatural disturbance, complete regeneration of harvested biomass</p> <p>Thinning, light and selective harvests assume minimal disturbance to forest floor and coarse woody debris</p>
<p>Levelized, Annual Greenhouse Gas Savings</p>	<p>Forestry options propose a cumulative number of acres be treated over a 15-year period. To calculate a representative (or average) year, the cumulative 15 year acreage is calculated as if it were treated in the middle year (2012.5) and divided by 15 to give average annual results. No ramp-up periods are specified.</p>
<p>Discounting</p>	<p>Emissions and emissions reductions are not discounted.</p> <p>Costs assume a 5 percent discount rate.</p>
<p>Time Periods</p>	<p><u>Method One:</u> 2005-2020, no benefits or costs counted beyond 2020</p> <p><u>Method Two:</u> 2005-2020, addition of benefits and costs that accrue by 2100 as a direct result of actions taken between 2005-2020. Biomass replacement of harvested stands is calculated over 58.2 years to match average stand age in Maine. HARVCARB wood products effects are</p>

	calculated to 2100. These are added to annual savings in 2005-2020 to show full life cycle effects.
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Forestry Carbon Accounting Template

Proposed Forestry Option: X	MTCO2e
Acres treated by forest type 2005-2020	Proposed
Cords removed/reserved per acre	Proposed
MTCO2e removed/reserved per acre (2.079 MT CO2e/cord)	>
Annual MTCO2e removed/reserved	>

% Harvested Biomass To/From Wood Products	Proposed
MTCO2 to/from saw timber (durable wood), or pulpwood	>
<i>Products in use</i> – carbon storage	+
<i>Landfill</i> – carbon storage	+
<i>Biomass energy</i> – carbon emission	-
<i>Displaced energy</i> – carbon reduction	+
<i>Other WP emission (processing residue)</i> – carbon emission	-
<i>Forest Sequestration</i> – carbon storage	+
<i>Logging residue</i> – carbon emission	-
<i>Building materials substitution</i> – carbon reduction	+
<i>Stand mortality</i> – carbon emission or reduction	+ -
<i>Forest floor/CWD decay</i> – carbon emission	+ -
Total GHG Savings	SUM

% Biomass To/From Energy Recapture	Proposed
<i>Biomass energy</i> – carbon emission	-
<i>Displaced energy</i> – carbon reduction	+
<i>Forest Sequestration</i> – carbon storage	+
<i>Logging residue</i> – carbon emission	-
<i>Stand mortality</i> – carbon emission or reduction	+ -
<i>Forest floor/CWD decay</i> – carbon emission	+ -
Total GHG Savings	SUM
Option Total GHG Savings	SUM

Proposed	= Policy Action Proposed By Technical Work Group
>	= Calculated From Proposal Based On Conversion Factors
+	= Reduced Flow Of Emissions Or Accounting Credit
-	= Increased Flow Of Emissions Or Accounting Debit
SUM	= Net Sum Of Accounts

HARVCARB

Disposition Of Harvested Wood Products For The Northeastern U.S. (Maine Adjusted)

