



Ministry of
Forests, Lands and
Natural Resource Operations

A CARBON CALCULATOR FOR HARVESTED WOOD PRODUCTS USER'S MANUAL

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This user's manual describes a spreadsheet tool that can be used by resource professionals, architects, designers, and people interested in carbon offset projects to determine carbon emissions generated from harvested wood products.

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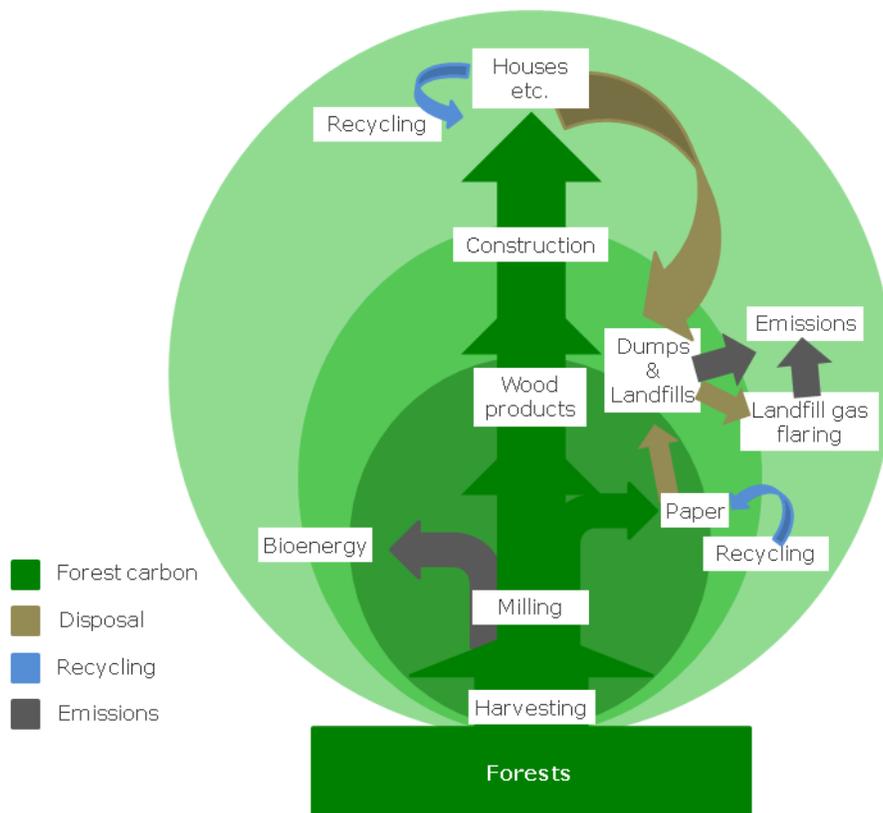


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INTRODUCTION

WHAT IS A CARBON CALCULATOR FOR HARVESTED WOOD

Since 2010, when it became mandatory for the public sector in British Columbia to be carbon-neutral, interest in determining emission levels from the use of various commodities, including wood products, has been growing. The B.C. government regulates carbon management through the Greenhouse Gas Reductions Targets Act, the BC Emissions Offset Regulation, and the Forest Carbon Offset Protocol.

This carbon calculator is simple spreadsheet that you can use to determine the carbon footprint – emissions - of your wood products (logs, lumber, plywood, or panels). In addition to the emissions of carbon, you can see the storage of carbon in different products over time.

The tool uses data generated by the BC Harvested Wood Products, Version 1 model. The model was developed by Caren Dymond of the B.C. Ministry of Forests, Lands, and Natural Resource Operations in collaboration with Werner Kurz, Michael Magnan, and Mark Hafer of the Canadian Forest Service.

New in the 2016 version: On the Life Cycle page, you can see additional calculations that would be part of a Life Cycle Assessment, such as the fossil fuel emissions and the emissions avoided by using wood instead of other materials.

INTENDED USES

We expect that the calculator spreadsheet will be used by resource professionals, architects, designers, and people interested in carbon offset projects to estimate the carbon footprint associated with the wood products they use in North America¹. It automatically converts a variety of input parameters to tonnes of carbon dioxide equivalent, and will provide you with information on total carbon storage and emissions based on how wood is used (e.g. single family homes), and how carbon levels change over time

The calculator is meant to help you quickly estimate carbon emissions with minimal input on your part. This user's manual provides detailed instructions on how to use the calculator and interpret results. We have also provided definitions and explanatory notes within the calculator to help minimize the need to refer back to the manual.

The calculator will work best with larger projects such as those using more than 10 m³ roundwood, 1000 bf of lumber, 50 sheets of plywood, or panels.

Definitions For Some Terms in This Document

Biogenic Manufacturing Emissions -

Emissions released from the burning of excess wood e.g. sawdust in a lumber mill.

