TOPAKUSTIK

VERIFIED by SCS GLOBAL SERVICES
ENVIRONMENTAL PRODUCT DECLARATION
BASED ON LCA

Declaration Owner

NH Akustik + Design AG
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Product

TOPAKUSTIK® and ***TOPPERFO®*** Acoustical Panels

UNSPSC Code 56101905
CSI Code 09 84 13

Functional Unit

The functional unit is one square meter of acoustic panel product over a 75-year period

EPD Number and Period of Validity

SCS-EPD-05539
EPD Valid May 28, 2019 through May 27, 2024
Version: August 13, 2019

Product Category Rule

PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 3.2. UL Environment. Sept. 2018
PCR Guidance for Building-Related Products and Services Part B: Non-Metal Ceiling Panel EPD Requirements. Version 1. UL Environment. October 2015.

Program Operator

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SCSglobal SERVICES

Declaration Owner:	NH Akustik + Design AG
Address:	Obseestrasse 11, 6078 Lungern, Switzerland
Declaration Number:	SCS-EPD-05539
Declaration Validity Period:	EPD Valid May 28, 2019 through May 27, 2024
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Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Gerard Mansell, Ph.D., SCS Global Services
LCA Software:	SimaPro 8.3
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external
LCA Reviewer:	Tom Gloria, Ph.D., Industrial Ecology Consultants
Part A Product Category Rule:	PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 3.2. UL Environment. Sept. 2018
Part A PCR Review conducted by:	Lindita Bushi, PhD (Chair); Hugues Imbeault-Tétreault, ing., M.Sc.A.; Jack Geibig
Part B Product Category Rule:	PCR Guidance for Building-Related Products and Services Part B: Non-Metal Ceiling Panel EPD Requirements. Version 1. UL Environment. October 2015.
Part B PCR Review conducted by:	Lindita Bushi, PhD (Chair); Tom Gloria, PhD; and Philip Moser, P.E
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external
EPD Verifier:	Tom Gloria, Ph.D., Industrial Ecology Consultants

Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044, and ISO 21930.*

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.*

In accordance with ISO 21930:2017, EPDs are comparable only if they comply with the core PCR, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

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1. About TOPAKUSTIK®

Since 1991, the company NH Akustik + Design AG with its own developed products and registered brands TOPAKUSTIK® and TOPPERFO® has established itself as an industry leader through continuing innovation, exceptional quality, and expert craftsmanship. We have gained a reputation worldwide as the superior acoustical wood provider. NH Akustik + Design AG uses the highest quality materials and produces to project specific requirements in our own factory. With our strength in systems engineering coupled with the expertise of our fabricators, we are able to bridge the gap between invention and reality. NH Akustik + Design AG offers time tested engineering and installation strategies even for the most unique projects. Our goal is to both encourage creativity and meet its demands.

2. Product

2.1 Product Description

The TOPAKUSTIK® and TOPPERFO® (hereinafter called TOPAKUSTIK®) acoustic panel products are described below.

Product	*Description*
TOPAKUSTIK® Veneer Finish	Wood veneer surfaces are available in all customary types of wood, including FSC certified wood. It can be natural lacquered or it can be stained to match any custom finish. The veneers are custom processed for each project in order to obtain the most even appearance possible for color and pattern. Only select veneers, such as European and North American hardwoods, are included in the assessed products. NH Akustik + Design AG controls the entire process from veneering to the final details in our ISO 9001 certified factories located in Lungern, Switzerland. TOPAKUSTIK®- products are manufactured from medium density fiberboard (MDF) as a standard. MDF panels are produced from soft and hard wood fibers width adding binding agents. Only panels meeting the international emission standards are processed. Panels with no added formaldehyde and FSC certified are available upon request. The TOPAKUSTIK® panel products are fabricated with various perforation or groove patterns and configurations.
TOPAKUSTIK® Melamine Finish	TOPAKUSTIK® products are available in attractive melamine coating decors. The melamine finish has high abrasion resistance.
TOPAKUSTIK® Painted Finish	Paint color matching is available for any manufacturer's color specification. The application is done with the latest generation spray robotics, providing a guaranteed even application. The standard paint is water-based and low VOC classified.

2.2 Application

TOPAKUSTIK® panels provide the primary function of acoustical paneling for interior applications.

2.3 Technical Data

Fire ratings for the TOPAKUSTIK® products are summarized in Table 1, in accordance with the indicated technical standards.

Table 1. *Fire rating specifications for the* TOPAKUSTIK® Acoustic *Panel Products.*

Product	*Fire Rating* (EN13501-1:2007)	*Fire Class* ASTM (E84)
TOPAKUSTIK® Veneer Finish	B-s2, d0	A
TOPAKUSTIK® Melamine Finish	B-s2, d0	A
TOPAKUSTIK® Painted Finish	B-s2, d0	A

The acoustic performance of all the TOPAKUSTIK® panel products is tested in accordance with the relevant European (ISO 11654:1997) and North American (ASTM C423) standards. Sound absorption and noise reduction coefficients for the panel products vary by specific product line and installation configuration. Complete summaries of testing results for the assessed products can be obtained through the manufacturer's website (https://topakustik.ch/en/).

2.4 Delivery Status

Product dimensions and configuration vary by installation. The products include panels with thicknesses of 1.6 cm and 1.7 cm.

2.5 Base Materials

The primary materials include medium density fiberboard (MDF), containing some post-consumer recycled material, fleece, wood veneer, melamine and adhesives. Packaging materials consist of chipboard crates.