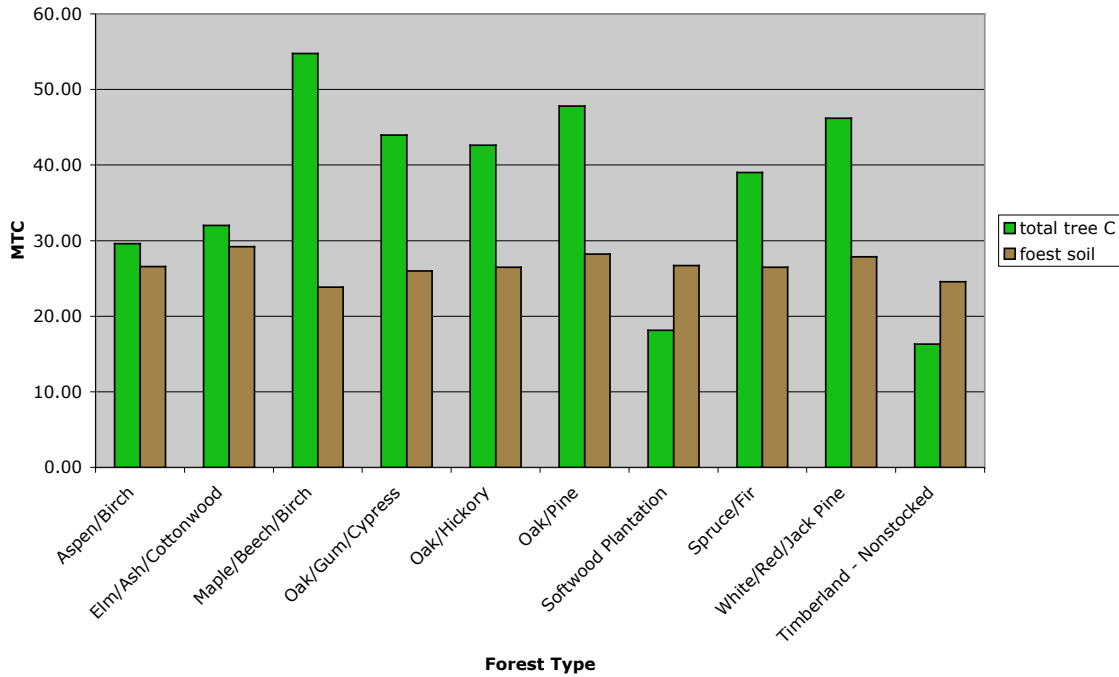
Biomass End Use	Years			
	0	7.5	60	100
Average Pulpwood				
Products	29.55%	23.56%	2.95%	2.45%
Landfills	0.00%	7.90%	13.00%	10.45%
Energy	41.35%	41.77%	43.25%	43.25%
Emissions	29.10%	30.72%	40.85%	43.85%
Average Saw timber				
Products	27.40%	23.77%	7.10%	5.55%
Landfills	0.00%	5.06%	11.85%	11.05%
Energy	42.95%	43.20%	44.35%	44.50%
Emissions	29.60%	30.45%	36.70%	38.95%
Statewide Average				
Products	28.48%	23.67%	5.03%	4.00%
Landfills	0.00%	6.48%	12.43%	10.75%
Energy	42.15%	42.48%	43.80%	43.88%
Emissions	29.35%	30.58%	38.78%	41.40%

Key Issues For Later Discussion, Potential Refinement:

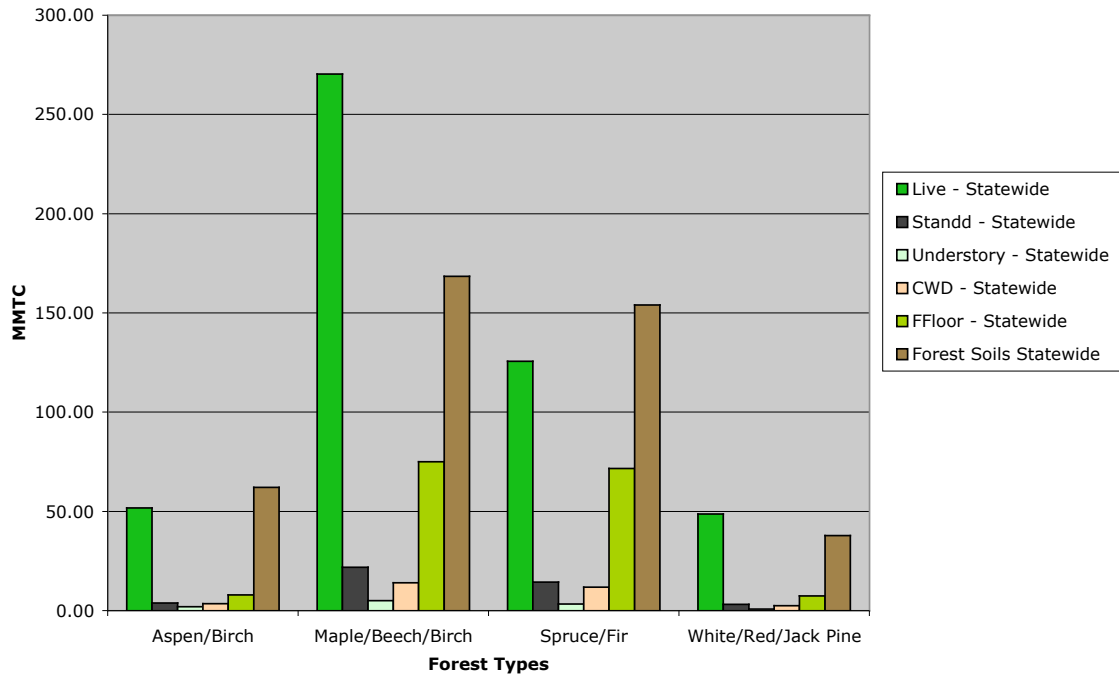
- Level of waste emissions (mill residue) estimated by HARVCARB (may be outdated and high)
- Harvest risk during biomass grow back period (analysis stops at age 58.2, average stand age in Maine, without interruption – may need risk adjustment; also need average age of harvests)
- Level and recovery rate of logging residue (may be outdated and low)
- Logging residue rate for pulp vs. saw timber (market based)
- Rate of natural stand mortality (may be lower with harvest)
- Rate of carbon release from forest floor and coarse woody debris (may be higher with certain harvest methods)
- Ecological risk (disease, storms, climate change – may need risk adjustment)

- Displacement rate of biomass power (no BGCC, natural gas prices?)
- Rate of wood products substitution for concrete and steel (market penetration?)
- Time value of assets (discounting of benefits same as costs?)

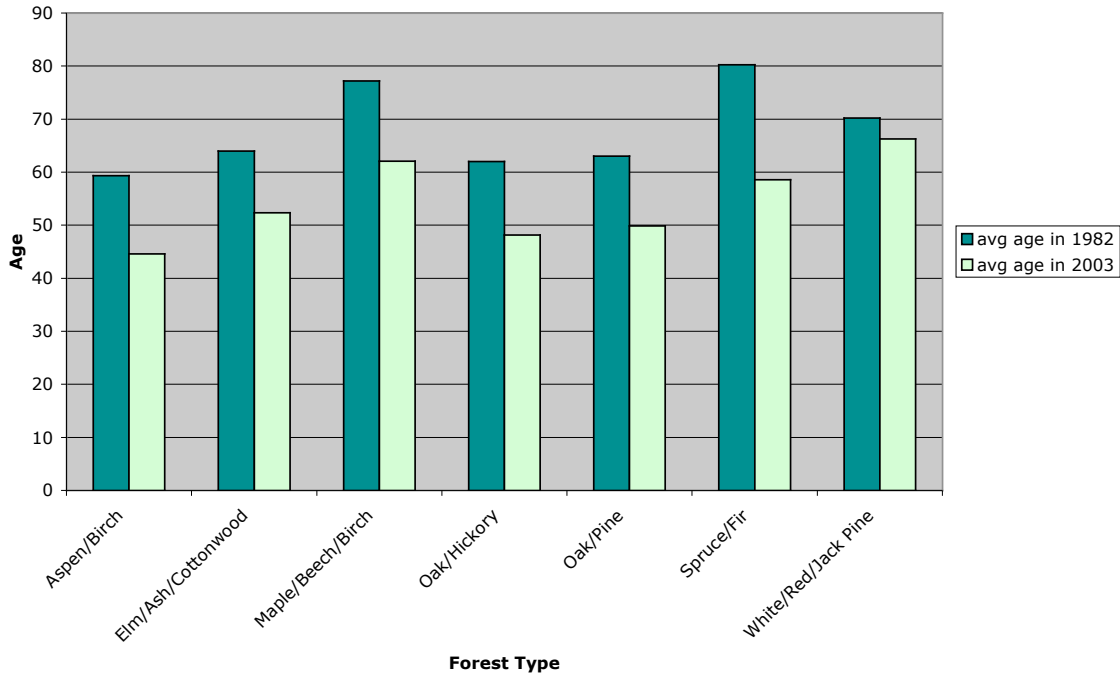
Maine Forests - MTC Per Acre By Forest Type