Carbon Pools –

Categories where wood-sourced carbon is stored for years: homes, commercial buildings, furniture, shipping pallets, repairs to homes and paper (these are collectively referred to as end-use products)

CO₂e - equivalent tonnes of carbon dioxide (e.g. 1 t of C is = to 3.667 t of CO₂)

Decay rate – the rate of conversion from storage in a carbon pool to an emission

Emission – the amount of carbon converted from wood fibers to a gas and released to the atmosphere because of decay or combustion

Roundwood - Harvested logs that have been delivered to a milling facility

Secondary Wood Products - Lumber, plywood, oriented strand board (OSB), medium density fiberboard (MDF), and pulp produced from roundwood

Storage – the retention in a carbon pool

Retirement rate – the rate of loss from a end-use carbon pool to disposal based on a products life-expectancy.

tC - metric tonnes of elemental carbon, in wood this may be within cellulose, lignin, carbohydrates or other complex molecules

¹ Disclaimer: The tool is meant to provide an estimate of carbon retention and emissions based on published research available in 2010. The user is cautioned to consider that data relationships and calculations may be different than when the tool was developed.

Carbon Calculator For Wood Products

More detailed information on the model and data supporting the calculator, including life cycle processes, wood product distribution, retirement statistics, and data sources, can be found in: Dymond, 2012. Forest carbon in North America: annual storage and emissions from British Columbia's harvest, 1965-2065. Carbon Balance and Management 7/8.

WHAT'S NEW

Changes between 2013 and 2016 versions of the Carbon Calculator for Harvested Wood Products

- Additional functionality to select different global warming potential multiplier for methane provided by the Intergovernmental Panel on Climate Change in recent reports.
- More detail provided in the Quick Results on storage and sources of emissions.
- Roundwood, Plywood, & OSB/MDF, total 100 year emissions are lower by <1% due error in accounting.
- Lumber total 100 year emissions are lower by 12% due error in accounting.
- Additional Calculations tab provides advanced users additional information on:
 - Estimates of the carbon footprint using a method similar to Life Cycle Assessments which include fossil fuel emissions.
 - Estimates of the benefit to the atmosphere if wood products are used instead of metal or concrete building products or fossil fuels.

INTRODUCTION TO THE WOOD PRODUCT LIFE

The flow of wood in the calculator starts with logs delivered to a mill, or with secondary wood products such as lumber and plywood that have been produced in a mill. If you input secondary wood products, the emissions associated with creating those products from whole logs are estimated and added onto the carbon footprint calculation. Based on statistics on wood use and retirement for North America, it tracks which carbon pools the wood ends up in, how long it persists until retirement, and how carbon contained in the wood is emitted back to the atmosphere through decay or combustion (see figure one).

For example, in 2010, 84% of logs harvested went to sawmills and of this, 47% was actually turned into lumber, of which 25% went into single family homes. As time passes, these single family homes are renovated, and some of the original material is sent to a landfill where it decays returning some of the wood in the atmosphere as carbon dioxide. At all of the life cycle stages for wood & paper products; fossil fuels are used in harvesting, transportation to mills, manufacturing, transportation to markets, and disposal.

We provide the storage and emissions in landfills and dumps because there are differences about how this material is treated in some carbon offset protocols. In some cases it is considered to be a valid form of carbon storage, and in other cases it isn't.

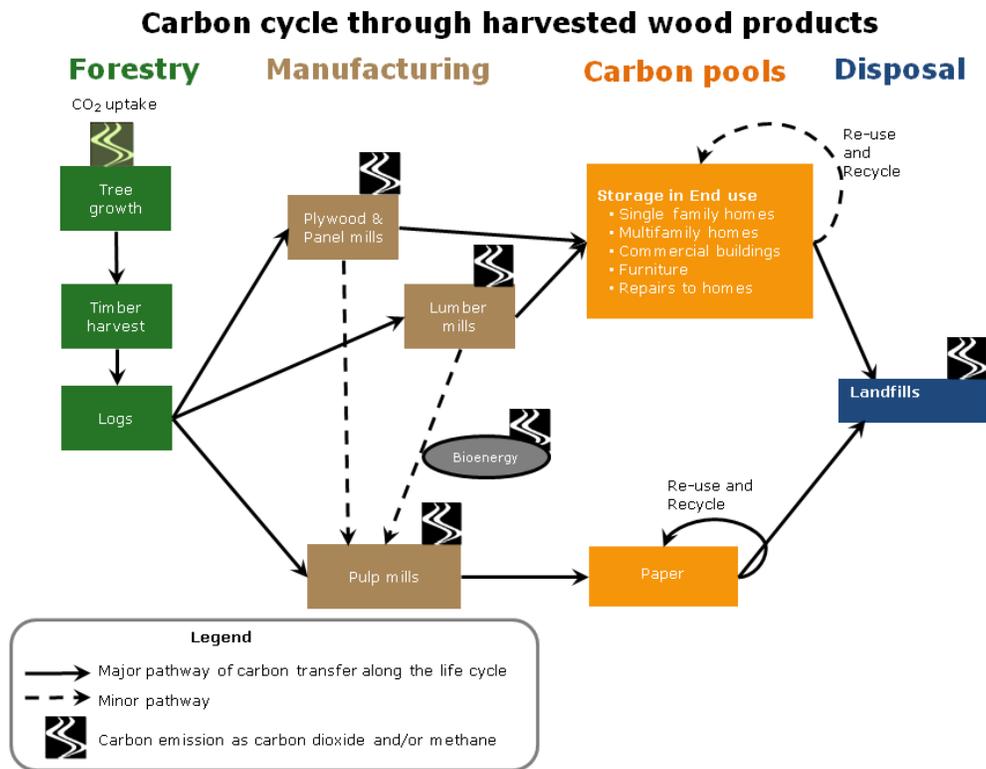


Figure 1. The flow of wood & paper products through different life cycle stages.

