

ENVIRONMENTAL PRODUCT DECLARATION

# NORTH AMERICAN SOFTWOOD PLYWOOD

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The American Wood Council (AWC) and the Canadian Wood Council (CWC) are pleased to present this Environmental Product Declaration (EPD) for North American softwood plywood. This EPD was developed in compliance with ISO 14025 and ISO 21930 and has been verified under UL Environment's EPD program.

The EPD includes Life Cycle Assessment (LCA) results for all processes up to the point that plywood is packaged and ready for shipment at the manufacturing gate; the cradle-to-gate product system includes forest management, logging, transportation of logs to plywood plants, lathing, veneer drying and application, and curing.

The AWC and CWC represent wood product manufacturers across North America. Our organizations have undertaken numerous sustainability initiatives on behalf of our membership and we are pleased to present this document to show how we are doing. The publication of this EPD, which is based on rigorous LCA research, is our effort to back up with science what we know to be true – that wood products stand alone as a green building material.

Please follow our sustainability initiatives at:

[www.awc.org](http://www.awc.org) and [www.cwc.ca](http://www.cwc.ca)





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## North American Softwood Plywood

North American Structural and Architectural Wood Products

According to ISO 14025 and ISO 21930

This declaration is an environmental product declaration in accordance with ISO 14025 that describes environmental characteristics of the described product and provides transparency and disclosure of the impacts caused by the product life cycle. This EPD does not guarantee that any performance benchmarks, including environmental performance benchmarks, are met. EPDs are intended to compliment Type I environmental performance labels.



PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	American Wood Council and Canadian Wood Council
DECLARATION NUMBER	13CA24184.103.1
DECLARED PRODUCT	North American Softwood Plywood
REFERENCE PCR	FPIinnovations: 2011. Product Category Rules (PCR) for preparing an Environmental Product Declaration for North American Structural and Architectural Wood Products, Version 1 (UN CPC 31, NAICS 321), November 8, 2011.

DATE OF ISSUE	April 16, 2013
PERIOD OF VALIDITY	5 years

CONTENTS OF THE DECLARATION	<ul style="list-style-type: none"> <li>Product definition and information about building physics</li> <li>Information about basic material and the material's origin</li> <li>Description of the product's manufacture</li> <li>Indication of product processing</li> <li>Information about the in-use conditions</li> <li>Life cycle assessment results</li> <li>Testing results and verifications</li> </ul>
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The PCR review was conducted by:	FPIInnovation
	PCR confirmed by PCR Review Panel 570 Saint-Jean Blvd. Pointe-Claire, QC Canada H9R 3J9 T 514 630-4100 info@fpinnovations.ca
This declaration was independently verified by Underwriters Laboratories in accordance with ISO 14025 <input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> EXTERNAL	 Loretta Tam, EPD Program Manager
	 Thomas P. Gloria, Ph. D., Industrial Ecology Consultants
This life cycle assessment was independently verified by in accordance with ISO 14044 and the reference PCR	





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## Description of Industry and Product

### Description of North American Softwood Plywood Industry

The North American forest product industry is a major contributor to both the American and Canadian economies. Many plywood manufacturing jobs are rurally located and are the primary driver of local economies. In 2012, North American plywood manufacturers produced more than 11,000 million square feet (3/8 inch basis) of plywood.

The North American plywood industry has weathered unprecedented economic changes in recent years through innovation and expansion into new and emerging markets. Efficiency improvements, beyond simply ensuring competitiveness, continually improve the environmental footprint of wood products. Now, more than ever, we are ready to present this EPD that reflects years of research and demonstrates the hard work we've been doing.





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### Description of Plywood Product

The product profile presented in this EPD is for a declared unit of 1 cubic meter of softwood plywood. Plywood is manufactured by peeling sheets of veneer from log “blocks” that are then combined with resin and arranged in layers that alternate their orientation. The layers of veneer and resin are then pressed into sheets of plywood which are trimmed and squared to standard sizes.

