Declaration Owner:

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RedBuilt™ designs and manufactures engineered structural wood products for commercial and multi-family applications. Products include Open-Web trusses, Red-I™ I-Joists, RedLam™ LVL, complementary components, as well as product engineering and technical on-site support. RedBuilt™ is headquartered in Boise, Idaho and operates four manufacturing plants and thirteen design and sales offices throughout the United States.

Products

Red-I™ I Joists

Declared Unit

The declared unit is 1 meter (one linear meter) of Red-I™ I-Joist.
The scope of this EPD is cradle-to-gate

EPD Number and Period of Validity

SCS-EPD-04127
Beginning Date: August 16, 2016 – End Date: August 15, 2021
Version: March 16, 2020

Product Category Rule

North American Structural and Architectural Wood Products, Version 2.0, June 18, 2015.

Program Operator

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Disclaimers: *This Environmental Product Declaration (EPD) conforms to ISO 21930, 14025, 14040, and ISO 14044.*

Scope of Results Reported: *The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.*

Accuracy of Results: *Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.*

Comparability: *The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.*

PCR review, was conducted by	Tom Gloria, PhD, Industrial Ecology Consultants (Review Chair) Email: t.gloria@industrial-ecology.com
Approved Date: August 16, 2016 - End Date: August 15, 2021 Version: March 16, 2020	
Independent verification of the declaration and data, according to ISO 14025:2006 and ISO 21930:2007.	☐ internal ☑ external
Third party verifier	Tom Gloria, PhD, Industrial Ecology Consultants

PRODUCT DESCRIPTION

Red-I™ I-Joists are engineered wood products manufactured in Stayton, Oregon and comprised mainly of two flanges and oriented strand board (OSB) web. The flanges are made from RedLam™ Laminated Veneer Lumber (RedLam™ LVL) cut to specific dimensions, while the web material is made from OSB panel. The web-to-flanges connection is a proprietary tongue-and-groove glued joint, forming the "I" shape cross-section.

For the Red-I™ I-Joist series, dimensions of top and bottom flanges range from 1-3/8" x 1-3/4" (34.9 mm x 44.5 mm) to 2-1/2" x 3-1/2" (63.5 mm x 88.9 mm), OSB web thickness range from 3/8" (9.5 mm) to 1/2" (12.7 mm), and I-Joists depths range from 9-1/2" (241 mm) to 32" (813 mm). Red-I™ I-Joists are engineered to replace structural lumber in floor, ceiling, and roof applications.

PRODUCT LIFE CYCLE FLOW DIAGRAM:

The system boundary and life cycle stages are illustrated in Figure 1 with the major individual unit processes that make up each module of the production stage shown in Figure 2.