USING THE SPREADSHEET TOOL

The calculator comprises two main sheets in a Microsoft Excel workbook; plus some additional sheets for more information and some Visual Basic for Applications that helps with formatting. The three main sheets in the workbook are:

- the Calculator sheet
- a Graphs sheet
- the Life Cycle sheet

You will need to allow macros for the calculator to work.

Except for the data entry cells (indicated by yellow fill) on the Calculator sheet, the spreadsheets are locked and protected so the results remain consistent with the published model. To obtain additional access please contact us.

THE INSTRUCTION

We provided an instruction sheet in the workbook to help make the tool more user-friendly. The instruction sheet contains information on the origin and purpose of the tool, basic information on how to use it, and a User's Agreement which specifies the terms and conditions under which you can use the tool. It also contains a copy of the wood product life cycle (shown above in figure 1) which is intended to help you visualize how the whole process fits together.

Carbon Calculator For Wood Products

User Agreement

We also included a User Agreement in the calculator, reproduced here, to make sure you understand the limitations of liability associated with its use.

1. Copyright for the **Calculator & Results sheets** and User's Manual Reside with the Crown. The copyright permits unrestricted use, distribution, and reproduction, provided that the original work is cited as: Dymond, C.C. 2012. Forest carbon in North America: annual storage and emissions from British Columbia's harvest, 1965-2065. *Carbon Balance and Management* 7/8.
2. Any changes to the default parameters and relationships must be clearly listed in any communication of results. Furthermore, the results cannot be said to have come from the model BC-HWPv1 or BC Harvested Wood Products, Version 1.
3. While this workbook and associated User's Manual have been developed carefully and with the best information available at the time, the individuals and organizations involved in their development do not, either collectively or individually, warrant their use for any purpose nor make any representations regarding their fitness for any use or purpose whatsoever. Each user agrees to use them at their own risk and under no circumstances will the individuals or organizations involved in their development be liable for any damages whatsoever arising from the use of these materials, or from an inability to use them.

How to Use This Calculator

The instruction sheet in the calculator also includes an abbreviated description of basic steps you need to know to use the calculator. You can quickly refer to this while you have the workbook open, or can review the more detailed information in this User's Manual.

CALCULATOR SHEET

The calculator sheet is where you enter your information about the roundwood or secondary wood products you are using. You enter data in cells with yellow fill (see the example below). All cells except the cells with yellow fill are protected and cannot be changed.

Project Description

In the Project description section, enter text to help describe the project. Information you include in this section will serve as a header for the Results sheet. If you enter more than about 90 characters (including blanks) in the User Identification or Project Identification sections, you will not be able to see them all. In the project description section you can use up to about 400 characters. It is also OK to leave this section blank.

Project Description	
User Identification:	Jane Doe, Carbon Management Inc User name and affiliation
Project Identification:	Building material sales by Green Buildings Corp Short name/title for the project
Project Description:	An analysis of the carbon implications generated from sales of building materials by Green Buildings Corporation's Vancouver outlets Provide a description of the project (e.g. location, size, purpose)

Carbon Calculator For Wood Products

Input Data

This section of the Calculator sheet is where you enter data on the type and amount of product that is being used in your project. Storage and emissions will be reported for all products combined. Note that engineered wood products will need to be entered as ft³ or m³ of lumber (or bf for I-joists).

Input Data					
Input Product:	Roundwood	Lumber	Plywood	OSB	MDF
Input Metric:	tC	tC	sf		
	Select the correct input metric from the drop down list				
Input Type		SPF	SPF		
	Select the correct input type from the drop down list				
Thickness			3/8		
	Select the correct panel thickness from the drop down list (inches)				
Input Quantity:		0	1,000,000		
	Enter the quantity of input product being used in the project				

The first step is to select the correct **input metric** (unit of measurement) for each input product you have selected. Definitions for each unit of measurement are included in the cells with blue fill adjacent to the Project Description section.

Definitions and Acronyms	
Roundwood	Harvested sawlogs or pulplogs that have been delivered to a milling facility.
Products	Lumber, plywood, oriented strand board (OSB), medium density fibreboard (MDF), and paper produced from roundwood.
End Use	Homes, commercial buildings, manufactured products like furniture, shipping products, repairs. Also referred to as a carbon pool.
Paper	Includes all paper products. Paper is both a secondary wood product and a separate carbon pool.
tC	Mass of elemental carbon in metric tonnes.
CO ₂ e	Equivalent tonnes of carbon dioxide (e.g. 1 tonne of C is equivalent to 3.667 tonnes of CO ₂).
ft ³	Volume in cubic feet. A unit of measure for roundwood.
m ³	Volume in cubic metres. A unit of measure for roundwood and lumber.
bf	Board foot - a unit measure for sawn timber (also denoted as fbm) that is 12 inches long by 12 inches wide by 1 inch thick.
tonnes	Metric tonnes (1000kg)
biogenic manufacturing emissions	Emissions released from the burning of excess wood e.g. sawdust in a lumber mill.