One cubic meter of average North American softwood plywood weighs 491.17 kg, excluding the variable moisture content. The product composition is presented below:

- Wood: 480.61 oven dry kg (97.8%)
- Phenol formaldehyde (PF) resin: 10.13 kg (2.1%)
- Catalysts and Fillers: 0.43 kg (0.1%)

This EPD is based on LCA studies that considered the entire range of sizes of sheets of plywood. The most common dimensions of sheets of plywood are 4 feet x 8 feet. The results are presented for the metric unit of measure, 1 cubic meter, which is equal to 1,130 square feet of 3/8 inch thick plywood.



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## Cradle-to-Gate Life Cycle of Softwood Plywood

### Business-to-Business EPD and Cradle-to-Gate LCA

Business-to-business EPD's are those that focus on the life cycle up to the point that the product has been manufactured and is ready for shipment, the portion of the life cycle referred to as cradle-to-gate. This EPD includes the cradle-to-gate processes as shown in Figure 1.

The delivery of the product to the customer, its use, and eventual end-of-life processing are excluded from the cradle-to-gate portion of the life cycle. This exclusion limits the accounting of carbon sequestration in the wood product because the benefit of sequestration is not realized at the point of manufacturing, but occurs over the life cycle of the product.

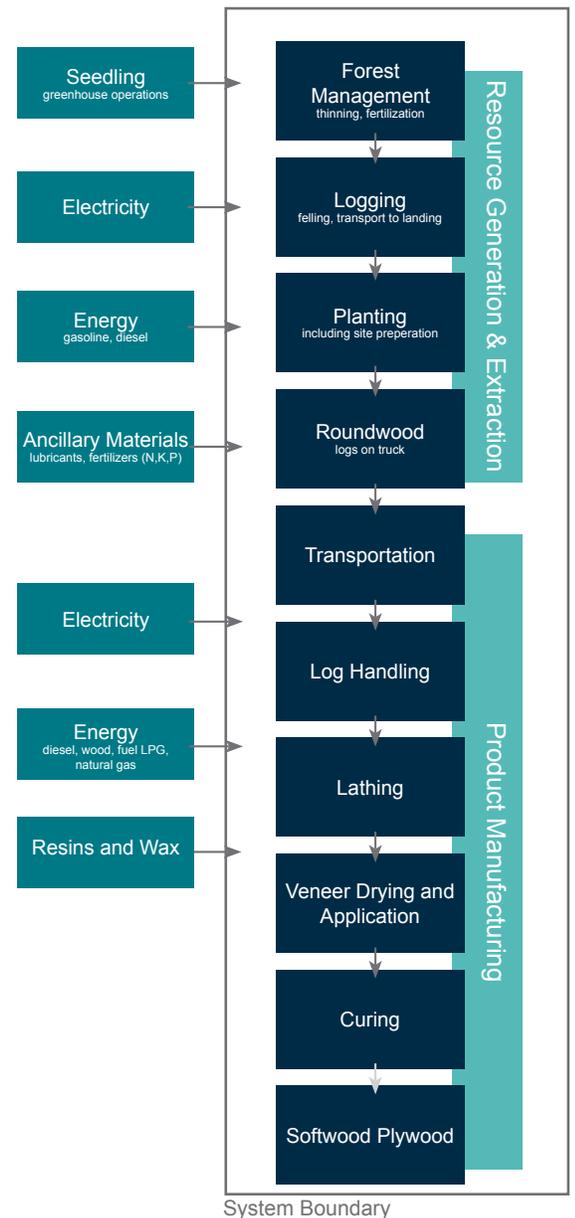
### Forest Operations

The assessment of the life cycle impacts of a wood product begins with its origin in natural or managed forests and the energy use and emissions caused by its extraction. Forest management and the reforestation that occurs after extraction are also included. The PCR requires that the cradle-to-gate product system includes all forest management activities which may include site preparation, thinning, and fertilization. The forest operations portion of the resource extraction/generation phase also includes the production and planting of seedlings that occurs after logging.