Table 2. *Material content for the TOPAKUSTIK® panel products, per square meter.*

Component Material	*TOPAKUSTIK® Veneer Finish*		*TOPAKUSTIK® Melamine Finish*		*TOPAKUSTIK® Painted Finish*	
	(kg/m^2)	(%)	(kg/m^2)	(%)	(kg/m^2)	(%)
Product						
Fleece	$7.3x10^{-2}$	0.72%	$7.3x10^{-2}$	0.68%	$7.1x10^{-2}$	0.72%
MDF	9.34	92%	9.30	87%	9.1	92%
Wood veneer	0.29	2.81%	0.00	0.0%	0.00	0.0%
Melamine	0.0	0.0%	0.83	7.76%	0.00	0.0%
Paint	0.0	0.0%	0.00	0.0%	0.75	7.54%
Adhesive	0.50	4.86%	0.49	4.61%	$2.02x10^{-2}$	0.20%
Total Product	**10.2**	**100%**	**10.7**	**100%**	**9.90**	**100%**
Packaging						
Chipboard	0.57	100%	0.57	100%	0.57	100%
Total Packaging	**0.57**	**100%**	**0.57**	**100%**	**0.57**	**100%**

2.6 Manufacture

TOPAKUSTIK®'s acoustic panels are manufactured at two production facilities: NH Akustik + Design AG in Lungern, Switzerland, and Staufer Holz GmbH, located in Rheinau, Germany. The primary component materials include MDF, synthetic (PET) fleece, wood veneer, melamine, paint and adhesives. Resources use at the fabrication facilities is allocated to the product based on mass.

2.7 Environment and Health during Manufacture

No environmental or health impacts are expected during the manufacture of the acoustical panel product.

2.8 Product Processing/Installation

Typical installation is accomplished using hand tools.

2.9 Packaging

The TOPAKUSTIK® products are packaged for shipment using chipboard cartons.

2.10 Condition of Use

No special conditions of use are noted.

2.11 Environment and Health during use

No environmental or health impacts are expected due to normal use of the panel product.

2.12 Reference Service Life

The Reference Service Life (RSL) of the acoustical panel product is 75 years.

2.13 Extraordinary Effects

No environmental or health impacts are expected due to extraordinary effects including fire and/or water damage and product destruction.

2.14 Re-Use Phase

The acoustic panel product is not typically reused at end-of-life.

2.15 Disposal

At end-of-life, the products may be recycled or disposed of in a landfill or via incineration.

2.16 Further Information

Further information on the product can be found on the manufacturers' website at https://topakustik.ch/en/

3. LCA: Calculation Rules

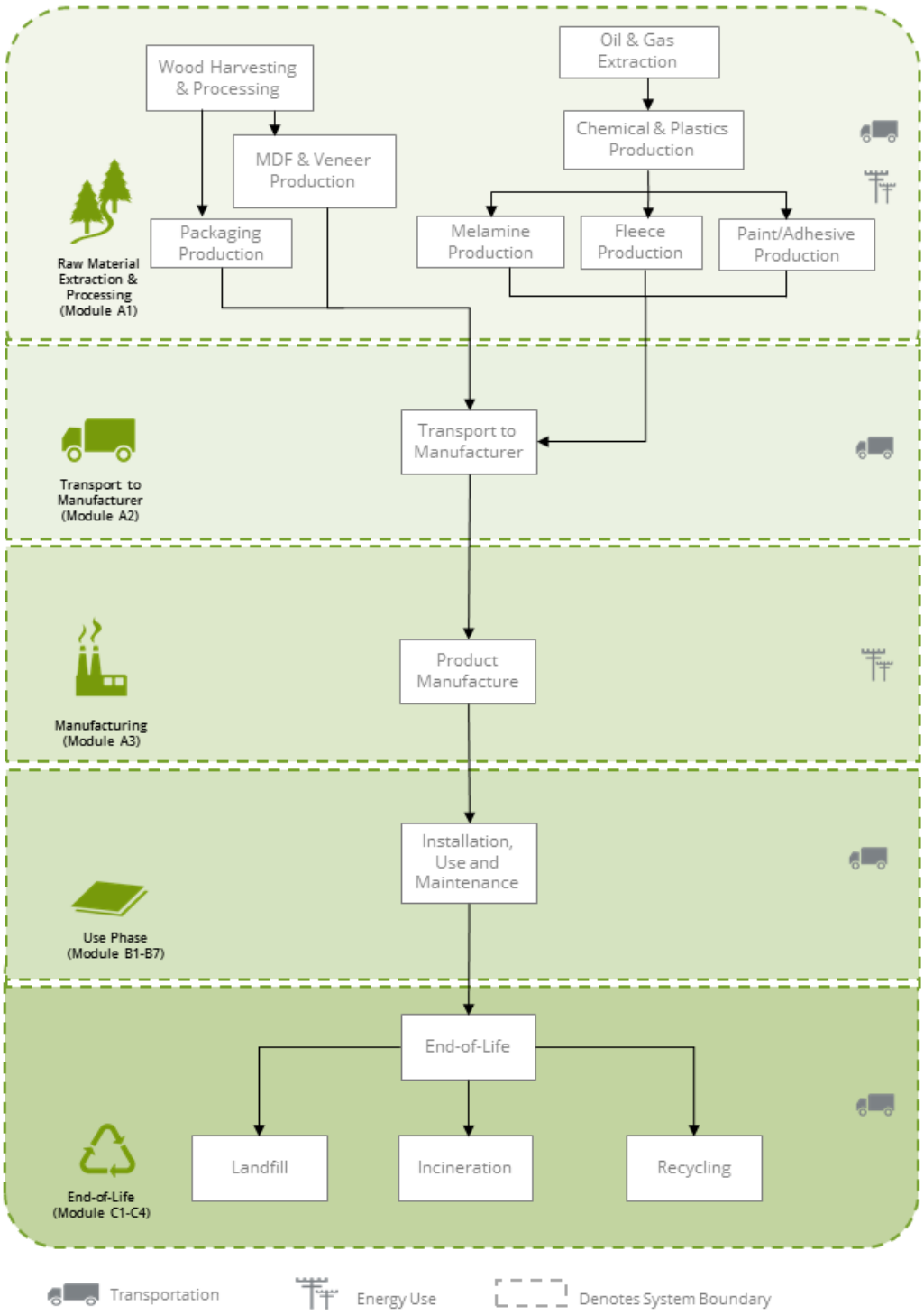
3.1 Functional Unit

The functional unit used in the study is defined as 1 m^2 of acoustic panel installed for use over a 75-year period. The reference flows for the product systems are summarized below.