The calculator allows you to choose between tC (tonnes of carbon) or another unit of measure that is commonly used for that product (e.g. for lumber its bf or m³). To select the correct unit, just click on the yellow cell under the chosen product and a drop down box will appear. Click on the correct unit within the drop down box. Very different results will be obtained with different **input metrics**. The calculator automatically converts the unit of measure you have chosen to tonnes of carbon dioxide equivalent and this is what is reported in the Quick Results section.

If you know how much wood product you have, but the information is in an input metric that is not available in the drop down boxes, you will need to convert it to one of those available. A good source for such information is Briggs, D.G. 1994. Forest products measurements and conversion factors: with special emphasis on the U.S. Pacific Northwest. Institute of Forest Resources. available at http://www.ruraltech.org/projects/conversions/briggs_conversions/briggs_book.asp.

After clicking on the correct metric either press the Enter key on your keyboard or click on a new cell. If you want to change your selection, just click on the correct input cell again and choose a different metric.

The next step is to choose the **input type** that you are using. For roundwood, lumber, plywood, OSB or MDF this will involve selecting the appropriate species of wood. With roundwood and lumber you have a choice of SPF (spruce pine fir mix), cedar, or hardwood. In B.C., spruce, pine, and true fir lumber are normally not separated. Because cedar has such a different density, and is usually sold as a separate

Carbon Calculator For Wood Products

product, the calculator provides it as a separate choice. The same is true of hardwoods². If your product is primarily hemlock or hembol you should select SPF. For plywood the only option for input type is SPF. For OSB or MDF you can choose SPF or Hardwood.

With plywood and OSB/MDF, before you enter information on the quantity of product you are using, you will need to choose the **thickness** that you are using in inches.

The options available in the drop down boxes include thicknesses that are commonly used for these products (e.g. 1/2"). If your project involves more than one thickness you will need to first convert the different thicknesses to a 3/8" basis (a standard thickness used in specifying quantities of plywood and panels), and then choose 3/8" in the drop down box. You can do this by dividing the thickness of your product (expressed as decimal) by 0.375, or you can look the value up in the thickness tables in the Conversions and Parameters sheet. Once you have converted different thicknesses to the 3/8" basis you will need to add the quantities for those products together and enter this value in the input quantity cell. Here is an example of how the unit conversion calculation works:

Original Dimension	Plywood 1/2"	Plywood 3/4"
3/8" Basis	$0.5/0.375 = 1.333$	$0.75/0.375 = 2.666$
Quantity	1500 sf	1000 sf
Input Quantity Used In The Calculator	$(1.333*1500)+(2.666*1000) = 4665$ sf	

No option has been provided to enter metric thicknesses since these products are not normally sold in metric dimensions in BC. If you only have quantities in metric dimensions, you can use the conversion factors in the Conversions and Parameters sheet. Note also that, although there are different thicknesses for lumber, an option to enter lumber in different thicknesses has not been provided. You must convert different thickness and width dimensions to board feet, m³, or tC.

The last step under Input Data is to specify the **quantity of material** being used in the project. Ensure that the correct input metric and type have been selected.

If you decide to **remove** a product from the project, just enter zero (0) as the quantity.

After clicking on the correct metric either press the Enter key on your keyboard or click on a new cell. If you want to change your selection, just click on the correct input cell again and choose a different metric.

Finally, you can select a value for the global warming potential of methane. The default in BC is "GWP over 100 yrs from IPCC 1995" or 21. This value is used to convert methane to the equivalent amount in carbon dioxide. Different protocols and standards use different values as the science changes or because they are reflecting different time spans.

Global Warming Potential of Methane

BC Default is GWP over 100 yrs from IPCC 1995

GWP over 100 yrs from IPCC 1995

21

² When hardwood is selected as input type for roundwood, the calculator uses trembling aspen density in converting m³ to tonnes of CO₂e. When hardwood is selected as input type for lumber or OSB/MDF, the calculator uses paper birch density in converting m³ to tonnes of CO₂e.

Carbon Calculator For Wood Products

Quick Results

In the Calculator sheet, we have included a Quick Results section. This simply summarizes total wood and paper carbon emissions and storage at year 0 (i.e. year of harvest or manufacturing) and at the end of 100 years. It was provided to allow you to quickly get the carbon footprint (emissions) without having to go to another sheet.

You can make a change to any input and immediately see how the 100-year carbon storage and emissions change. It is important to note that you must press the Enter key on your keyboard or click on a new cell before the Quick Results section (and Results sheet) will be updated.

