Durable Wood Products

Initiative Summary:

This option seeks to enhance the use and lifetime of durable wood products. Durable products made from wood prolong the length of time forest carbon is stored and not emitted to the atmosphere. Wood products disposed of in landfills may store carbon for long periods under conditions that minimize decomposition, especially when methane gas is captured from landfills (carbon originally stored in wood products becomes methane during decomposition). Substituting products made from wood for products with higher embodied energy in building materials can reduce life-cycle GHG emissions from other products. This can be achieved through improvements in production efficiency, product substitution, expanded product lifetimes, and other practices. Increasing the efficiency of the manufacturing life cycle for wood products will enhance GHG benefits. To quantify the categories for disposition of carbon in harvested wood, the analysis relied on USDA USFS Northern Research Station GTR-NE-343, *Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States.*[1] This methodology demonstrates the eventual destination of carbon from harvested wood in five broad categories: products in use, in landfills, emitted with energy capture, emitted without energy capture, and emitted at harvest.

Goal:

Enhance management activities and timber sales to provide a reliable supply of timber for durable wood products through one of three scenarios:

- Scenario 1: Maintain a 2006 era harvest level of 1.12 Bbf/yr through 2020
- Scenario 2: Increase and maintain a statewide harvest level of 1.5 Bbf/yr through 2020
- Scenario 3: Maintain a harvest level on PA state forest land of 80 MMbf/yr through 2020

Implementation Period: 2013–2020

Quantification Methods:

Carbon sequestration in harvested wood products was calculated following guidelines published by USFS in GTR-NE-343 (Smith et al., 2006). Details on each step of the analysis can be found in the guidelines, following the methodology referred to as "Product-based estimates."

To quantify carbon stored in long-term products, forest harvest is used as a starting point. The methodology calculates the proportion of harvested wood that is diverted to each of four pools after 100 years: wood in use (i.e., building materials, furniture), wood in landfills (i.e., products that ere previously in use and have been discarded), wood burned for energy capture, and wood that has decayed or burned without energy capture. The wood that has not been burned or decayed (i.e., the wood in the "in use" or "landfill" pools) is assumed to remain stored 100 years after harvest. Most of the carbon stored in harvested wood products is emitted to the atmosphere over time. Because this method quantifies the amount of carbon in the current year's harvest that is expected to remain stored (or "in use") for a defined period of time, rather than accounting instantaneously for the carbon stored in various products each year, this 100-year approach likely underestimates the carbon stored over

[1] J.E. Smith et al. 2006. *Methods for Calculating Forest Ecosystem and Harvested Carbon with Standards Estimates for Forest Types of the United States.* GTR-NE-343. USFS Northern Research Station. (Also published as part of the DOE Voluntary GHG Reporting Program.)

the implementation period of this analysis. Despite its conservatism, the 100-year method has the advantage of being simple and consistent, and has compared well with other accounting methods (Miner, 2006).

The general methodology for all scenarios in this option followed these steps:

1. Find the proportion of harvested volume that is in softwood or hardwood logs.
2. For each of the species types (hardwood and softwood), find the proportion of harvested volume in sawtimber and pulpwood.
3. Calculate tons of carbon in harvested volume.
4. Project carbon stored in long-term storage pools 100 years after harvest for each scenario.

The approach for each of the above steps is described below.

1. The U.S. Census estimates that 1,121 MMbf were harvested from PA forests in 2006,[2] of which 1,055 MMbf (94%) was hardwood and 66 MMbf (6%) was softwood. These values were used directly for Scenario 1, and the total volume of hardwood and softwood harvested for Scenarios 2 and 3 was calculated assuming the same proportions.
2. The fraction of growing-stock volume in hardwood and softwood that occurs in each of the size classes (sawtimber and pulpwood) is given by GTR-NE-343. The distribution of harvest volume was assumed to follow the distribution of growing-stock volume presented in the guidelines. An average mix of 50% Maple-Beech-Birch and 50% Oak-Hickory forest was assumed (Table 1).