### Plywood Production

The plywood production phase begins with the transportation of logs to the manufacturing facility and includes the unit processes of lathing, veneer drying and application, and curing. These processes consume electricity drawn from regional grids, fossil fuel, and internally generated biomass.

Figure 1: Cradle-to-gate product system for softwood plywood





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## Methodology of Underlying LCA

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### Declared Unit

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The declared unit in this EPD is 1 cubic meter (m<sup>3</sup>) of softwood plywood. This is equivalent to 1,130 square feet of plywood at 3/8 inch thickness. The average density of North American softwood plywood, including resins, is 491.17 kg/m<sup>3</sup> excluding all moisture content. Softwood plywood produced in North America is understood to contain some moisture, while the oven dry unit of measure contains neither free moisture (moisture in cell cavities) nor bound moisture (moisture in cell walls).

### System Boundaries

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The system boundary begins with forest management and resource extraction and ends with finished plywood ready for shipment at the manufacturer. The forest resources system boundary includes planting the seedlings, site preparation, thinning, fertilization and final harvest. Plywood manufacturing includes the transportation of logs, lathing, veneer drying and application, and curing. Seedlings and the fertilizer and electricity it took to grow them were also considered in the system boundary.

### Cut-off Rules

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The cut-off criteria for flows to be considered within the system boundary are as follows:

- Mass – if a flow is less than 1% of the cumulative mass of the model flows it may be excluded, provided its environmental relevance is minor.
- Energy – if a flow is less than 1% of the cumulative energy of the system model it may be excluded, provided its environmental relevance is minor.
- Environmental relevance – if a flow meets the above two criteria, but is determined (via secondary data analysis) to contribute 2% or more to the selected impact categories of the products underlying the EPD, based on a sensitivity analysis, it is included within the system boundary.



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### Data Quality

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#### Precision and Completeness

Primary data on raw materials, energy, and emissions were provided by logging operations and plywood manufacturing facilities, based on input purchases, production output, and reported process emissions. All upstream and downstream secondary data was drawn from publicly available databases, primarily the United States Life Cycle Inventory (USLCI) database. The LCA practitioners performed quality control on all secondary data sources to ensure completeness.

All inventory flows were modeled and at no time were data excluded due to application of the studies' cut-off criteria.

#### Consistency and Reproducibility

To ensure consistency, only primary data as provided by the study participants were used to model gate-to-gate plywood manufacturing processes. All other secondary data (upstream and downstream) were consistently applied and adaptations to the databases were documented in the LCA reports.

Reproducibility by third parties is possible using the background LCIs documented in the CORRIM and Athena LCA reports.

#### Temporal Coverage

Primary data collected from the manufacturing facilities related to the product processes of interest are representative for the years 2004-2009. The LCA models were updated in 2012 to reflect updates in underlying secondary data used to develop the LCI.

#### Geographical Coverage

The geographical coverage for this study is based on North American (NA) system boundaries for all processes and products.

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### Treatment of Biogenic Carbon

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Biogenic carbon dioxide emissions were accounted as global warming neutral in accordance with the PCR. Under this approach, the carbon dioxide emissions from the combustion of internally generated wood fuels are considered equal to the carbon dioxide uptake in the forest during tree growth.

Crediting carbon sequestration against the global warming potential was excluded as the long term carbon storage is dependant on gate-to-grave processes not considered directly in this EPD. The expected carbon sequestration for average end-use and end-of-life treatment is provided in the section on "Additional Information".