Quick Results (tonnes of CO₂e)		
Storage		
Carbon stored in roundwood at year 0		2,981
Carbon stored in products at year 0		1,956
Carbon stored in products at year 100		615
Carbon stored in landfills and dumps at year 100		864
Total storage at year 100		1,479
Emissions		
Biogenic manufacturing emissions at year 0		1,025
Total carbon emissions from wood by year 100		1,564
Range of Carbon Emissions Over 100 Years	1,283	1,987

GRAPHS

In this section of the calculator, data on yearly change in carbon stocks are used to create some charts that portray carbon the decline in wood storage and increasing emissions over time. Charts generated in this version of the calculator include:

- Carbon stored as the wood and paper are being used (single family homes, multi-family homes, etc).
- Carbon in wood and paper stored in-use and in landfills
- Cumulative emissions from all life cycle stages of the wood and paper products including manufacturing and disposal. This graph does not include any fossil fuel emissions

These graphs are generated automatically and use the entire 100 year data set. They are password protected and cannot be changed. If you want to create your own graphs you will need to create a new sheet and then copy data for it from the Results sheet.

Carbon Calculator For Wood Products

RESULTS

In the Results sheet there are tabular results. Results are produced by the calculator for each carbon in-use pool as well as for all carbon pools combined, including and excluding landfill/dump storage. Results tables are available in annual, 5-year and decadal intervals.

The results tables show **cumulative** in CO₂e over time (reported as equivalent tonnes of CO₂). For example, in the table below, the amount of carbon stored dropped from 1,910 to 1,479 tonnes over a 100 year period. During this same period, cumulative emissions from **all** carbon pools increased from 1,074 to 1,564 tonnes.

It is important to note that these results are based on regional statistics from Canadian and U.S. sources regarding the distribution, retention, and retirement of wood products and may not exactly reflect retention or emissions in your project. This page does not include fossil fuel emissions.

Product Retention and Emissions (in Tonnes of CO ₂)													
Year No.	Single Family Homes	Multi-Family Homes	Commercial Buildings	Manuf. Prod.s (furniture etc)	Paper	Shipping	Repairs	Other	CO ₂ e Storage in Products (exclude landfills)	CO ₂ e Storage In Landfills and Dumps	CO ₂ e Emissions from Landfill and Dumps	CO ₂ e Total Storage	CO ₂ e Total Emissions
10	748	54	162	116	0	2	405	159	1647	263	49	1910	1074
20	693	49	148	97	0	0	322	149	1457	399	107	1856	1132
30	641	45	135	81	0	0	255	139	1296	505	169	1801	1194
40	594	41	123	67	0	0	203	129	1156	590	231	1746	1256
50	550	37	112	56	0	0	161	118	1034	659	292	1693	1317
60	509	34	102	47	0	0	128	108	928	715	349	1643	1374
70	471	31	93	39	0	0	101	99	834	762	403	1596	1428
80	436	28	85	32	0	0	80	90	752	802	452	1554	1477
90	404	26	77	27	0	0	64	81	679	835	498	1515	1523
100	374	23	70	22	0	0	51	74	615	864	539	1479	1564

LIFE CYCLE SHEET

Product Carbon Footprint

The biogenic (biological) greenhouse gas emissions may be considered alongside the fossil greenhouse gas emissions caused by the cradle-to-gate manufacturing of wood products to estimate the net carbon footprint of the five products identified in the calculator. On the Life Cycle sheet, the first value provides an estimate of the emissions from fossil fuels used in harvesting and manufacturing the wood products entered on the Calculator sheet. This value is based on cradle-to-gate life cycle assessments of lumber, plywood, OSB, and MDF that have been completed by the Athena Institute³.

The product footprint is calculated in this sheet based on the two most prominent carbon accounting standards⁴. In these systems, the initial carbon storage of the wood products is granted as a credit. The carbon emissions cancel a portion of this credit. The net carbon footprint is presented as the storage of carbon in year 0 minus 100 years of emissions.

³ Life Cycle Assessment reports are available under the heading "LCI/LCA Reports" at: <http://www.athenasmi.org/resources/publications/>

⁴ British Standards Institute (2011): Publicly Available Specification (PAS) for the assessment of the life cycle greenhouse gas emissions of goods and services. <http://shop.bsigroup.com/en/forms/PASs/PAS-2050/>
Bhatia et al (2011) Greenhouse Gas Protocol Product Life Cycle Accounting and Reporting Standard. Published by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) http://www.ghgprotocol.org/files/ghgp/public/Product-Life-Cycle-Accounting-Reporting-Standard_041613.pdf

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Product Carbon Footprint Including Fossil Fuel Use		tonnes of CO ₂ e
Fossil fuel emissions from harvesting and manufacturing at year 0		306
Carbon storage in products credit at year 0		-1,956
Product carbon dioxide emissions from end-of-life at year 100		467
Product methane emissions from end of life at year 100		72
Product greenhouse gas emissions from end of life at year 100		539
Product carbon footprint at year 100 (yr 0 storage minus emissions)		-1,110

Benefit of using wood products

“Displacement effects” occur when using wood products instead of those with more emissions whether for building materials or fossil fuels. The results in this section estimate the substitution effect of wood products for non-wood products and the substitution of fossil fuels with biomass fuels. There are no displacement effects for paper products because we haven’t identified what alternative products they would be replacing.

