Online Carbon Calculators from the Northern Research Station

FFACCTs Webinar
August 5, 2011

Three new tools for evaluating
forest product lifecycles and
carbon emissions

Mark Twery,
USDA Forest Service, Northern Research Station

Overview of Online Tools

- **ForGATE - A Forest-sector GHG Assessment Tool for Maine**
  - Chris Hennigar, John Gunn, David Maclean, Luke Amos-Binks, Ryan Cameron, Mark Twery

- **CarbonPlus Calculator**

- **FS CarbonPlus Calculator**
  - Mark Twery, Lynne Westphal, David Nowak, David Bloniarz, Dan Golub, Greg Ina, Lianghu Tian, Scott Maco, Charlie Lord, Charlie Schweik, Andrei Semenov

ForGATE

1. What exactly does the tool do?

   - It is a downloadable spreadsheet tool that does carbon accounting for the Northeast forest sector

2. What audience is it for?

   - Resource managers and others interested in life-cycle accounting for carbon in forest products

3. In what context should it be useful?

   - Evaluating alternative forest management strategies in light of their effects on GHGs and long-term carbon sequestration

forest management options

ID	Regime	Rotation target (yrs)	Eligibility	%BA removal	Residual target (ft2/acre)	FVS mean rotation period (yrs)	FVS min rotation period (yrs)	FVS max rotation period (yrs)3
0	Clearcut	>60	>2500 merch. ft^3	100%	-	85	60	190
1	Clearcut	>100	>2500 merch. ft^3	100%	-	104	100	190
2	Clearcut / Spruce Plantation					84	60	200
3a	Plant 1000 White Spruce	>70 years	>2500 merch. ft^3	100%				
3b	Thin from below	>40 years post plant	>1000 merch. ft^3	<=40%	>40			
3c	Clearcut	>30 years post thin	>2500 merch. ft^3	100%	-			
4	Partial Harvest (thin from above)	>30 years	>100 BA	<=30%	>70	39	30	190
5	Heavy Harvest (thin from above)	>50 years	>2500 merch. ft^3	>=60%	>40	56	30	190
6	Shelterwood					78	54	210
6a	1st Entry - thin from below	>70 years	>2500 merch. ft^3	<=60%	>60			
6b	2nd Entry - thin from above	10 years after 1st entry	na	100% of overstory	-			
7	Selection method					30	29	30
7a	Thin from below w/o species preference	>30	>2500 merch. ft^3	30% removal	>70 BA with Q dbh distribution			

input parameters

Saw mills	Grid electricity (kWh)	0.000393	0.000393	0.000393
	Fossil Fuel (GJ)	0.066700	0.066700	0.066700
Pulp & paper mills	Grid electricity (kWh)	0.000393	0.000393	0.000393
	Fossil Fuel (GJ)	0.064800	0.064800	0.064800
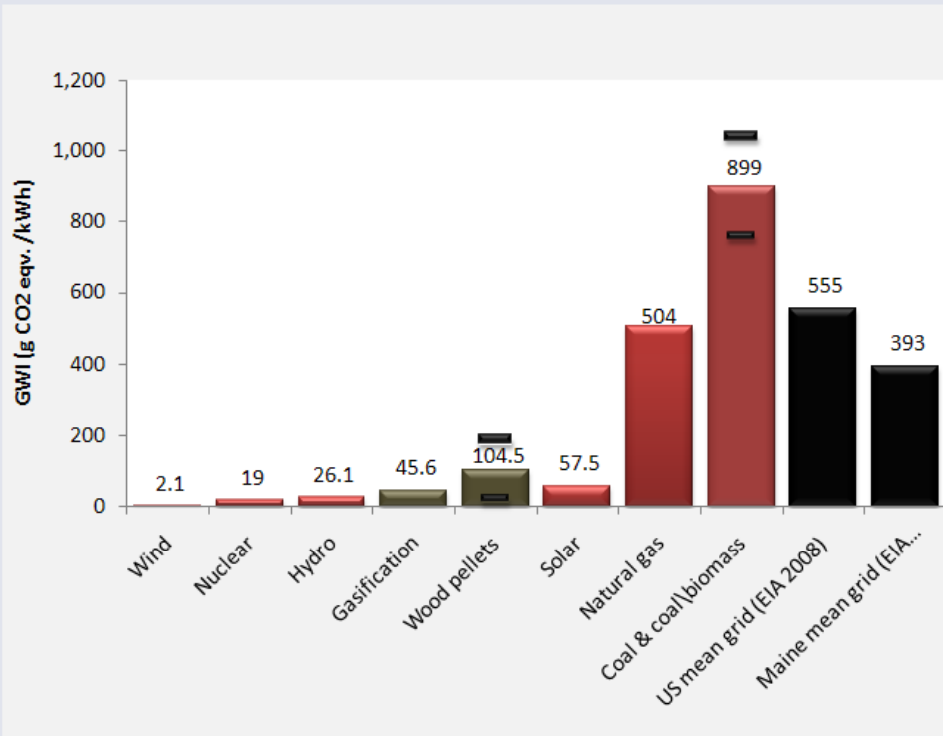
Wind	2	2.1	1.7	2.5
Nuclear	1	19	-	-
Hydro	1	26.1	-	-
Gasification	4	45.6	38.9	52.3
Wood pellets	1	104.5	21.2	187.7
Solar	3	57.5	43.7	71.2
Natural gas	1	504	-	-
Coal & coal\biomass	5	899	758	1,040
US mean grid (EIA 2008)		**555**		
Maine mean grid (EIA 2005)		**393**		