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### Allocation

Allocation followed the requirements and guidance of ISO 14044:2006, clause 4.3.4, which gives preference to mass based allocation, and the following description of allocation from the PCR:

- Allocation of multi-output processes shall be based on mass. However, if economic value difference is at least ten times greater between products from a multi-output process, a suitable revenue based allocation principle shall be applied and these deviations shall be substantiated and readily available for review.

The plywood co-products fall within this 10 times value threshold and were thus allocated on a mass basis.

### Aggregation of Regional Results

The LCA results that follow represent the weighted average of three different LCA studies; one for each of the two primary American manufacturing regions and one Canadian average study. The three regions and their weighting relative to the aggregate profile are as follows:

- United States - Pacific Northwest: 22%
- United States - Southeast: 66%
- Canada - National Average: 12%

The weighting factors were developed from the relative annual production of the three manufacturing regions. The United States regional weights are based on the production totals for the years 2001-2009 which is representative of the data vintage that underlies those two studies. The Canadian weight is based on the 2010 production year to represent the more recent data that was used in that study. The selection of 2010 for the Canadian weighting is also conservative because North American plywood production was lower in that year than in the preceding years. This means that the potential Canadian impacts, which are generally lower than those of the American regions, is weighted less than if the same production years were selected for all weight derivations.

In addition to calculating weighted average impact assessment results, these weighting factors were also used to calculate the weighted average density of North American softwood plywood. All other values presented in this EPD also utilize this weighting.

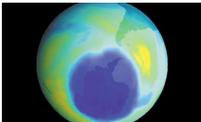


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## Life Cycle Assessment Results

The life cycle impact assessment (LCIA) establishes links between the life cycle inventory results and potential environmental impacts. In the LCIA, results are calculated for impact category indicators such as global warming potential and smog potential. These impact category indicator results provide general, but quantifiable, indications of potential environmental impacts. The various impact category indicators and means of characterizing the impacts are summarized in the table below. Environmental impacts are determined using the TRACI 2 method. These five impact categories are reported consistently with the requirements of the PCR.

Table 1: Impact Assessment Categories		
Impact Category Indicators		Characterization Model
Global Warming Potential		Calculates global warming potential of all greenhouse gasses that are recognized by the IPCC. The characterization model scales substances that include methane and nitrous oxide to the common unit of kg CO <sub>2</sub> equivalents.
Ozone Depletion Potential		Calculates potential impact of all substances that contribute to stratospheric ozone depletion. The characterization model scales substances that include CFC's, HCFC's, chlorine, and bromine to the common unit of kg CFC-11 equivalents.
Acidification Potential		Calculates potential impacts of all substances that contribute to terrestrial acidification potential. The characterization model scales substances that include sulfur oxides, nitrogen oxides, and ammonia to the common unit of H <sup>+</sup> moles equivalents.
Smog Potential		Calculates potential impacts of all substances that contribute to photochemical smog potential. The characterization model scales substances that include nitrogen oxides and volatile organic compounds to the common unit of kg O <sub>3</sub> equivalents.
Eutrophication Potential		Calculates potential impacts of all substances that contribute to eutrophication potential. The characterization model scales substances that include nitrates and phosphates to the common unit of kg N equivalents.





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### Cradle-to-Gate Impact Assessment Results

The impact assessment results are shown in Table 2. This LCIA does not make value judgments about the impact indicators, meaning that no single indicator is given more or less value than any of the others. All are presented as equals. Additionally, each impact indicator value is stated in units that are not comparable to others. Some variations exist between the three underlying data sets and are a result of differences in regional energy mixes, particularly the sources of electricity, as well as differences in production practices and efficiencies.

The results presented below indicate the potential impacts caused by the cradle-to-gate production of softwood plywood. Ozone depletion was below  $10^{-5}$  kg CFC-11 eq. in all three of the LCA studies and is thus not reported in the results table. Water consumption was estimated for Canada as required by the PCR. However, the U.S. regional estimate include all water withdrawals without netting out non-consumptive use. As a result, the combined weighted average overstates total water consumption and is therefore conservative.