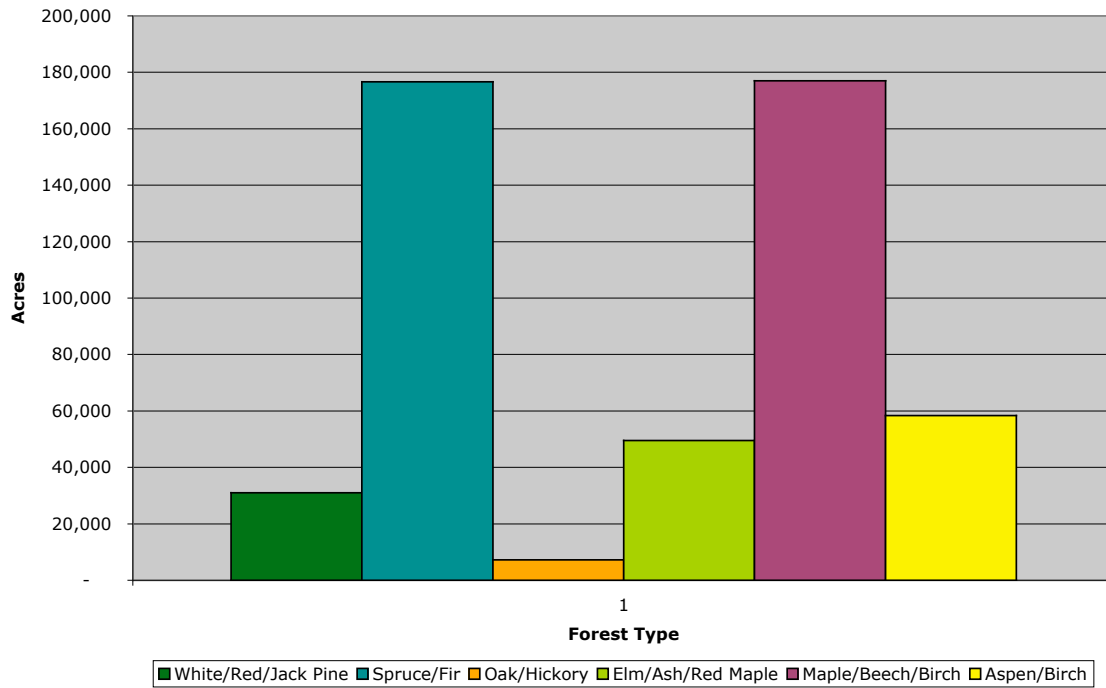
Maine Forest Carbon Totals By Forest Type



Maine Forest Stand Ages 1982 v. 2003 (wtd. Avg. 58.2)