Proportion of Grid Electricity Generation/Consumption

Source	US (2008)	Maine (2005)
Coal	48.2%	2.0%
Petroleum	1.1%	19.4%
Natural Gas	21.4%	51.2%
Other Gases	0.3%	0.0%
Nuclear	19.6%	0.0%
Hydroelectric Conventional	6.0%	22.0%
Other Renewables	3.1%	30.0%
Other	0.3%	0.0%

U.S. Energy Information Administration http://www.eia.doe.gov/cneaf/elec
U.S. Dept. Energy - Maine http://apps1.eere.energy.gov/state

Life-cycle Fuel Emission Rates

Fuel type	Emissions (kg CO_2e/GJ)	
	Combustion	Upstream
Natural gas	56.2	10.5
Diesel fuel	74.3	15.1
Coal	95	8.6
Gasoline	69.3	20.1
Propane	63.1	9.4

harvest outputs

Forest Management Activities: Baseline Vs. Offset-Project

Forest Area Statistics

	Silviculture Regime	Baseline vs Offset Project Comparison		
		Baseline	Offset project	% change
Acres by regime	Reserve (no harvest)	20,000	120,000	500%
	Clearcut - target 60 yr	-	-	0%
	Clearcut - target 100yr	100,000	-	-100%
	Clearcut - spruce plantation	-	-	0%
	Partial harvest	2,000	2,000	0%
	Heavy harvest	-	-	0%
	Selection method	3,000	3,000	0%
	Shelterwood	15,000	15,000	0%
	Total	**140,000**	**140,000**	
Estimated acres cut/yr	Clearcut - target 60 yr	-	-	0%
	Clearcut - target 100yr	961.5	-	-100%
	Clearcut - spruce plantation	-	-	0%
	Partial harvest	51.3	51.3	0%
	Heavy harvest	-	-	0%
	Selection method	100.0	100	0%
	Shelterwood	192.3	192.3	0%
	Total	**1,305**	**344**	