Carbon benefit of wood replacing plastic, concrete other building materials		tonnes of CO ₂ e
Minimum		-587
Middle estimate		-1,540
Maximum		-3,374
Carbon benefit if biogenic manufacturing waste (sawdust etc.) burned with energy recovery		
instead of using coal		-471
instead of using oil		-296
instead of using natural gas		-218

CONVERSIONS SHEET

The Conversions sheet is provided so that you can see what factors have been used in generating the results and to assist you with making any conversions that are not made automatically by the calculator. It summarizes user options, provides conversion tables to convert imperial thickness to metric equivalents and to convert thickness to 3/8” basis, and lists all the conversion factors used by the calculator to convert data you provide into tonnes of carbon dioxide equivalent.

References are also provided so you can delve into the conversions more thoroughly to better understand the impact these variables might have on carbon flux estimates.

VIEWING AND PRINTING

Information contained on each individual sheet can be viewed and printed using standard Microsoft Excel page layout formatting. We recommend you use “Print Preview” and make adjustments using the Page Setup and Scaling tools to configure printing to suit your needs. Selecting a group of cells and choosing “Print Selected” before going to “Print Preview” can also be a useful approach. Clicking on a chart will allow you to print only the chart, not the whole page.

While we have endeavored to format the document so it is easy to view and is pleasing to the eye, different monitors will portray colours differently and people have their own preferences with respect to

fonts and text size. It is not possible to change the fonts or colours on protected sheets. However, you can copy the sections you want and paste them onto a new sheet to make the changes there.

INTERPRETING THE RESULTS

INTERPRETING THE QUICK RESULTS SECTION

The calculator starts by determining the mass of carbon stored in the wood molecules of the products you are using in your project. Adjustments are made to convert area or volume measurements to mass, and to account for water content, adhesives, additives, and the losses during initial manufacturing for everything except logs. Once these adjustments are made, the mass is converted into an equivalent amount of carbon dioxide (CO₂e). This value is the amount of greenhouse gases (primarily carbon dioxide) that was removed from the atmosphere by growing trees and makes up most of what we report in the first line of the Quick Results section - Carbon stored in roundwood at year 0. If you input secondary products, the losses during manufacturing are added to the Carbon stored in products at year 0.

During the year after harvesting, the roundwood is manufactured into secondary products. These are reported on the second line of the Quick Results section - Carbon stored in products at year 0. If you entered quantities of secondary products, then this value is simply converted to the amount of carbon dioxide equivalent stored in your wood products.

Over the next 100 years, some of that material will be retired from use, recycled, or be sent to a landfill. At the landfill, some is burned for energy, some decays, and some is just buried (see Figure 1).

The portion of CO₂e that is stored after 100 years is reported in the Quick Results section. Line three presents the amount stored in wood products that are still in use. Line four presents the carbon stored in landfills. And line five is just the sum of storage in products and landfills.

When round logs are made into rectangular lumber or plywood, there is a fair amount of extra wood left over as chips, sawdust and shavings. Most of that material is used for other products, such as paper or MDF. But during the process of making white paper, about half of the carbon is removed and used for bioenergy. Some of the smaller sawmills in BC still burn some of their waste without energy capture.

The burning of wood during the manufacturing process creates carbon emissions. These are estimated for your project on the sixth line of the Quick Results section - Biogenic manufacturing emissions at year 0.

As paper and wood products decay or burn, further carbon is returned to the atmosphere. In the Quick Results section this is reported as Total carbon emissions from wood by year 100. This value represents the estimate of total cumulative emissions that occurred over the next 100 year period.

There is considerable uncertainty around the exact values for manufacturing efficiency, life expectancy of different wood products, recycle rates of paper and other aspects of the forest product life cycle. The range of potentially reasonable values for the Carbon Emissions is provided as the minimum and maximum estimates. There are also uncertainties for the carbon storage, but those have not yet been quantified.

While the calculator is meant to be simple and quick to use, it does have limitations. It can be used to determine the emission associated with roundwood or secondary wood products but does not currently provide you with the option to specify the end use for your products. The calculator will only provide you

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with information on which end use products these secondary wood products normally end up in North America, and how they are retired from use over time.