Parameter	Value			Unit
	TOPAKUSTIK® Veneer Finish	*TOPAKUSTIK® Melamine Finish*	*TOPAKUSTIK® Painted Finish*	
Declared unit	1.00	1.00	1.00	m^2
Declared thickness	1.7	1.7	1.6	cm
Surface weight per declared unit	10.20	10.70	9.90	kg/m^2

3.2 System Boundary

The scope of the EPD is cradle-to-grave, including raw material extraction and processing, transportation, product manufacture, product delivery, installation and use, and product disposal. The life cycle phases included in the product system boundary are shown below.



3.3 Estimates and Assumptions

- The NH Akustik + Design AG and Staufer Holz GmbH facilities are located in Switzerland and Germany, respectively. Electricity and resource use at the facilities is based on regional Ecoinvent data for electricity generation and distribution in Switzerland.

- Electricity and resource use at the production facilities were allocated to the acoustic panel products based on product mass utilizing production data for calendar year 2018 provided by the manufacturer.

- The MDF core containing no added urea formaldehyde (NAUF) was modeled in the LCA using an Ecoinvent dataset for MDF, modified based on the material content information from the supplier's EPD[1].

- Specific data were not available for adhesives used in the products. Based on the SDSs of these chemicals, secondary datasets on acrylic binders and dispersions from the Ecoinvent database were used to represent these chemicals in the LCA model.

- Disposal of product and packaging is modeled based on regional statistics regarding municipal solid waste generation and disposal, as specified in the PCR. The data include end-of-life recycling rates of packaging and product materials.

- For final disposal of the packaging material at end-of-life, all materials are assumed to be transported approximately 32 km (20 miles) by diesel truck to either a landfill, incineration facility, or material reclamation facility (for recycling). Datasets representing disposal in a landfill and waste incineration are from Ecoinvent.

It should also be noted that LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

The PCR requires the results for several inventory flows related to construction products to be reported including energy and resource use and waste and outflows. These are aggregated inventory flows, and do not characterize any potential impact; results should be interpreted taking into account this limitation.

3.4 Cut-off criteria

According to the PCR, processes contributing greater than 1% of the total environmental impact indicator for each impact are included in the inventory. No data gaps were allowed which were expected to significantly affect the outcome of the indicator results. No known flows are deliberately excluded from this EPD

3.5 Background Data

Primary data were provided by TOPAKUSTIK® for their manufacturing facilities. The sources of secondary LCI data are the Ecoinvent database.

[1] Core material_Sonae Arauco_MDF B1 FF_EPD_Medium density fibreboard (MDF) uncoated_en.pdf

Table 3. *Data sources for the TOPAKUSTIK® product system.*

Component	Material Dataset	Data Source	Publication Date
PRODUCT			
Fleece	Fleece, PET {RER}| production | Alloc Rec	Ecoinvent	2016
MDF	MDF, for Topakustik {RER}| medium density fibre board production, uncoated | Alloc Rec	Ecoinvent; Primary data	2016; 2016
Wood veneer	Dry veneer, at plywood plant /kg	Ecoinvent	2016
Melamine	Paper, melamine impregnated {RER}| melamine impregnated paper production | Alloc Rec	Ecoinvent	2016
Adhesives	Acrylic dispersion, without water, in 65% solution state {RER}| acrylic dispersion production, product in 65% solution state | Alloc Rec	Ecoinvent	2016
Paint	Alkyd paint, white, without water, in 60% solution state {RER}| alkyd paint production, white, water-based, product in 60% solution state | Alloc Rec	Ecoinvent	2016
PACKAGING			
Chipboard	Folding boxboard/chipboard {RER}| folding boxboard production | Alloc Rec	Ecoinvent	2016
RESOURCES			
Regional electricity mix	Electricity, medium voltage {CH}| market for | Alloc Rec	Ecoinvent	2016
Wood pellet fuel	Heat, central or small-scale, other than natural gas {RoW}| heat production, wood pellet, at furnace 300kW, state-of-the-art 2014 | Alloc Rec	Ecoinvent	2015
Propane	Heat, district or industrial, natural gas {CH}| market for heat, district or industrial, natural gas | Alloc Rec	Ecoinvent	2015
Light fuel oil	Heat, district or industrial, other than natural gas {CH}| heat production, light fuel oil, at industrial furnace 1MW | Alloc Rec	Ecoinvent	2015
Propane	Heat, district or industrial, other than natural gas {RoW}| heat production, propane, at industrial furnace >100kW | Alloc Rec	Ecoinvent	2015
Solar	Electricity, low voltage {CH}| electricity production, photovoltaic, 3kWp flat-roof installation, multi-Si | Alloc Rec	Ecoinvent	2015
Solar	Electricity, low voltage {CH}| electricity production, photovoltaic, 3kWp flat-roof installation, multi-Si | Alloc Rec	Ecoinvent	2015
TRANSPORTATION			
Truck	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO} | market for	Ecoinvent	2016

3.6 Data Quality

The data quality assessment addressed the following parameters: time-related coverage, geographical coverage, technological coverage, precision, completeness, representativeness, consistency, reproducibility, sources of data, and uncertainty.

Table 4. *Data quality assessment for the TOPAKUSTIK® product system.*

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 (typically 2015 or more recent). All of the data used represented an average of at least one year's worth of data collection, and up to three years in some cases. Manufacturer-supplied data (primary data) are based on annual production for 2018.
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 European. 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. Data representing product disposal are based on regional statistics.
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.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations 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 the acoustic panel products. In some instances, surrogate data used to represent upstream and downstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	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. Data sources of similar quality and age are used with a bias towards Ecoinvent v3 data where available. Different portions of the product life cycle are equally considered; however, it must be noted that final disposition of the product is based on assumptions of current average practices in Europe and the United States.
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 *TOPAKUSTIK®* manufacturing facilities 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. The Ecoinvent database is used for secondary LCI datasets.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the panel products and packaging is low. Actual supplier data for upstream operations was not available for all suppliers and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data (<10 years), but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

3.7 Period under review

The period of review is calendar year 2018.