Forest Long-run Sustained Yield Estimates

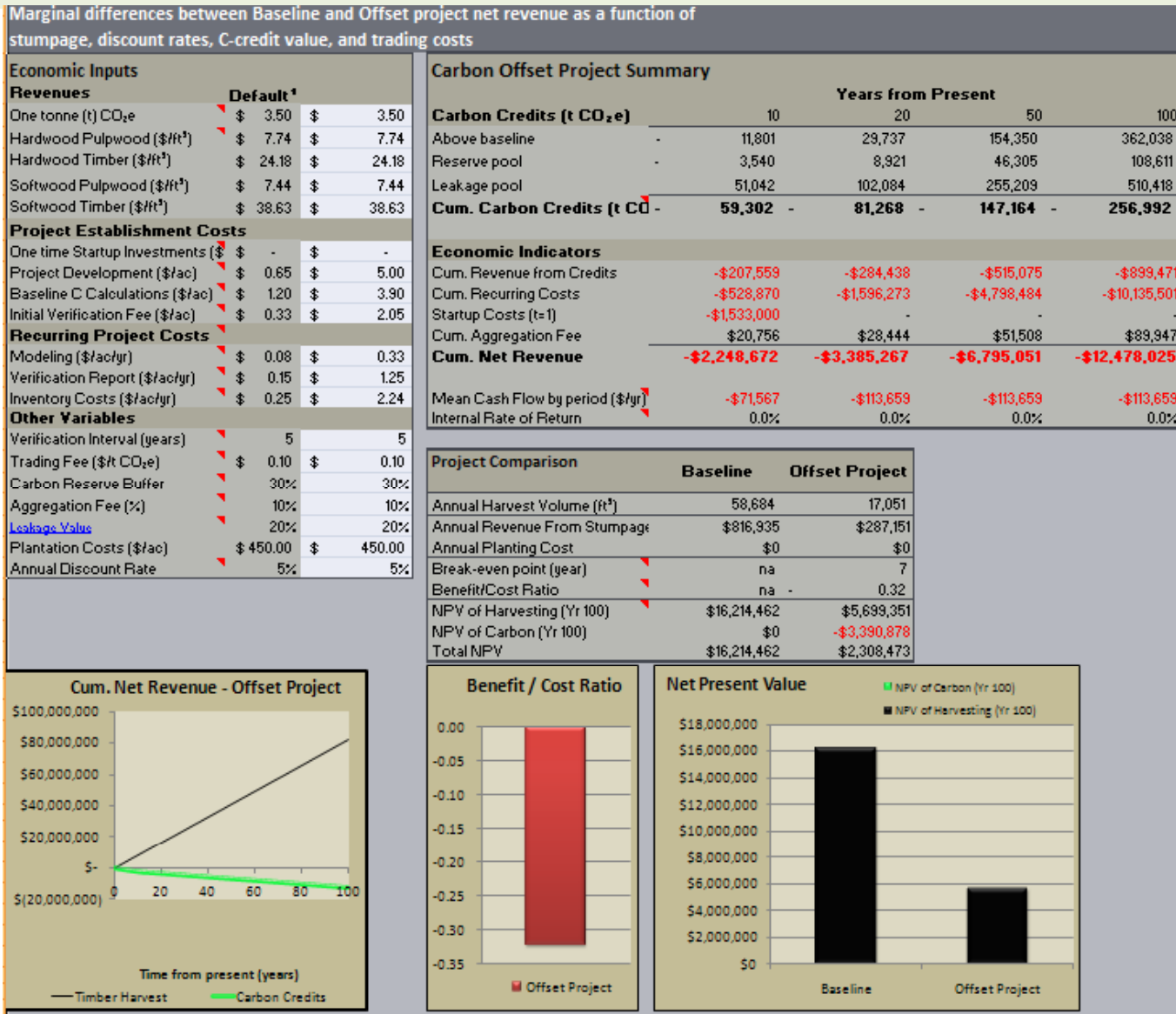|	m3/ha/yr	Baseline vs Offset Project Comparison		
		Baseline	Offset project	% change
By management	Clearcut - target 60 yr	-	-	0%
	Clearcut - target 100yr	1.247	-	-100%
	Clearcut - spruce plantation	-	-	0%
	Partial harvest	1.629	1.629	0%
	Heavy harvest	-	-	0%
	Selection method	0.980	0.980	0%
	Shelterwood	1.460	1.460	0%
	Mean for managed forest	**1.273**	**1.405**	
By product	Softwood saw timber	0.155	**0.869**	460%
	Softwood pulp log	0.108	**1.125**	940%
	Hardwood saw timber	0.189	**0.311**	64%
	Hardwood pulp log	0.821	**1.167**	42%
	Total	**1.273**	**3.472**	173%
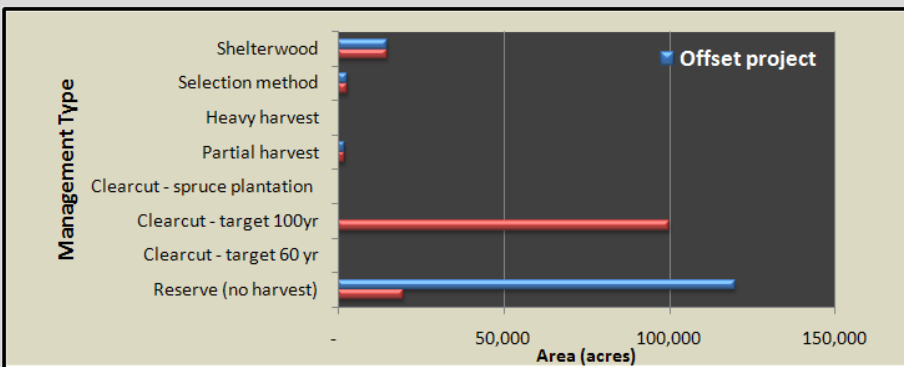
emissions scenarios