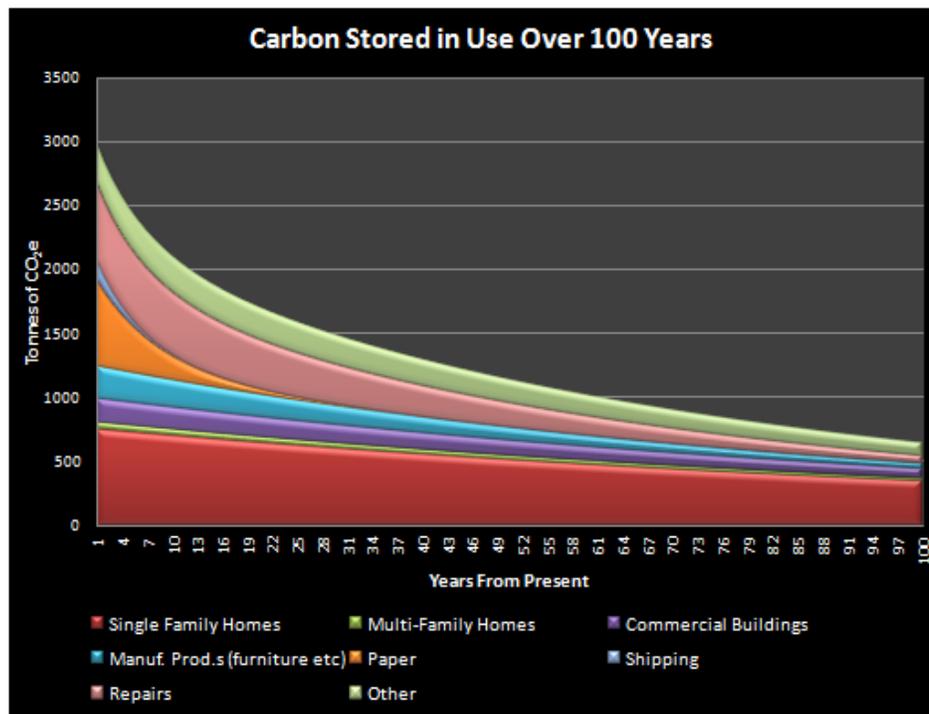
Other aspects worth noting include:

- the Quick Results and Results sheets do not account for fossil fuel emissions used in the production or transportation of the products;
- the Quick Results and Results sheets doesn't address the substitution benefit of wood compared to other building products;
- the tool counts the burning of wood for energy as creating emissions.

INTERPRETING THE GRAPHS

On the Graphs page, the chart entitled "Carbon Stored in Use Over 100 Years" (see example below) provides a visual representation of how the cumulative storage of carbon changes over time.

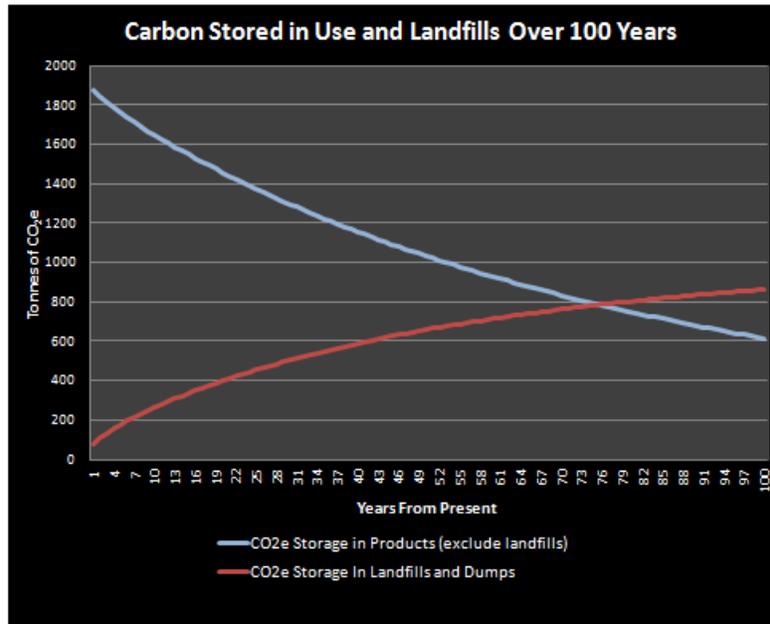
The calculator uses the data you provided on quantities of logs, lumber, panels, and paper to determine the storage in the first year. After that, the storage declines based on the life expectancy and recycle rate of different products. For example, the red band in the chart below represents wood within single-family homes. It declines slowly because the life-expectancy of homes in North America is over 100 years partly because our society tends to renovate rather than demolish older homes. Repairs and renovations to our dwellings (pink band) tend to last a shorter period of time - on average, about 30 years.