3.8 Allocation

Manufacturing resource use was allocated to the products based on mass. Impacts from transportation were allocated based on the mass of material and distance transported.

The product system includes some recycled materials, which were allocated using the recycled content allocation method (also known as the 100-0 cut off method). Using the recycled content allocation approach, system inputs with recycled content do not receive any burden from the previous life cycle other than reprocessing of the waste material. At end-of-life, materials which are recycled leave the system boundaries with no additional burden.

3.9 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.

4. LCA: Scenarios and Additional Technical Information

Delivery and Installation stage (A4 - A5)

Distribution of the panel products to the point of installation is included in the assessment. Average transport distance for distribution of the products from the fabrication facility to the point of installation is approximately 700 km by diesel truck. Transportation parameters for modeling are summarized in Table 5.

Table 5. *Transport parameters, per m^2 (A4)*

Parameter	Value	Unit
Liters of fuel	15.5	l/100 km
Transport distance	700	km
Capacity utilization (including empty runs)	67	%
Gross density of products transported – Veneer Finish	600	kg/m^3
Gross density of products transported – Melamine Finish	629	kg/m^3
Gross density of products transported – Painted Finish	619	kg/m^3
Gross mass of products transported – Painted Finish	1.0	-

Installation of the product is accomplished using hand tools with no associated emissions (dust or VOCs) and negligible impacts. No scrap is generated at installation as the products are custom built for the specific application.

The impacts associated with packaging disposal are included with the installation phase, as per PCR requirements. Using the recycling rates for packaging, there are 0.418 kg of packaging waste (chipboard) disposed. Assuming 44% biogenic carbon content of the chipboard results in a GWP of 0.681 kg CO_2e per m^2 of panel product.

Use stage (B1)

No impacts are associated with the use of the product over the Reference Service Lifetime.

Maintenance stage (B2)

The panel product can be cleaned and maintained by removing dust and dirt with a soft bristle brush, with no associated impacts.

Repair/Replacement/Refurbishment stage (B3 - B5)

Product repair, replacement and refurbishment are not relevant during the lifetime of the product. No product replacements are required over the 75 year building lifetime.

Building operation stage (B6 – B7)

There is no operational energy or water use associated with the use of the product and the results for these stages are zero.

Disposal stage (C1 - C4)

The disposal stage includes demolition of the products (*C1*); transport of the panel products to waste treatment facilities (*C2*); waste processing (*C3*); and associated emissions as the product degrades in a landfill or is burned in an incinerator (*C4*). For the TOPAKUSTIK® panel products, no emissions are generated during demolition (*C1*) while no waste processing (*C3*) is required for incineration or landfill disposal. Transportation of waste materials at end-of-life (*C2*) assumes a 32 km (20 mile) average distance to disposal, consistent with assumptions used in the US EPA WARM model. The relevant recycling rates used for the product and packaging are based on regional statistics regarding municipal solid waste generation and disposal, as specified in the PCR. The data include end-of-life recycling rates of packaging and product materials. The relevant recycling rates used for the product and packaging are summarized in Table 6.

Table 6. *Recycling rates for materials at end-of-life.*

Material	Product	Packaging
Recycling Rates		
Wood	50%	39.8%
Plastics	50%	n/a
Disposal of Non-recyclables		
Incineration	26%	45%
Landfill	74%	55%

5. LCA: Results

Results of the Life Cycle Assessment are presented below. It is noted that LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

Table 7. *Life cycle phases included in the product system boundary.*

Product			Construction Process		Use							End-of-life				Benefits and loads beyond the system boundary
A1	A2	A3	A4	A5	B1	B1	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material extraction and processing	Transport to manufacturer	Manufacturing	Transport	Construction - installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, recovery and/or recycling potential
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	MND

The following environmental impact category indicators are reported using characterization factors based on the CML-IA methodology:

Impact Category	Unit
Global Warming Potential (GWP 100)	kg CO_2 eq
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq
Acidification Potential of soil and water (AP)	kg SO_2 eq
Eutrophication Potential (EP)	kg PO_4^{3-} eq
Photochemical Oxidant Creation Potential (POCP)	kg C_2H_4 eq
Abiotic depletion potential (ADP-elements) for non-fossil resources	kg Sb eq
Abiotic depletion potential (ADP-fossil fuels) for fossil resources	MJ, LHV

The following optional environmental impact category indicators are also reported based on characterization factors from the U.S. EPA's Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts – TRACI 2.1:

Impact Category	Unit
Global Warming Potential (GWP 100)	kg CO_2 eq
Ozone Depletion Potential (ODP)	kg CFC 11 eq
Acidification Potential (AP)	kg SO_2 eq
Eutrophication Potential (EP)	kg N eq
Smog Formation Potential (POCP)	kg O_3 eq
Fossil Fuel Depletion Potential (FFD)	MJ Surplus, LHV

Table 8. *Life Cycle Impact Assessment (LCIA) results for the **TOPAKUSTIK® Veneer Finish** panel product over a 75-yr time horizon. All values are rounded to two significant digits. Results reported in MJ are calculated using lower heating values.*