Table 1. Factors Used to Apportion Harvest Volume into Saw-timber and Pulpwood Classes for PA Forests

Forest Type	Fraction of Softwood Volume That Is Sawtimber	Pulpwood (1 – Sawtimber)	Fraction of Hardwood Volume That Is Sawtimber	Pulpwood (1 – Sawtimber)
Maple-Beech-Birch	0.604	0.396	0.526	0.474
Oak-Hickory	0.706	0.294	0.667	0.333
Average	**0.655**	**0.345**	**0.597**	**0.403**

Source: Table 4, USDA, GTR-NE-343.

3. The fractions above were used to determine the total harvest (MMbf) in each of the four categories (hardwood sawtimber, hardwood pulpwood, softwood sawtimber, softwood pulpwood) under each scenario. These values were converted to m^3, and then multiplied by average specific gravity (from Table 4, GTR-NE-343) to find total carbon in harvested volume (Table 2).

Table 2. Carbon in Harvested Volume Under Three Scenarios in PA

Wood Categories	tC in Harvested Volume (tC/year)		
	Scenario 1: Current Statewide Harvest (1.12 Bbfyr)	Scenario 2: 1.5 Bbf/yr	Scenario 3: 80 MMbf/yr on State Forest Land
Softwoods			
Sawtimber	19,306	25,833	1,378

[2] From U.S. Census: http://www.census.gov/industry/1/ma321t06.pdf.

Pulpwood	10,169	13,607	726
Hardwoods			
Sawtimber	390,555	522,598	20,056
Pulpwood	264,189	353,509	13,567
Total (MMt/year)	**0.684**	**0.916**	**0.036**

Bbf/yr = billion board feet per year; MMbf/yr = million board feet per year; MMt = million metric tons.

4. Methods described in GTR-NE-343 were used to calculate the proportions of harvested carbon that were stored in each of the four disposition categories after 100 years (Table 3). These proportions were used to calculate the proportion of harvested carbon remaining in use or in landfills after 100 years.

Table 3. Proportion of Harvested Carbon Remaining in Various Pools 100 Years After Harvest

Disposition Categories	Disposition Factor
Softwoods–Sawlogs	
In use	0.095
Landfill	0.223
Energy	0.338
Emitted w/o energy	0.344
Softwoods–Pulpwood	
In use	0.006
Landfill	0.084
Energy	0.51
Emitted w/o energy	0.4
Hardwoods–Sawlogs	
In use	0.035
Landfill	0.281
Energy	0.387
Emitted w/o energy	0.296
Hardwoods–Pulpwood	
In use	0.103
Landfill	0.158
Energy	0.336
Emitted w/o energy	0.403

Source: USDA, GTR-NE-343, Table 6.

Summary results for all three scenarios, describing the total carbon stored in each long-term pool 100 years after harvest, are listed in Table 4.

The cumulative results of the GHG savings from implementing these three scenarios over the full policy implementation period (2013–2020) are summarized in Table 5.

Table 4. Total Carbon Stored in Harvested Wood Products After 100 Years for Three Scenarios

Disposition Categories	Scenario 1: Current Statewide Harvest (tC/year)	Scenario 2: Increase Harvest to 1.5 Bbf (tC/year)	Scenario 3: Maintain Current State Forest Land Harvest (tC/year)
Softwoods-Sawlog			
In use	1,834.03	2,454.10	130.88
Landfill	4,305.16	5,760.69	307.23
Softwoods-Pulpwood			
In use	61.01	81.63	4.35
Landfill	854.16	1,142.95	60.95
Hardwoods-Sawlog			
In use	13,669.42	18,290.93	701.96
Landfill	109,745.96	146,850.09	5,635.76
Hardwoods-Pulpwood			
In use	27,211.50	36,411.47	1,397.38
Landfill	41,741.92	55,854.48	2,143.56
Total C Stored 100 years post harvest (tC/year)	**199,423.20**	**266,846.38**	**10,382.12**
Total C Stored 100 years post harvest ($MMtCO_2e$/year)	**0.731**	**0.978**	**0.038**

Bbf = billion board feet; tCe = metric tons of carbon; tCO_2e = million metric tons of carbon dioxide equivalent; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent.