Forest-level cumulative GHG exchange (change in tonnes of CO₂e stored vs. emitted) over time as a function of forest, forest management, and forest-sector emission assumptions

Categor	Account	Include	\[Baseline\] 0	10	20	50	100	150	200	300		\[Offset−Baseline\] 10	20	50	100	150	200	300
Forest stocks	Above ground live	TRUE	15,644,538	15,892,106	16,139,673	16,882,376	18,120,214	19,358,053	19,358,053	19,358,053	○	789,596	1,579,191	3,947,979	7,895,957	11,843,936	11,843,936	11,843,936
	Below ground live	TRUE	4,371,397	4,378,190	4,384,983	4,405,363	4,439,329	4,473,295	4,473,295	4,473,295	○	96,399	192,798	481,995	963,990	1,445,985	1,445,985	1,445,985
	Live stock change from 2010 onward	-		254,361	508,722	1,271,804	2,543,608	3,815,412	3,815,412	3,815,412	○	885,995	1,771,989	4,429,973	8,859,947	13,289,920	13,289,920	13,289,920
	Standing dead wood	TRUE	994,920	1,073,081	1,151,241	1,385,723	1,776,526	2,167,330	2,167,330	2,167,330	◇	-45,235	-90,470	-226,176	-452,352	-678,527	-678,527	-678,527
	Down dead wood	TRUE	3,697,451	3,819,289	3,941,128	4,306,643	4,915,836	5,525,028	5,525,028	5,525,028	○	9,563	19,126	47,814	95,629	143,443	143,443	143,443
	Forest floor dead	TRUE	3,175,491	3,519,216	3,862,941	4,894,116	6,612,741	8,331,366	8,331,366	8,331,366	◇	-34,556	-69,111	-172,778	-345,555	-518,333	-518,333	-518,333
	Below ground dead	TRUE	479,588	631,189	782,790	1,237,592	1,995,596	2,753,600	2,753,600	2,753,600	◇	-94,326	-188,653	-471,632	-943,264	-1,414,896	-1,414,896	-1,414,896
	Dead stock change from 2010 onward			695,325	1,390,650	3,476,625	6,953,249	10,429,874	10,429,874	10,429,874	◇	-164,554	-329,108	-822,771	-1,645,542	-2,468,313	-2,468,313	-2,468,313
Product stocks	'Net' product stock change			628,184	1,192,769	2,886,525	5,709,451	8,532,377	11,355,304	13,209,835	◇	-549,957	-1,046,576	-2,536,431	-5,019,524	-7,502,617	-9,985,710	-11,561,389
Operation emissions	Operation emissions			359,729	719,458	1,798,646	3,597,292	5,395,939	7,194,585	10,791,877	○	-300,137	-600,273	-1,500,683	-3,001,365	-4,502,048	-6,002,731	-9,004,096
Avoided emissions	Emissions avoided			564,878	1,129,756	2,824,390	5,648,779	8,473,169	11,297,559	16,946,338	◇	-483,421	-966,842	-2,417,104	-4,834,208	-7,251,313	-9,668,417	-14,502,625
Cumulative net GHG emissions from yr. 0			-	-1,783,018	-3,502,438	-8,660,697	-17,257,795	-25,854,894	-29,703,563	-33,609,582		11,801	-29,737	-154,350	-362,038	-569,726	2,829,789	6,238,310

Legend:
- Baseline scenario - biomass stocks and emission inventory
- Carbon off-set project scenario - biomass stocks and emission inventory
- Carbon off-set project scenario MINUS baseline scenario