Figure 1. *System boundary and life cycle stages included in the LCA study.*

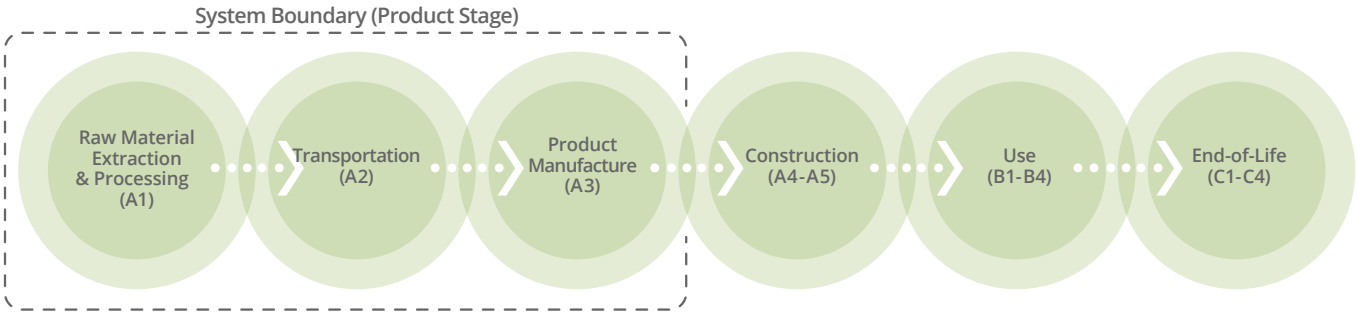
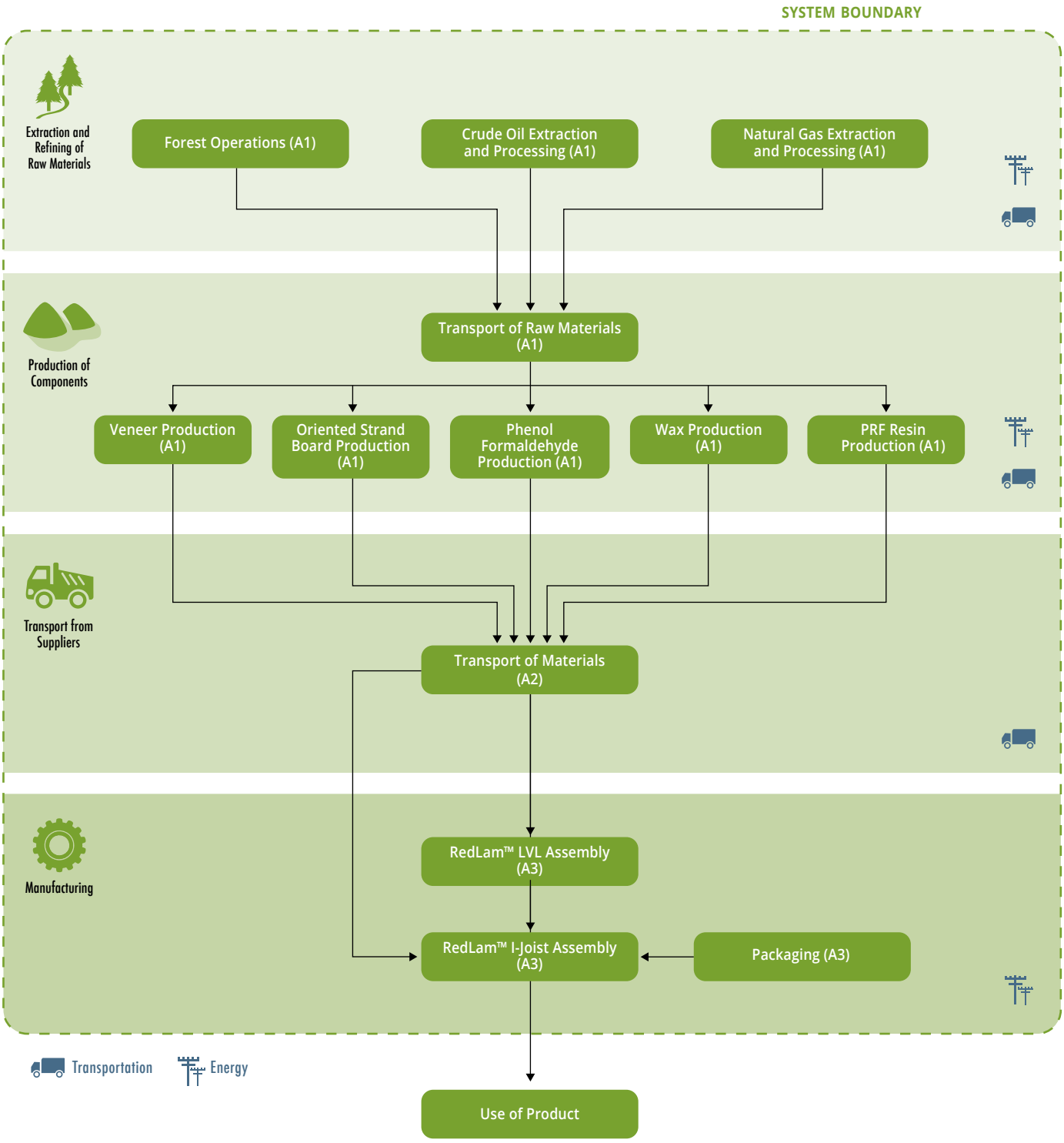


Figure 2. *Flow diagram representing the major processes in the production stage of Red-I™ I-Joists.*



PRODUCT COMPOSITION

The material composition of Red-I™ I-Joist, including packaging of the finished product, is shown in Table 1.