Table 2: Cradle-to-Gate Impact Assessment Results - 1m<sup>3</sup> North American Softwood Plywood

Impact category indicator	Unit	Total	Forestry operations	Plywood production
Global warming potential	kg CO <sub>2</sub> eq.	129.77	12.78	116.99
Acidification potential	H <sup>+</sup> moles eq.	75.88	8.33	67.55
Eutrophication potential	kg N eq.	0.0666	0.0244	0.0422
Ozone depletion potential	kg CFC-11 eq.	0.0000	0.0000	0.0000
Smog potential	kg O <sub>3</sub> eq.	22.28	4.28	18.00
<b>Total primary energy consumption</b>	<b>Unit</b>	<b>Total</b>	<b>Forestry operations</b>	<b>Plywood production</b>
Non-renewable fossil	MJ	2111.96	195.68	1916.28
Non-renewable nuclear	MJ	278.53	1.89	276.64
Renewable, biomass	MJ	3191.40	0.00	3191.40
Renewable, other	MJ	61.00	0.32	60.68
<b>Material resources consumption</b>	<b>Unit</b>	<b>Total</b>	<b>Forestry operations</b>	<b>Plywood production</b>
Non-renewable materials	kg	0.59	0.00	0.59
Renewable materials	kg	472.46	0.00	472.46
Fresh water	L	450.55	4.75	445.80
<b>Non-hazardous waste generated</b>	<b>Unit</b>	<b>Total</b>	<b>Forestry operations</b>	<b>Plywood production</b>
Solid waste	kg	32.49	0.16	32.33





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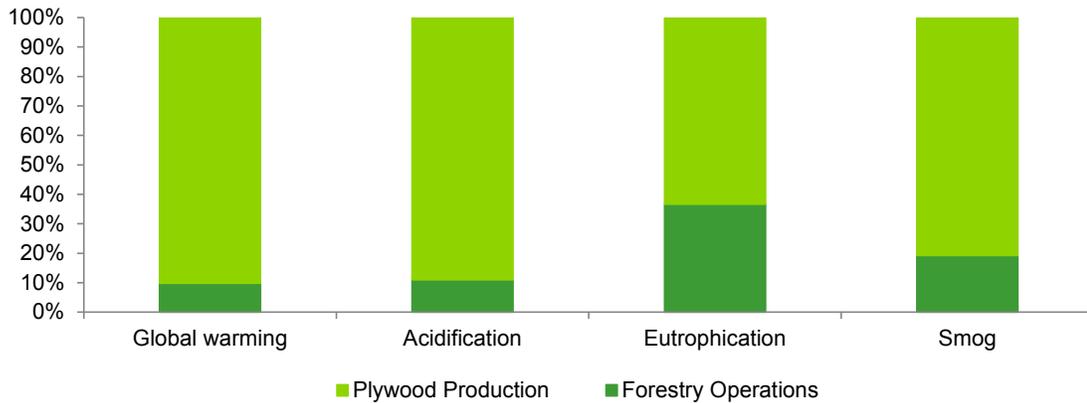
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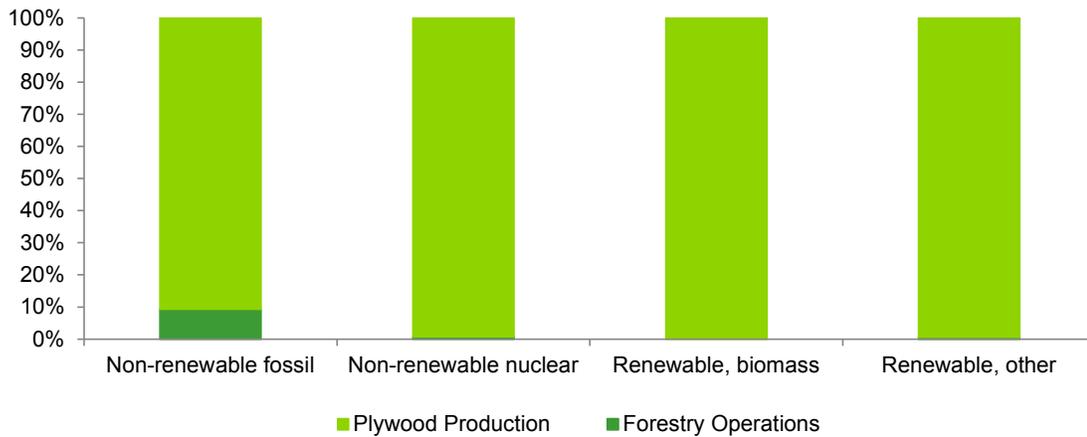
### Impact Assessment Results by Life Stage