Y-axis: Cumulative Net GHG emissions (t CO₂ equiv.)
X-axis: Years from present
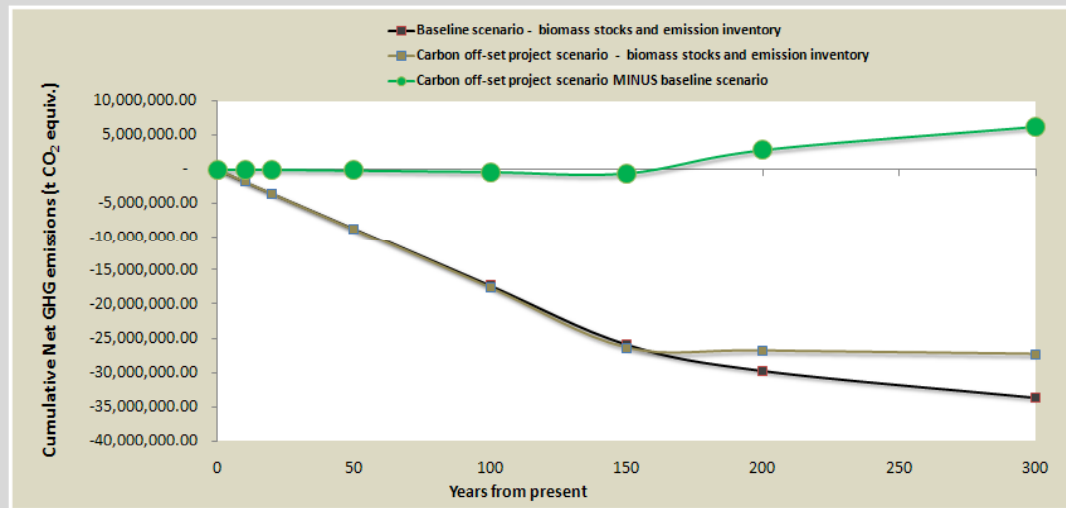
	Mean change	
	Off-set project minus baseline (tCO₂e/yr)	
Category	0-100 yrs	0-300 yrs

Preface | Forest | Silviculture | Forest Products | Forest Baseline | Forest Offset Project | Mill | Landfill | Avoided Emissions | Harvest Outputs | GHG Emissions | Economics

economic analyses

Marginal differences between Baseline and Offset project net revenue as a function of stumpage, discount rates, C-credit value, and trading costs

Economic Inputs

Revenues	Default[1]			
One tonne (t) CO_2e		$ 3.50	$	3.50
Hardwood Pulpwood ($/ft³)		$ 7.74	$	7.74
Hardwood Timber ($/ft³)		$ 24.18	$	24.18
Softwood Pulpwood ($/ft³)		$ 7.44	$	7.44
Softwood Timber ($/ft³)		$ 38.63	$	38.63

Project Establishment Costs

One time Startup Investments ($	$	-	$	-
Project Development ($/ac)	$	0.65	$	5.00
Baseline C Calculations ($/ac)	$	1.20	$	3.90
Initial Verification Fee ($/ac)	$	0.33	$	2.05

Recurring Project Costs

Modeling ($/ac/yr)	$	0.08	$	0.33
Verification Report ($/ac/yr)	$	0.15	$	1.25
Inventory Costs ($/ac/yr)	$	0.25	$	2.24

Other Variables

Verification Interval (years)	5	5
Trading Fee ($/t CO_2e)	$ 0.10	$ 0.10
Carbon Reserve Buffer	30%	30%
Aggregation Fee (%)	10%	10%
Leakage Value	20%	20%
Plantation Costs ($/ac)	$ 450.00	$ 450.00
Annual Discount Rate	5%	5%

Carbon Offset Project Summary

		Years from Present		
Carbon Credits (t CO_2e)	10	20	50	100
Above baseline	- 11,801	29,737	154,350	362,038
Reserve pool	- 3,540	8,921	46,305	108,611
Leakage pool	51,042	102,084	255,209	510,418
Cum. Carbon Credits (t CO -	59,302 -	81,268 -	147,164 -	256,992

Economic Indicators

Cum. Revenue from Credits	-$207,559	-$284,438	-$515,075	-$899,471
Cum. Recurring Costs	-$528,870	-$1,596,273	-$4,798,484	-$10,135,501
Startup Costs (t=1)	-$1,533,000	-	-	-
Cum. Aggregation Fee	$20,756	$28,444	$51,508	$89,947
Cum. Net Revenue	**-$2,248,672**	**-$3,385,267**	**-$6,795,051**	**-$12,478,025**
Mean Cash Flow by period ($/yr)	-$71,567	-$113,659	-$113,659	-$113,659
Internal Rate of Return	0.0%	0.0%	0.0%	0.0%