Table 1. *Material composition summary, including packaging of the finished product, by mass (kg) and percentage of total mass (%), for 1 meter of Red-I™ I-Joist.**

Material Type	Red-I45™	Red-I65™	Red-I90™
Wood	3.73 (93%)	4.63 (93%)	6.97 (93%)
Phenol formaldehyde	0.100 (2.5%)	0.124 (2.5%)	0.186 (2.5%)
Polymeric diphenylmethane diisocyanate	0.160 (4.0%)	0.198 (4.0%)	0.298 (4.0%)
Paraffin wax	$2.00x10^{-2}$ (0.50%)	$2.48x10^{-2}$ (0.50%)	$3.73x10^{-2}$ (0.50%)
TOTAL (Product)	4.01 (100%)	4.95 (100%)	7.46 (100%)
Plastic Wrap	$1.38x10^{-2}$	$1.71x10^{-2}$	$2.57x10^{-2}$
TOTAL (Packaging)	$1.38x10^{-2}$	$1.71x10^{-2}$	$2.57x10^{-2}$

**Values may not sum to the exact totals due to rounding*

LIFE CYCLE IMPACT ASSESSMENT RESULTS

Life Cycle Impact Assessment is calculated using TRACI v2.1. Impact categories include: global warming potential, acidification potential, eutrophication potential, smog creation potential, and ozone depletion potential. Key life cycle inventory parameters include a breakdown of total primary energy consumption, material resources consumption, and waste generated. All results are calculated using SimaPro software, version 8.1.

This Type III environmental declaration is developed according to ISO 21930 and 14025 for Red-I™ I-Joist. This EPD reports environmental impacts based on established life cycle impact assessment methods. The reported environmental impacts are estimates, and their level of accuracy may differ for a particular product line and reported impact. LCAs do not generally address site-specific environmental issues of related to resource extraction or toxic effects of products on human health. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change and habitat destruction. Forest certification systems and government regulations address some of these issues. The products in this EPD conform to ASTM D7612 Responsible or Non-Controversial fiber sourced from the western region of North America. EPDs do not report product environmental performance against any benchmark.

Table 2. *LCIA results for 1 meter of Red-I45™ I-Joist. Values in parenthesis show the percent contribution of each life cycle stage to the total result for each impact category.*

Impact Category	Units	Total (A1-A3)	Extraction of Raw Materials and Processing (A1)	Transport to Manufacturing Facility (A2)	Product Manufacturing (A3)
Global Warming Potential	kg CO_2 eq	2.7 (100%)	1.5 (54%)	0.32 (12%)	0.94 (35%)
Acidification Potential	kg SO_2 eq	$8.5x10^{-2}$ (100%)	$7.5x10^{-2}$ (89%)	$1.9x10^{-3}$ (2.2%)	$7.8x10^{-3}$ (9.2%)
Eutrophication Potential	kg N eq	$4.6x10^{-3}$ (100%)	$4.3x10^{-3}$ (94%)	$1.1x10^{-4}$ (2.3%)	$1.5x10^{-4}$ (3.3%)
Smog Creation Potential	kg O_3 eq	2.5 (100%)	2.4 (96%)	$5.2x10^{-2}$ (2.1%)	$5.4x10^{-2}$ (2.2%)
Ozone Depletion Potential	kg CFC-11 eq	$1.6x10^{-9}$ (100%)	$9.6x10^{-10}$ (60%)	$1.2x10^{-11}$ (0.76%)	$6.4x10^{-10}$ (40%)

Table 3. *LCIA results for 1 meter of Red-I65™ I-Joist. Values in parenthesis show the percent contribution of each life cycle stage to the result for each impact category.*

Impact Category	Units	Total (A1-A3)	Extraction of Raw Materials and Processing (A1)	Transport to Manufacturing Facility (A2)	Product Manufacturing (A3)
Global Warming Potential	kg CO_2 eq	3.3 (100%)	1.8 (53%)	0.40 (12%)	1.2 (35%)
Acidification Potential	kg SO_2 eq	0.10 (100%)	0.092 (88%)	$2.4x10^{-3}$ (2.3%)	$9.8x10^{-3}$ (9.4%)
Eutrophication Potential	kg N eq	$5.6x10^{-3}$ (100%)	$5.3x10^{-3}$ (94%)	$1.3x10^{-4}$ (2.3%)	$1.9x10^{-4}$ (3.3%)
Smog Creation Potential	kg O_3 eq	3.0 (100%)	2.9 (96%)	$6.5x10^{-2}$ (2.1%)	$6.7x10^{-2}$ (2.2%)
Ozone Depletion Potential	kg CFC-11 eq	$2.1x10^{-9}$ (100%)	$1.3x10^{-9}$ (61%)	$1.5 x10^{-11}$ (0.73%)	$7.9x10^{-10}$ (38%)

Table 4. *LCIA results for 1 meter of Red-I90™ I-Joist. Values in parenthesis show the percent contribution of each life cycle stage to the total result for each impact category.*