Table 5. Cumulative Carbon Stored by Durable Wood Products Under Three Scenarios for Option F-5, 2013–2020

Scenarios	Annual GHG Savings ($MMtCO_2e$/year)	2013–2020 GHG Savings ($MMtCO_2e$)
Scenario 1: 2006 statewide harvest held constant (1.1 Bbf/yr)	0.73	5.85
Scenario 2: Statewide harvest increased to 1.5 billion board feet/year in 2013, maintained through 2020	0.98	7.83
Scenario 3: PA state forest harvest held constant (80 MMbf/yr)	0.04	0.30

Bbf/yr = billion board feet per year; MMbf/yr = million board feet per year; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent.

Economic Cost:

The cost of durable wood products production is dependent upon various factors, which make a cost analysis difficult and uncertain. An increase in carbon sequestration in durable wood products can be approached from various angles, including production efficiency, product substitution, expanded product lifetimes, and other practices. However, in this analysis, only an estimate of GHG savings was provided for scenarios that increase supply of high-quality wood for the manufacture of durable wood products.

The cost analysis for all three scenarios under this initiative is based on reforestation costs, inclusive of planting, tree and herbicide costs and the costs for fencing. The total estimated cost, based on DCNR data, is $716 per acre, after adjusting to 2010 dollars.

Additional costs might include development of marketing materials and program administration meant to promote the use of durable wood products. These costs are not currently included in the analysis. Table 6 shows the costs and cost-effectiveness for the three scenarios in 2020 and cumulatively (2013 through 2020).

Table 6. GHG Reductions, Costs and Cost-effectiveness 2020 and Cumulative

	2020			2013 - 2020		
	GHG Reductions (MMtCO2e)	Costs ($ Million)	Cost-effectiveness ($/tCO2e)	GHG Reductions (MMtCO2e)	Net Present Value ($ Million)	Cost-Effectiveness ($/tCO2e)
Scenario 1	0.73	-41.65	-56.96	5.85	-244.18	-41.74
Scenario 2	0.98	-55.78	-57.01	7.83	-327.03	-41.78
Scenario 3	0.04	-2.97	-78.15	0.30	-17.44	-57.27

Implementation Steps:

Increase use of locally-sourced and sustainably produced wood products and raise awareness of the associated value of carbon sequestration benefits. An example would include structural wood within certified green building efforts that serves as a lower-carbon alternative to steel and concrete. This can be facilitated by expanding the state's current green building efforts beyond the current LEED (Leadership in Energy and Environmental Design) standards to include a mandate for greater utilization of locally-sourced wood products and by encouraging local and state government procurement processes to utilize locally-sourced or PA-sourced wood as a substitute material.

The state would do well to:

- Work with LEED to ensure that the standards fully recognize the carbon value of using wood building materials
- Support revising green building standards to give more credit for the utilization of wood products (including revising state building standards)
- Promote state lead-by-example programs and promotions for greater utilization of locally and sustainably produced wood products in DCNR and other state construction projects
- Continue and enhance management activities and timber sales on state forestlands that provide a reliable supply of timber for production of wood products.

Potential Overlap: None

Data Sources:

- Sampson and Kamp. 2007. *The Nature Conservancy Conservation Partnership Agreement*. Part 2: "Recent Trends in Sinks and Sources of Carbon."
- J.E. Smith et al. 2006. *Methods for Calculating Forest Ecosystem and Harvested Carbon with Standards Estimates for Forest Types of the United States.* GTR-NE-343. USFS Northern Research Station. (Also published as part of the DOE Voluntary GHG Reporting Program..
- Miner, Reid. 2006. The 100-year Method for Forecasting Carbon Sequestration in Forest Products in Use. Mitigation and Adaptation Strategies for Global Change.
- USDA Northeastern FIA tables at: http://www.fs.fed.us/ne/fia//pa/.
- Lumber Production and Mill Stocks data from U.S. Census at: http://www.census.gov// /ma321t06.pdf.