The two graphs below show that the plywood manufacturing itself is the primary driver of impacts in the cumulative cradle-to-gate product system. Plywood manufacturing consumes 91% of fossil fuels and 100% of biomass energy, which drive the impacts in every category.

**Figure 2: Cradle-to-Gate Impact Assessment Results**



**Figure 3: Cradle-to-Gate Primary Energy Consumption**





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Figure 4: Cradle-to-Gate Energy Use

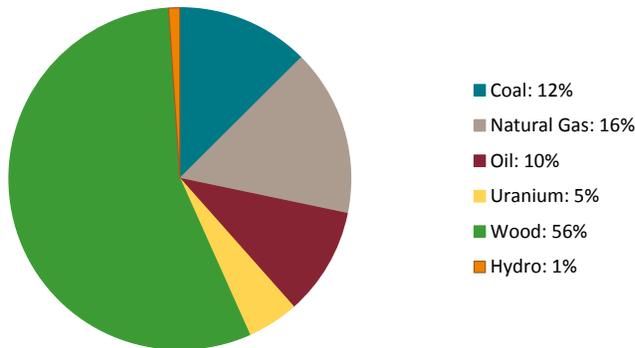


Figure 5: Forestry Operations Energy Use

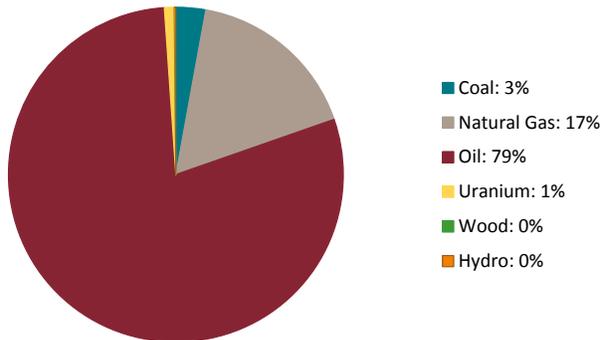
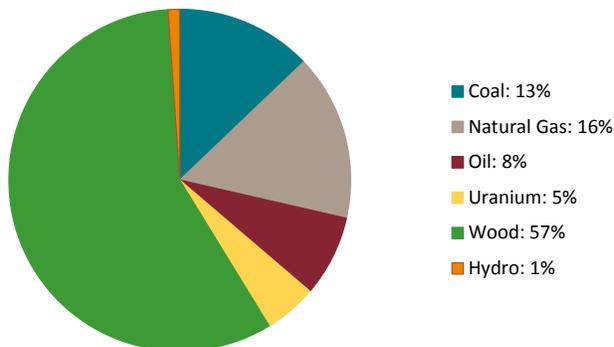


Figure 6: Plywood Production Energy Use



## Primary Energy Consumption by Resource

The three pie charts show the consumption of various energy resources in the cradle-to-gate portion of the life cycle. The cradle-to-gate and plywood production charts show similar results as manufacturing consumes the bulk of cradle-to-gate energy.