Impact category	Unit	Module A1 - Raw material extraction and processing	Module A2 - Transport to manufacturer	Module A3 - Manufacturing	Module A4 - Transport	Module A5 - Construction - installation	Module C2 - Transport	Module C4 - Disposal	Module D - Reuse, recovery and/or recycling potential
CML-IA									
Global warming (GWP, 100 year)	kg CO_2 eq	12	1.1	10	1.3	$4.0x10^{-2}$	0.43	0.48	MND
	%	48%	4.2%	39%	4.8%	0.15%	1.6%	1.9%	
Acidification	kg SO_2 eq	$7.9x10^{-2}$	$4.3x10^{-3}$	$2.9x10^{-2}$	$5.0x10^{-3}$	$1.5x10^{-4}$	$2.0x10^{-3}$	$5.0x10^{-4}$	MND
	%	66%	3.6%	24%	4.2%	0.12%	1.7%	0.42%	
Eutrophication	kg $(PO_4)^{3-}$ eq	$2.5x10^{-2}$	$9.7x10^{-4}$	$1.6x10^{-2}$	$1.1x10^{-3}$	$5.3x10^{-4}$	$4.3x10^{-4}$	$1.1x10^{-2}$	MND
	%	45%	1.8%	29%	2.1%	0.98%	0.79%	20%	
Ozone depletion	kg CFC-11 eq.	$1.2x10^{-6}$	$2.0x10^{-7}$	$2.8x10^{-6}$	$2.3x10^{-7}$	$5.0x10^{-9}$	$7.7x10^{-8}$	$1.2x10^{-8}$	MND
	%	26%	4.3%	62%	5.1%	0.11%	1.7%	0.27%	
Smog	kg C_2H_4 eq	$6.6x10^{-3}$	$1.8x10^{-4}$	$1.6x10^{-3}$	$2.1x10^{-4}$	$8.4x10^{-6}$	$8.0x10^{-5}$	$9.9x10^{-5}$	MND
	%	75%	2.1%	19%	2.4%	0.09%	0.91%	1.1%	
Abiotic depletion (elements)	kg Sb eq	$4.5x10^{-5}$	$3.2x10^{-6}$	$1.7x10^{-5}$	$3.7x10^{-6}$	$2.1x10^{-8}$	$2.8x10^{-7}$	$8.5x10^{-8}$	MND
	%	65%	4.6%	24%	5.4%	0.03%	0.41%	0.12%	
Abiotic depletion (fossil fuels)	MJ	200	17	140	20	0.43	6.4	1.3	MND
	%	52%	4.5%	37%	5.2%	0.11%	1.7%	0.34%	
TRACI 2.1									
Global warming (GWP, 100 year)	kg CO_2 eq	12	1.1	10	1.2	$3.7x10^{-2}$	0.42	0.41	MND
	%	48%	4.2%	40%	4.9%	0.15%	1.7%	1.6%	
Acidification	kg SO_2 eq	$7.9x10^{-2}$	$5.0x10^{-3}$	$2.9x10^{-2}$	$5.7x10^{-3}$	$1.8x10^{-4}$	$2.5x10^{-3}$	$6.0x10^{-4}$	MND
	%	65%	4.1%	24%	4.7%	0.15%	2.0%	0.49%	
Eutrophication	kg N eq	$4.6x10^{-2}$	$1.2x10^{-3}$	$3.6x10^{-2}$	$1.4x10^{-3}$	$1.4x10^{-3}$	$3.5x10^{-4}$	$2.9x10^{-2}$	MND
	%	40%	1.1%	31%	1.2%	1.2%	0.30%	25%	
Ozone depletion	kg CFC-11 eq	$1.2x10^{-6}$	$2.0x10^{-7}$	$2.8x10^{-6}$	$2.3x10^{-7}$	$5.0x10^{-9}$	$7.7x10^{-8}$	$1.2x10^{-8}$	MND
	%	26%	4.3%	62%	5.1%	0.11%	1.7%	0.27%	
Smog	kg O_3 eq	0.89	0.12	0.35	0.14	$4.8x10^{-3}$	$6.8x10^{-2}$	$1.5x10^{-2}$	MND
	%	56%	7.3%	22%	8.6%	0.31%	4.3%	0.93%	
Fossil fuel depletion	MJ surplus	22	2.3	17	2.7	$6.0x10^{-2}$	0.91	0.17	MND
	%	48%	5.2%	38%	6.1%	0.13%	2.0%	0.37%	

MND = Module not declared

Table 9. *Resource use, waste and outflows for the **TOPAKUSTIK® Veneer Finish** panel product over a 75-yr time horizon. All values are rounded to two significant digits. Results reported in MJ are calculated using lower heating values.*

Impact category	Unit	Module A1 - Raw material extraction and processing	Module A2 - Transport to manufacturer	Module A3 - Manufacturing	Module A4 - Transport	Module A5 - Construction - installation	Module C2 - Transport	Module C4 - Disposal	Module D - Reuse, recovery and/or recycling potential
Resource Use									
Use of renewable primary energy excluding the renewable primary energy resources used as raw materials	MJ	7.6	0.20	80	0.24	$3.6x10^{-3}$	$2.8x10^{-2}$	$4.0x10^{-2}$	MND
	%	8.6%	0.23%	91%	0.28%	0.00%	0.03%	0.05%	
Use of renewable primary energy resources used as raw materials	MJ	140	0.0	0.0	0.0	0.0	0.0	0.0	MND
	%	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	MND
Use of non-renewable primary energy resources used as raw materials	MJ.	INA	INA	INA	INA	INA	INA	INA	MND
Use of secondary materials	Kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	MND
Use of renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	MND
Use of non-renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	MND
Use of net fresh water	m^3	1.3	$1.2x10^{-2}$	1.4	$1.4x10^{-2}$	$3.2x10^{-4}$	$2.2x10^{-3}$	$3.3x10^{-3}$	MND
	%	48%	0.44%	50%	0.51%	0.01%	0.08%	0.12%	
Waste Flows									
Hazardous waste disposed	kg	$5.5x10^{-4}$	$1.0x10^{-5}$	$4.8x10^{-4}$	$1.1x10^{-5}$	$1.9x10^{-7}$	$2.1x10^{-6}$	$1.4x10^{-6}$	MND
	%	52%	0.95%	46%	1.1%	0.02%	0.20%	0.13%	
Non-hazardous waste disposed	kg	1.9	0.76	2.1	0.89	0.19	$2.6x10^{-2}$	4.0	MND
	%	19%	7.7%	21%	9.0%	1.9%	0.27%	41%	
Radioactive waste disposed (high-level)	kg	$9.6x10^{-5}$	$8.7x10^{-7}$	$5.5x10^{-4}$	$1.2x10^{-6}$	$1.5x10^{-8}$	$1.5x10^{-7}$	$1.3x10^{-7}$	MND
	%	15%	0.13%	85%	0.18%	0.00%	0.02%	0.02%	
Radioactive waste disposed (low-level)	kg	$5.7x10^{-4}$	$1.1x10^{-4}$	$2.9x10^{-3}$	$1.3x10^{-4}$	$2.7x10^{-6}$	$4.4x10^{-5}$	$6.6x10^{-6}$	MND
	%	15%	3.0%	77%	3.5%	0.07%	1.2%	0.18%	
Components for re-use	kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	MND
Materials for recycling	kg	0.0	0.0	3.2	0.0	0.0	0.0	0.0	MND
	%	0.00%	0.00%	100%	0.00%	0.00%	0.00%	0.00%	
Materials for energy recovery	Kg	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	MND
Exported energy	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	MND