Project Comparison

	Baseline	Offset Project
Annual Harvest Volume (ft³)	58,684	17,051
Annual Revenue From Stumpage	$816,935	$287,151
Annual Planting Cost	$0	$0
Break-even point (year)	na	7
Benefit/Cost Ratio	na -	0.32
NPV of Harvesting (Yr 100)	$16,214,462	$5,699,351
NPV of Carbon (Yr 100)	$0	-$3,390,878
Total NPV	$16,214,462	$2,308,473

CarbonPlus Calculator

1. What exactly does the tool do?

   – Provides locally specific estimates of carbon emissions from household energy use

2. What audience is it for?

   – Individual citizens, businesses, and local agencies

3. In what context should it be useful?

   – Improving awareness of carbon emissions, affecting attitudes toward energy conservation, enabling local organizations to support action

CarbonPlus Calculator

CarbonPlus Calculator

Welcome to the CarbonPlus Calculator!

Are you curious about the size of your carbon footprint? Would you like to know the dollar value of your yearly emissions? Wouldn't it be great to offset your emissions locally and contribute to the beautification of your city in one step? Well you can do all of these things and more by using this exciting new tool.

Select Location ▾

Please choose the city in which you live so that the calculator can accurately determine your emissions footprint. If cookies are enabled in your browser, the next time you come to the site, you will automatically be taken back to the city you choose today with all of your previously entered data saved and intact. Click here for instructions on how to enable cookies in your browser. We do not store any personally identifiable information on this web site.

CarbonPlus household data

CarbonPlus "Pledge"

ERASE YOUR TRACE
Philadelphia's CarbonPlus Calculator
and Offset Project
Home

Print Friendly   Clear All Input

I Want To Estimate My CO₂ Emissions For:

My House	My Car Travel	My Air Travel
$93	$0	$0

My Total Emissions:

CO₂ tons/yr   4.650

Value: $93

ACT LOCALLY!
REDUCE My Emissions
OFFSET My Emissions
Take The Carbon Pledge

Philadelphia Carbon Pledge

By signing this pledge, you are committing to the following emission reduction activities. These activities will reduce your total CO₂ emissions and you have the option (if you haven't already done so) of offsetting the remainder of your emissions with the Philadelphia Carbon*Plus* Calculator.

I pledge to take these 10 greenhouse gas reducing actions:

- ☐ Replace incandescent light bulbs with compact fluorescent bulbs.
- ☐ Use warm or cold water instead of hot for laundry.
- ☐ Plan car-free days. Walk, ride a bike or take public transportation.
- ☐ Plant a tree.
- ☐ Turn the thermostat down in the winter and up in the summer, especially at night and while away from home.
- ☐ Recycle as much as possible, including newspapers, glass and plastic containers, and aluminum and steel cans.
- ☐ Buy locally grown food when available.
- ☐ Unplug electronic equipment when not in use.
- ☐ Re-use paper and plastic bags; or better yet, bring a re-usable bag to stores.
- ☐ Spread the word! Tell family and friends about climate action.

FS CarbonPlus Calculator

1. What exactly does the tool do?

   – Enables locally customized estimations of carbon emissions from office operations

2. What audience is it for?

   – Forest Service staff charged with monitoring operations efficiencies

3. In what context should it be useful?

   – Analyzing factors and influencing potential changes in carbon emissions inside the FS

US FOREST SERVICE
100 Years of Caring for the land and serving people

CarbonPlus Calculator

Print Friendly   Clear All Input   Clear Page Input   Save   Retrieve

CO$_{2e}$ Emissions For: SO, Green Mountain and Finger Lakes

Offices	Vehicles	Air Travel	Equipment
0 Mg	0 Mg	0 Mg	0 Mg

Total Emissions: CO$_{2e}$ Metric Tons (Mg)/Year: 0   **Value:** $0

Help create a greener Forest Service!

Calculate your Office emissions

Calculate your Vehicle emissions

We all contribute to global warming every day. The Forest Service CarbonPlus Calculator is a tool to help you calculate how much carbon dioxide you are emitting annually.

Calculate your Air Travel emissions

More information

Calculate your Equipment emissions

Forest Service CarbonPlus Calculator. Acknowledgments

Northern RESEARCH STATION

DAVEY

FS CarbonPlus

FS CarbonPlus