The forest operations portion of the life cycle relies heavily on oil-based energy as consumed in the form of diesel by heavy machinery. Oil accounts for 79% of energy resources consumed in forestry operations.

More than half of the energy requirement in manufacturing is met by renewable energy sources, 57% from biomass and 1% from hydro power. This translates to 56% of cradle-to-gate energy use for biomass and 1% for hydro power. The biomass consumption is used exclusively in the veneer drying process while the hydro energy use is due to electricity that is consumed throughout the cradle-to-gate product system. Coal, natural gas, oil, and nuclear comprise the remaining energy use.

The prevalence of renewable energy use in the life cycle of softwood plywood means that only 39% of energy consumption is derived from fossil fuel sources. This means that plywood has a particularly low carbon footprint relative to the energy required for plywood manufacturing.





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## Additional Information

### Range of Applications

Softwood plywood is used in a variety of applications. Plywood is most commonly associated with the construction and renovation of single family homes. It is no surprise that commercial and residential construction consumes the greatest share of plywood relative to other uses.

The following lists the breakdown of plywood end uses in North America:

- New single family residential construction: 15%
- Residential upkeep and improvement: 21%
- New non-residential construction: 16%
- Manufacturing furniture and other products: 32%
- Other end-uses: 16%

Source: APA - Engineered Wood Association (2012) Structural Panel and Engineered Wood Yearbook, APA Economics Report E178.



Photos: APA - The Engineered Wood Association



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### Carbon Sequestration

The PCR requires that carbon sequestration may only be credited to the product if the end-of-life fate of that carbon is considered in the LCA study. FPIInnovations has recently published a carbon sequestration calculation tool that estimates the emissions from typical end-of-life treatment of wood products that includes recycling, combustion, and landfilling. The carbon sequestered in the product at the manufacturing gate serves as the basis for such an analysis and is as follows (all conversion factors and assumptions are documented in carbon tool):

1m<sup>3</sup> plywood = 480.61 oven dry kg = 240.31 kg Carbon = 881.12 kg CO<sub>2</sub> eq.

This initial carbon sequestration may then be considered against its emission as the plywood product reaches the end of its service life in various applications. The FPI carbon tool is used to estimate the biogenic carbon balance at year 100, including service life estimations for various applications and the average landfill decay rate. The carbon tool gives the following results:

Carbon sequestered in product at manufacturing gate:  
881.12 kg CO<sub>2</sub> eq. = -881.12 kg CO<sub>2</sub> eq. emission

Methane emitted from fugitive landfill gas:  
3.95 kg CH<sub>4</sub> = 98.76 kg CO<sub>2</sub> eq. emission

Carbon dioxide emitted from fugitive landfill gas and the combustion of waste and captured landfill gas:  
280.12 kg CO<sub>2</sub> eq. emission

**Carbon sequestration at year 100, net of biogenic carbon emissions:  
502.24 kg CO<sub>2</sub> eq. = -502.24 kg CO<sub>2</sub> eq. emission**





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CORRIM:2012. Cradle to Gate Life Cycle Assessment of Softwood Plywood Production from the Southeast

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FPIInnovations and Athena Institute: 2013. Business-to-Business (B2B) Carbon Sequestration Tool for Wood EPD's as per PCR for North American Structural and Architectural Wood Products, Version 1.

ISO 14025:2006. Environmental Labels and Declarations – Type III Environmental Declarations – Principles and Procedures.

ISO 14040:2006. Environmental Management – Life Cycle Assessment – Principles and Framework.

ISO 14044:2006. Environmental Management – Life Cycle Assessment – Requirements and guidelines.

ISO 21930:2007 – Building and Construction Assets – Sustainability in building construction – Environmental declaration of building products.

TRACI: Tool for the Reduction and Assessment of Chemical and other environmental Impacts: <http://www.epa.gov/ORD/NRMRL/std/sab/traci/>

USLCI Database: <http://www.nrel.gov/lci>