MND = Module not declared
INA = Indicator not assessed
Neg. = Negligible

Table 10. *Life Cycle Impact Assessment (LCIA) results for the* ***TOPAKUSTIK® Melamine Finish*** *panel product over a 75-yr time horizon. All values are rounded to two significant digits. Results reported in MJ are calculated using lower heating values.*

Impact category	Unit	Module A1 - Raw material extraction and processing	Module A2 - Transport to manufacturer	Module A3 - Manufacturing	Module A4 - Transport	Module A5 - Construction - installation	Module C2 - Transport	Module C4 - Disposal	Module D - Reuse, recovery and/or recycling potential
CML-IA									
Global warming (GWP, 100 year)	kg CO_2 eq	16	1.1	2.5	1.3	$4.0x10^{-2}$	0.45	0.73	MND
	%	72%	4.9%	11%	6.0%	0.18%	2.0%	3.3%	
Acidification	kg SO_2 eq	0.10	$4.3x10^{-3}$	$1.0x10^{-2}$	$5.2x10^{-3}$	$1.5x10^{-4}$	$2.1x10^{-3}$	$5.6x10^{-4}$	MND
	%	82%	3.5%	8.0%	4.2%	0.12%	1.7%	0.45%	
Eutrophication	kg $(PO_4)^{3-}$ eq	$3.0x10^{-2}$	$9.8x10^{-4}$	$6.3x10^{-3}$	$1.2x10^{-3}$	$5.3x10^{-4}$	$4.5x10^{-4}$	$1.1x10^{-2}$	MND
	%	59%	1.9%	12%	2.3%	1.1%	0.89%	22%	
Ozone depletion	kg CFC-11 eq.	$1.7x10^{-6}$	$2.0x10^{-7}$	$1.0x10^{-6}$	$2.4x10^{-7}$	$5.0x10^{-9}$	$8.1x10^{-8}$	$1.3x10^{-8}$	MND
	%	52%	6.2%	31%	7.6%	0.15%	2.5%	0.42%	
Smog	kg C_2H_4 eq	$8.1x10^{-3}$	$1.8x10^{-4}$	$5.9x10^{-4}$	$2.2x10^{-4}$	$8.4x10^{-6}$	$8.4x10^{-5}$	$1.4x10^{-4}$	MND
	%	87%	2.0%	6.4%	2.4%	0.09%	0.91%	1.5%	
Abiotic depletion (elements)	kg Sb eq	$6.5x10^{-5}$	$3.2x10^{-6}$	$4.4x10^{-6}$	$3.9x10^{-6}$	$2.1x10^{-8}$	$3.0x10^{-7}$	$9.4x10^{-8}$	MND
	%	85%	4.1%	5.7%	5.1%	0.03%	0.39%	0.12%	
Abiotic depletion (fossil fuels)	MJ	260	17	30	21	0.43	6.8	1.4	MND
	%	77%	5.0%	8.9%	6.1%	0.13%	2.0%	0.41%	
TRACI 2.1									
Global warming (GWP, 100 year)	kg CO_2 eq	16	1.1	2.5	1.3	$3.7x10^{-2}$	0.45	0.62	MND
	%	72%	5.0%	11%	6.1%	0.17%	2.1%	2.9%	
Acidification	kg SO_2 eq	0.10	$5.0x10^{-3}$	$1.0x10^{-2}$	$6.0x10^{-3}$	$1.8x10^{-4}$	$2.6x10^{-3}$	$6.7x10^{-4}$	MND
	%	81%	3.9%	8.1%	4.7%	0.14%	2.0%	0.53%	
Eutrophication	kg N eq	$5.5x10^{-2}$	$1.2x10^{-3}$	$1.3x10^{-2}$	$1.5x10^{-3}$	$1.4x10^{-3}$	$3.6x10^{-4}$	$3.1x10^{-2}$	MND
	%	53%	1.2%	13%	1.4%	1.4%	0.35%	30%	
Ozone depletion	kg CFC-11 eq	$1.7x10^{-6}$	$2.0x10^{-7}$	$1.0x10^{-6}$	$2.4x10^{-7}$	$5.0x10^{-9}$	$8.1x10^{-8}$	$1.3x10^{-8}$	MND
	%	52%	6.2%	31%	7.6%	0.15%	2.5%	0.42%	
Smog	kg O_3 eq	1.1	0.12	0.14	0.14	$4.8x10^{-3}$	$7.1x10^{-2}$	$1.6x10^{-2}$	MND
	%	69%	7.4%	8.9%	9.0%	0.31%	4.5%	1.0%	
Fossil fuel depletion	MJ surplus	31	2.3	2.5	2.9	$6.0x10^{-2}$	0.96	0.18	MND
	%	78%	5.9%	6.3%	7.2%	0.15%	2.4%	0.45%	