Impact Category	Units	Total (A1-A3)	Extraction of Raw Materials and Processing (A1)	Transport to Manufacturing Facility (A2)	Product Manufacturing (A3)
Global Warming Potential	kg CO_2 eq	5.1 (100%)	2.7 (53%)	0.60 (12%)	1.8 (35%)
Acidification Potential	kg SO_2 eq	0.16 (100%)	0.14 (88%)	$3.6x10^{-3}$ (2.3%)	$1.5x10^{-2}$ (9.5%)
Eutrophication Potential	kg N eq	$8.5x10^{-3}$ (100%)	$8.0x10^{-3}$ (94%)	$2.0x10^{-4}$ (2.3%)	$2.8x10^{-4}$ (3.3%)
Smog Creation Potential	kg O_3 eq	4.6 (100%)	4.4 (96%)	$9.7x10^{-2}$ (2.1%)	0.10 (2.2%)
Ozone Depletion Potential	kg CFC-11 eq	$3.0x10^{-9}$ (100%)	$1.8x10^{-9}$ (60%)	$2.3x10^{-11}$ (0.75%)	$1.2x10^{-9}$ (39%)

Table 5. *Key life cycle inventory parameters for 1 meter of Red-I™ I-Joists.*

Parameter	Units	Red-I45™	Red-I65™	Red-I90™
Total Primary Energy Consumption				
Non-renewable fossil	MJ	41	50	76
Non-renewable nuclear	MJ	14	18	27
Renewable*	MJ	$6.7x10^{-3}$	$8.5x10^{-3}$	0.013
Renewable, biomass	MJ	4.1	4.5	7.3
Material Resources Consumption				
Non-renewable materials	kg	0.31	0.37	0.57
Renewable materials	kg	4.6	5.7	8.6
Fresh water**	L	8.7	10	16
Waste Generated				
Hazardous waste	kg	$9.2x10^{-7}$	$1.2x10^{-6}$	$1.7x10^{-6}$
Non-hazardous waste	kg	$1.2x10^{-3}$	$1.5x10^{-3}$	$2.2x10^{-3}$

**Includes solar, wind, hydroelectric, and geothermal.*

***The PCR requires that data used in the LCA are from national databases, such as the USLCI database. Data in the USLCI for electricity generation does not account for water consumption, which is a noted as a limitation.*

ADDITIONAL ENVIRONMENTAL INFORMATION

Wood products such as I-Joists have the potential to store carbon; as trees grow, carbon dioxide is removed from the atmosphere and incorporated into the wood. The carbon storage is impermanent and will change over time as the wood product degrades or is burned. Product carbon storage is estimated following the methods in the PCR, and is shown in Table 6. These calculations assume that wood is "carbon neutral" following the PCR method and based on review of North American forest carbon stocks.[2]

Table 6. *Carbon storage results for 1 m Red-I™ I-Joists. Values may not sum to the exact totals due to rounding.*

Parameter	Unit	Red-I45™	Red-I65™	Red-I90™
Carbon sequestered in product at manufacturing gate	kg CO_2 eq	-6.7	-8.3	-13
Total carbon dioxide emissions from landfill	kg CO_2	1.6	1.9	2.9
Total methane emissions from landfill	kg CH_4	0.021	0.026	0.039
Net Global Warming Potential Credit	**kg CO_2 eq**	**-4.6**	**-5.7**	**-8.6**

[2]National forest carbon stocks are reported under the United Nations Framework Convention on Climate Change. See Table 7.1 for United States forest carbon stocks and Table 7.1 for Canadian forest carbon stocks. Canadian forest carbon stocks have fluctuated near net neutrality in recent years (ranging from -98 Tg to +69 Tg since 1990) while United States forest carbon stocks have shown annual stock increases of 600-900 Tg annual since 1990.

SUPPORTING TECHNICAL INFORMATION

System Boundaries

The EPD for Red-I™ I-Joists includes the extraction of raw materials and processing, transport of materials, product manufacture, and packaging (i.e., "cradle-to-gate"). The cradle-to-gate system boundary includes all unit processes contributing measurably to the category indicator results and is represented by the production stage, which is comprised of three life cycle stages (A1-A3).

- A1 – The extraction and processing of raw materials and the manufacture of material components (e.g., resin, oriented strand board). This includes reforestation processes that include nursery operations (e.g., fertilizer, irrigation, energy), site preparation, as well as planting, fertilization, and other management operations.
- A2 – The transportation of materials from source to manufacturing site.
- A3 – Manufacture of Red-I™ I-Joists. Packaging is included in this module.