Maine Poorly Stocked Forests 2003



Maine Forest Growth Rates

**R3. Northeast, Maple,
 Beech, Birch**

Age	Mean Volume	Mean Carbon Density						
		Live tree	Standing dead tree	Under-story	Down dead wood	Forest floor	Soil organic	Total nonsoil
Years	m3/ha	Metric tons carbon per hectare						
0	0	0	0	0.8	9.9	27.7	59.0	38
5	0	22.1	0.8	1.9	7.1	20.3	59.0	52
15	28	36.9	2.4	1.8	5	16.3	59.0	62
25	58	52.6	3.4	1.8	4.8	17.6	59.0	80
35	90	68.9	4.4	1.7	5.3	20.3	59.0	101
45	119	83.9	5.3	1.7	6.1	23	59.0	120
55	147	97.7	6	1.7	7	25.3	59.0	138
65	172	110.4	6.6	1.7	7.9	27.4	59.0	154
75	196	122	7	1.7	8.7	29.2	59.0	168
85	217	132.5	7.2	1.7	9.4	30.7	59.0	181
95	237	141.9	7.3	1.7	10.1	32	59.0	193
105	254	150.3	7.2	1.6	10.6	33.1	59.0	203
115	270	157.7	7.1	1.6	11.2	34.2	59.0	212
125	283	164.1	6.9	1.6	11.6	35.1	59.0	219
135	295	169.4	6.7	1.6	12	35.9	59.0	226
145	304	173.9	6.5	1.6	12.3	36.6	59.0	231
155	312	177.4	6.3	1.6	12.6	37.3	59.0	235
165	317	180	6.1	1.6	12.7	37.9	59.0	238
175	321	181.6	6	1.6	12.9	38.4	59.0	241

R6. Northeast, Spruce & Balsam Fir

Age	Mean Volume	Mean Carbon Density						
		Live tree	Standing dead tree	Under-story	Down dead wood	Forest floor	Soil organic	Total nonsoil
Years	m3/ha	Metric tons carbon per hectare						
0	0	0	0	0.6	9.6	33.7	65.4	44
5	0	19.3	1	1.6	7.7	23.6	65.4	53
15	11	24.3	3.1	1.5	5.6	18.6	65.4	53
25	29	31.9	4	1.5	4.9	20.7	65.4	63
35	52	41.5	5.1	1.5	4.9	24.2	65.4	77
45	77	52	6.2	1.4	5.4	27.7	65.4	93
55	103	62.6	7.1	1.4	6.1	30.7	65.4	108
65	126	72.2	7.8	1.4	6.9	33.3	65.4	122
75	149	81.3	8.2	1.3	7.6	35.5	65.4	134
85	171	89.9	8.6	1.3	8.4	37.4	65.4	146
95	192	97.9	8.7	1.3	9.1	39.1	65.4	156
105	211	105.4	8.8	1.3	9.7	40.6	65.4	166
115	230	112.3	8.8	1.3	10.4	41.9	65.4	175
125	247	118.9	8.7	1.3	11	43	65.4	183
135	264	125	8.6	1.3	11.5	44	65.4	190
145	279	130.7	8.4	1.3	12.1	45	65.4	197
155	294	136	8.2	1.3	12.5	45.8	65.4	204
165	310	142	7.9	1.3	13.1	46.6	65.4	211
175	326	147.7	7.6	1.2	13.6	47.3	65.4	217

Maine Tree Equation Data For FORCARB, As Revised

Summarized from the current Maine FIADB and FORCARB2
 "Wharton equations" where individual tree biomass equations from Wharton 1998
 (Northeastern Resource Bulletin NE-142) In Metric Tons Carbon Per Acre

Source of estimate:	Wharton equations	Wharton equations
Forest type	Live tree	Standing dead
Aspen/Birch	22.14	1.69
Elm/Ash/Cottonwood	17.62	2.40
Exotic Softwoods	11.99	0.09
Maple/Beech/Birch	38.32	3.11
Non-stocked	1.14	2.21
Oak/Gum/Cypress	29.72	2.04
Oak/Hickory	35.88	1.25
Oak/Pine	32.66	1.83
Spruce/Fir	21.59	2.47
White/Red/Jack Pine	35.83	2.40

Maine Forest Stand Age Comparison 1982 Vs. 2003

Type	Avg Age 1982	Avg Age 2003	Change	2003 Acres
Aspen/Birch	59	45	-15	2,341,937
Elm/Ash/Cottonwood	64	52	-12	407,184
Maple/Beech/Birch	77	62	-15	7,055,581
Oak/Hickory	62	48	-14	320,044
Oak/Pine	63	50	-13	334,384
Spruce/Fir	80	59	-22	5,819,039
White/Red/Jack Pine	70	66	-4	1,359,302
		Wtd Avg 58		17,637,470