MND = Module not declared

Table 11. *Resource use, waste and outflows for the **TOPAKUSTIK® Melamine Finish** panel product over a 75-yr time horizon. All values are rounded to two significant digits. Results reported in MJ are calculated using lower heating values.*

Impact category	Unit	Module A1 - Raw material extraction and processing	Module A2 - Transport to manufacturer	Module A3 - Manufacturing	Module A4 - Transport	Module A5 - Construction - installation	Module C2 - Transport	Module C4 - Disposal	Module D - Reuse, recovery and/or recycling potential
Resource Use									
Use of renewable primary energy excluding the renewable primary energy resources used as raw materials	MJ	8.9	0.20	50	0.26	$3.6x10^{-3}$	$2.9x10^{-2}$	$4.6x10^{-2}$	MND
	%	15%	0.34%	84%	0.43%	0.01%	0.05%	0.08%	
Use of renewable primary energy resources used as raw materials	MJ	150	0.0	0.0	0.0	0.0	0.0	0.0	MND
	%	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	MND
Use of non-renewable primary energy resources used as raw materials	MJ.	INA	INA	INA	INA	INA	INA	INA	MND
Use of secondary materials	Kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	MND
Use of renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	MND
Use of non-renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	MND
Use of net fresh water	m^3	1.8	$1.2x10^{-2}$	0.81	$1.5x10^{-2}$	$3.2x10^{-4}$	$2.3x10^{-3}$	$3.8x10^{-3}$	MND
	%	68%	0.46%	31%	0.56%	0.01%	0.09%	0.14%	
Waste Flows									
Hazardous waste disposed	kg	$6.0x10^{-4}$	$1.0x10^{-5}$	$2.3x10^{-4}$	$1.2x10^{-5}$	$1.9x10^{-7}$	$2.2x10^{-6}$	$1.8x10^{-6}$	MND
	%	70%	1.2%	27%	1.4%	0.02%	0.26%	0.21%	
Non-hazardous waste disposed	kg	2.2	0.77	0.23	0.94	0.19	$2.8x10^{-2}$	4.2	MND
	%	26%	8.9%	2.7%	11%	2.2%	0.32%	49%	
Radioactive waste disposed (high-level)	kg	$1.1x10^{-4}$	$8.7x10^{-7}$	$3.2x10^{-4}$	$1.2x10^{-6}$	$1.5x10^{-8}$	$1.6x10^{-7}$	$1.6x10^{-7}$	MND
	%	25%	0.20%	74%	0.29%	0.00%	0.04%	0.04%	
Radioactive waste disposed (low-level)	kg	$7.3x10^{-4}$	$1.1x10^{-4}$	$1.3x10^{-3}$	$1.4x10^{-4}$	$2.7x10^{-6}$	$4.6x10^{-5}$	$7.1x10^{-6}$	MND
	%	31%	4.7%	56%	5.8%	0.12%	1.9%	0.30%	
Components for re-use	kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	MND
Materials for recycling	kg	0.0	0.0	3.2	0.0	0.0	0.0	0.0	MND
	%	0.00%	0.00%	100%	0.00%	0.00%	0.00%	0.00%	
Materials for energy recovery	Kg	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	MND
Exported energy	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	MND

MND = Module not declared
INA = Indicator not assessed
Neg. = Negligible

Table 12. *Life Cycle Impact Assessment (LCIA) results for the **TOPAKUSTIK® Painted Finish** panel product over a 75-yr time horizon. All values are rounded to two significant digits. Results reported in MJ are calculated using lower heating values.*