Cut-off Criteria

No data gaps were allowed which were expected to significantly affect the outcome of the indicator results (2% or more to the selected impact categories). No single flow that represents more than 1% of the total mass or energy flows were excluded.

Data sources

Unit processes were developed within SimaPro 8.1, drawing upon data from multiple sources.

Primary data was collected from RedBuilt™ for their facility operations. Where primary upstream data were unavailable, secondary data sources were used. The principal sources of secondary LCI data are USLCI and Ecoinvent. Secondary datasets with the greatest degree of representativeness were chosen, with a preference for USLCI in accordance with the PCR. The LCI datasets shown in Table 7 are used in the LCA model.

Table 7. *LCI datasets and associated databases used to model material production and processing.*

Flow	Dataset	Data Source	Date
Materials			
Veneer	Dry veneer, at plywood plant, US PNW/kg/US	USLCI	2015
Phenol formaldehyde	Phenol formaldehyde, at plant/US	USLCI	2015
Paraffin wax	Paraffin, at plant/RER U	Ecoinvent	2014
PRF resin	Phenol-resorcinol-formaldehyde resin, at plant/US	USLCI	2015
Oriented strand board	Oriented strand board product, Weyerhaeuser/kg/US	USLCI; SCS	2016
Water	Tap water, at user/RER U	Ecoinvent	2010
Electricity/Heat			
Electricity	Electricity, at eGrid, NWPP, 2010/kWh/RNA	USLCI; SCS	2015
Natural gas	Natural gas, combusted in industrial equipment/RNA	USLCI; SCS	2016
Diesel	Diesel, combusted in industrial equipment/US	USLCI	2015
Gasoline	Gasoline, combusted in equipment/US	USLCI	2015
Propane	Liquefied petroleum gas, combusted in industrial boiler/US	USLCI	2015
Packaging			
Plastic wrap	Polypropylene resin, at plant/RNA; Extrusion, plastic film/RER U	USLCI; Ecoinvent	2015; 2010
Transportation			
Truck	Transport, combination truck, diesel powered/US	USLCI	2015

Data quality

In accordance with Annex 2 of the PCR, the overall data quality level based on a calculated data quality rating (DQR) of 2.3 was determined to be "good quality".[3] The data quality assessment is discussed in the table below for each of the data quality parameters.

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected.	The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data are less than 10 years old. All of the primary data used represented an average of one year's worth of data collection. Manufacturer-supplied data are based on a data record from January 1, 2014 to December 31, 2014.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study.	The data used in the analysis provide the best possible representation available with current data. Actual processes for upstream operations are primarily North American. Surrogate data used in the assessment are representative of North American or European operations. Data representative of European operations are considered sufficiently similar to actual processes.
Technology Coverage: Specific technology or technology mix.	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations. Representative datasets, specific to the type of material, are used to represent the actual processes where primary data were not available.
Precision: Measure of the variability of the data values for each data expressed (e.g. variance).	Precision of results are not quantified due to a lack of data. Manufacturer data, and representative data used for upstream processes were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated.	The LCA model included all known mass and energy flows for production of Red-I™ I-Joists. In some instances, surrogate datasets used to represent upstream processes may be missing some data which is propagated in the model. No known processes or activities contributing to more than 2% of the total environmental impact for each indicator are excluded. In total, these missing data represent less than 5% of the mass or energy flows.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest (i.e. geographical coverage, time period and technology coverage).	Data used in the assessment represent typical or average processes as currently reported from multiple data sources, and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis.	The consistency of the assessment is considered to be high. Secondary data sources of similar quality and age are used; with a bias towards USLCI for secondary data, in accordance with the PCR. Different portions of the cradle-to-gate product life cycle are equally considered.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study.	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources.	Data representing energy use at the Stayton, Oregon facility represent an annual average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. A mass and energy balance check was completed during the data collection period. For secondary LCI datasets, both USLCI and Ecoinvent are used, with a bias towards USLCI data, in accordance with the PCR.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions.	Uncertainty related to materials in Red-I™ I-Joists and packaging is low. Primary data for upstream processes, with the exception of several records for the production of oriented strand board, were not available; as such, the study relied upon use of existing representative datasets for these cases. These representative datasets contained relatively recent data (~10 years, or more recent), but in some instances lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are relatively high. The impact assessment method includes impact potentials that lack characterization of providing and receiving environments or tipping points.

[3] Procedure adapted from the European Environmental Footprint (PEF) Guide.

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