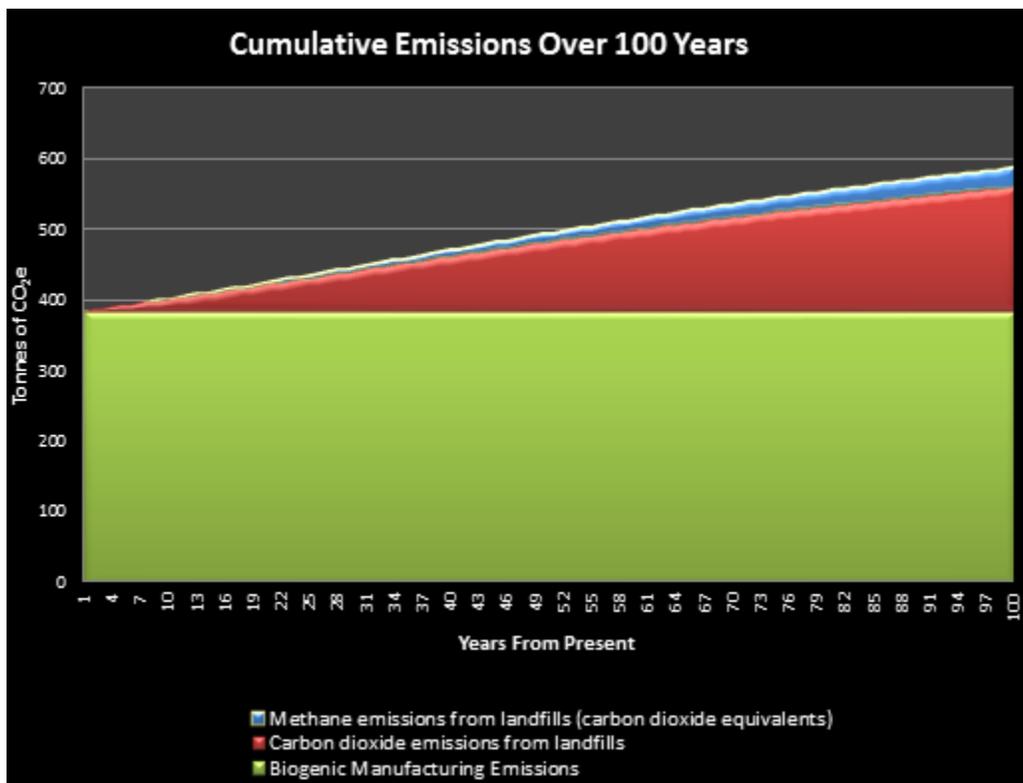
The chart called "Declining Carbon Storage Over 100 Years" depicts the storage of carbon (i.e. tonnes of CO₂e removed from the atmosphere) for all carbon pools combined. One line on the chart shows how much is stored when landfill and dump material that is no longer in use (but has not yet decayed) is counted as storage, and the other line shows total storage when material in landfills is not counted. The two approaches yield substantially different results. The option of accounting for storage in landfills and dumps is provided here because there are differences about how this material is treated in some carbon

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offset protocols. In some cases it is considered to be a valid form of carbon storage, and in other cases it is not.



The chart entitled "Cumulative Carbon Emissions Over 100 Years" is the opposite of the Carbon Storage chart (see below). The top value in year 100 from the chart below is reported on the Quick results for the total emissions of your project.



GETTING MORE INFORMATION

We hope our carbon calculator tool helps you better understand possible greenhouse gas implications associated with the wood products you use. Please contact us if you have any questions about any aspect of this User's Manual or the associated spreadsheet tool. Let us know what you think at:

Caren Dymond, M.Sc. P.Ag.

Competitiveness and Innovation Branch

Telephone: 778-747-2727,

E-mail: Caren.Dymond@gov.bc.ca

Mailing address: PO Box 9515 Stn Prov. Govt . Victoria BC V8W 9C2

Other Calculators and Models

If you want more control over wood product use, retirement functions, and decay rates you might find the National Council for Air and Stream Improvement (NCASI) model appropriate (available at www.ncasi.org/support/downloads/Detail.aspx?id=30). However, it does not consider the emissions associated with converting logs into lumber, plywood, paper, etc. and it is more difficult to use.

If you are interested in knowing the benefits of using wood instead of fossil fuel intensive products, an on-line calculator is produced by Woodworks (a North American Wood Associations cooperative). However, it does not include the emissions associated with converting logs into secondary wood products such as lumber and panels. <http://www.woodworks.org/design-tools/online-calculators/>

Further Reading

If you would like to know more about how forest products manufacturing in BC, carbon and greenhouse gas emissions from wood and paper products, try some of the links listed below.

- Dymond, C. 2012. Forest carbon in North America: annual storage and emissions from British Columbia's harvest, 1965-2065. <http://www.cbmjournal.com/content/7/1/8>
- The Canadian Forest Service Carbon Budget Model Framework for Harvested Wood Products. <http://cfs.nrcan.gc.ca/pages/94>
- The Woodworks on-line calculator available at <http://www.woodworks.org/design-tools/online-calculators/>
- The National Council for Air and Stream Improvement (NCASI) model available at www.ncasi.org/support/downloads/Detail.aspx?id=30.
- Sathre R, O'Connor J: A synthesis of research on wood products and greenhouse gas impacts. Vancouver, BC: FPInnovations Technical report TR-19; 2008. http://www.forintek.ca/public/Eng/E5-Pub_Software/5a.fact_sheets.html
- Lippke B, Oneil E, Harrison R, Skog K, Gustavsson L, Sathre R: Life cycle impacts of forest management and wood utilization on carbon mitigation: knowns and unknowns. Carbon Manage 2011, 2(3):303–333 www.corrin.org/pubs/articles/2011/FSG_Review_Carbon_Synthesis.pdf
- Briggs, D.G. 1994 Forest Products Measurements And Conversion Factors: With Special Emphasis on the U.S. Pacific Northwest. Institute of Forest Resources, University of Washington, Seattle. http://www.ruraltech.org/projects/conversions/briggs_conversions/briggs_book.asp
- Dymond, C.C. 2012. Our Logs' Story from Truck to Product. BC Forest Science Program Extension Note 107, Victoria, BC. <http://www.for.gov.bc.ca/hfd/pubs/docs/En/EN107.pdf>