Impact category	Unit	Module A1 - Raw material extraction and processing	Module A2 - Transport to manufacturer	Module A3 - Manufacturing	Module A4 - Transport	Module A5 - Construction - installation	Module C2 - Transport	Module C4 - Disposal	Module D - Reuse, recovery and/or recycling potential
CML-IA									
Global warming (GWP, 100 year)	kg CO_2 eq	16	1.1	2.5	1.2	$4.0x10^{-2}$	0.41	0.55	MND
	%	73%	5.0%	12%	5.7%	0.19%	1.9%	2.6%	
Acidification	kg SO_2 eq	0.11	$4.3x10^{-3}$	$1.0x10^{-2}$	$4.9x10^{-3}$	$1.5x10^{-4}$	$2.0x10^{-3}$	$5.0x10^{-4}$	MND
	%	84%	3.2%	7.6%	3.7%	0.11%	1.5%	0.38%	
Eutrophication	kg $(PO_4)^{3-}$ eq	$3.2x10^{-2}$	$9.6x10^{-4}$	$6.3x10^{-3}$	$1.1x10^{-3}$	$5.3x10^{-4}$	$4.2x10^{-4}$	$1.0x10^{-2}$	MND
	%	62%	1.9%	12%	2.1%	1.0%	0.81%	20%	
Ozone depletion	kg CFC-11 eq.	$1.5x10^{-6}$	$1.9x10^{-7}$	$1.0x10^{-6}$	$2.2x10^{-7}$	$5.0x10^{-9}$	$7.5x10^{-8}$	$1.2x10^{-8}$	MND
	%	50%	6.5%	33%	7.5%	0.17%	2.5%	0.41%	
Smog	kg C_2H_4 eq	$8.8x10^{-3}$	$1.8x10^{-4}$	$5.9x10^{-4}$	$2.1x10^{-4}$	$8.4x10^{-6}$	$7.8x10^{-5}$	$1.1x10^{-4}$	MND
	%	88%	1.8%	5.9%	2.1%	0.08%	0.78%	1.1%	
Abiotic depletion (elements)	kg Sb eq	$6.4x10^{-5}$	$3.1x10^{-6}$	$4.4x10^{-6}$	$3.6x10^{-6}$	$2.1x10^{-8}$	$2.7x10^{-7}$	$8.4x10^{-8}$	MND
	%	85%	4.2%	5.8%	4.8%	0.03%	0.36%	0.11%	
Abiotic depletion (fossil fuels)	MJ	220	17	30	19	0.43	6.3	1.3	MND
	%	75%	5.7%	10%	6.5%	0.14%	2.1%	0.42%	
TRACI 2.1									
Global warming (GWP, 100 year)	kg CO_2 eq	15	1.1	2.5	1.2	$3.7x10^{-2}$	0.41	0.47	MND
	%	73%	5.1%	12%	5.8%	0.18%	2.0%	2.2%	
Acidification	kg SO_2 eq	0.11	$4.9x10^{-3}$	$1.0x10^{-2}$	$5.6x10^{-3}$	$1.8x10^{-4}$	$2.4x10^{-3}$	$6.0x10^{-4}$	MND
	%	82%	3.7%	7.9%	4.3%	0.14%	1.8%	0.46%	
Eutrophication	kg N eq	$7.0x10^{-2}$	$1.2x10^{-3}$	$1.3x10^{-2}$	$1.4x10^{-3}$	$1.4x10^{-3}$	$3.4x10^{-4}$	$2.9x10^{-2}$	MND
	%	60%	1.0%	11%	1.2%	1.2%	0.29%	25%	
Ozone depletion	kg CFC-11 eq	$1.5x10^{-6}$	$1.9x10^{-7}$	$1.0x10^{-6}$	$2.2x10^{-7}$	$5.0x10^{-9}$	$7.5x10^{-8}$	$1.2x10^{-8}$	MND
	%	49%	6.5%	33%	7.5%	0.17%	2.5%	0.41%	
Smog	kg O_3 eq	1.0	0.11	0.14	0.13	$4.8x10^{-3}$	$6.6x10^{-2}$	$1.5x10^{-2}$	MND
	%	68%	7.7%	9.4%	8.8%	0.32%	4.4%	0.98%	
Fossil fuel depletion	MJ surplus	25	2.3	2.5	2.7	$6.0x10^{-2}$	0.88	0.16	MND
	%	74%	6.9%	7.5%	8.0%	0.18%	2.7%	0.49%	

MND = Module not declared

Table 13. *Resource use, waste and outflows for the **TOPAKUSTIK® Painted Finish** panel product over a 75-yr time horizon. All values are rounded to two significant digits. Results reported in MJ are calculated using lower heating values.*

Impact category	Unit	Module A1 - Raw material extraction and processing	Module A2 - Transport to manufacturer	Module A3 - Manufacturing	Module A4 - Transport	Module A5 - Construction - installation	Module C2 - Transport	Module C4 - Disposal	Module D - Reuse, recovery and/or recycling potential
Resource Use									
Use of renewable primary energy excluding the renewable primary energy resources used as raw materials	MJ %	8.3 14%	0.20 0.34%	50 85%	0.24 0.40%	$3.6x10^{-3}$ 0.01%	$2.7x10^{-2}$ 0.05%	$4.1x10^{-2}$ 0.07%	MND
Use of renewable primary energy resources used as raw materials	MJ %	150 100%	0.0 0.00%	0.0 0.00%	0.0 0.00%	0.0 0.00%	0.0 0.00%	0.0 0.00%	MND
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA	INA	INA	MND
Use of non-renewable primary energy resources used as raw materials	MJ.	INA	INA	INA	INA	INA	INA	INA	MND
Use of secondary materials	Kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	MND
Use of renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	MND
Use of non-renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	MND
Use of net fresh water	m^3 %	1.5 65%	$1.2x10^{-2}$ 0.49%	0.81 34%	$1.4x10^{-2}$ 0.57%	$3.2x10^{-4}$ 0.01%	$2.2x10^{-3}$ 0.09%	$3.3x10^{-3}$ 0.14%	MND
Waste Flows									
Hazardous waste disposed	kg %	$5.7x10^{-4}$ 69%	$9.8x10^{-6}$ 1.2%	$2.3x10^{-4}$ 28%	$1.1x10^{-5}$ 1.3%	$1.9x10^{-7}$ 0.02%	$2.0x10^{-6}$ 0.25%	$1.5x10^{-6}$ 0.18%	MND
Non-hazardous waste disposed	kg %	3.3 35%	0.75 8.2%	0.23 2.5%	0.87 9.4%	0.19 2.1%	$2.6x10^{-2}$ 0.28%	3.9 42%	MND
Radioactive waste disposed (high-level)	kg %	$1.0x10^{-4}$ 24%	$8.6x10^{-7}$ 0.20%	$3.2x10^{-4}$ 75%	$1.2x10^{-6}$ 0.27%	$1.5x10^{-8}$ 0.00%	$1.4x10^{-7}$ 0.03%	$1.3x10^{-7}$ 0.03%	MND
Radioactive waste disposed (low-level)	kg %	$6.5x10^{-4}$ 29%	$1.1x10^{-4}$ 4.8%	$1.3x10^{-3}$ 58%	$1.3x10^{-4}$ 5.6%	$2.7x10^{-6}$ 0.12%	$4.2x10^{-5}$ 1.9%	$6.5x10^{-6}$ 0.29%	MND
Components for re-use	kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	MND
Materials for recycling	kg %	0.0 0.00%	0.0 0.00%	3.2 100%	0.0 0.00%	0.0 0.00%	0.0 0.00%	0.0 0.00%	MND
Materials for energy recovery	Kg	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	MND
Exported energy	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	MND

MND = Module not declared | INA = Indicator not assessed | Neg. = Negligible

6. LCA: Interpretation

The main contributions to indicator results are from the raw material extraction and processing phase (*A1*) followed by the product manufacturing phase (*A3*). Other life cycle stage results vary across indicators although generally contribute less than 5%-8% to the total life cycle impacts of the product system.

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