

Declaration Owner

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Product

TechPanel™ Structural Insulated Panel

Functional Unit

The functional unit is 1 m^2 of installed product with a thickness that gives an average thermal resistance of RSI = 1 m^2K/W with a Reference Service Life of 75-years

EPD Number and Period of Validity

SCS-EPD-08294
EPD Valid October 3, 2022 through October 2, 2027
Version: October 20, 2022

Product Category Rule

ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services

Program Operator

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Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Beth Cassese, SCS Global Services
LCA Software and LCI database:	OpenLCA 1.10.3 software and the Ecoinvent v3.8 database
Product's Intended Application:	Insulated panels for walls, roofs, and floors
Product RSL:	75 Years
Markets of Applicability:	North America
EPD Type:	Product-Specific
EPD Scope:	Cradle-to-Grave
LCIA Method and Version:	TRACI and CML-IA Baseline
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☒ internal ☐ external
LCA Reviewer:	 Ilan MacAdam-Somer, SCS Global Services
Product Category Rule:	ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services
PCR Review conducted by:	ISO Technical Committee
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external
EPD Verifier:	 Thomas Gloria, Ph.D., Industrial Ecology Consultants
Declaration Contents:	1. ABOUT ZS2 Technologies ..... 2 2. PRODUCT ..... 2 3. LCA: CALCULATION RULES ..... 4 4. LCA: SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION ..... 8 5. LCA: RESULTS ..... 10 6. LCA: INTERPRETATION ..... 13 7. Additional Environmental Information ..... 13 7. REFERENCES 14

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 ZS2 Technologies

ZS2 Technologies was founded on the premise that chemistry and sustainability-driven innovation has the opportunity to advance construction and close the gap in the industry with the implementation of prefabricated manufacturing techniques, advances in software, and technologies in construction, with a focus on leading-edge material science.

2. PRODUCT

2.1 Product Description

The TechPanel™ product uses expanded polystyrene (EPS) insulation as the insulating material, sandwiched between the proprietary TechBoard™ which is a magnesium-based cement board.

2.2 Application

TechPanel™ structural insulated panel products are designed for a variety of applications, including walls, roofs, and flooring in both residential, commercial, industrial, and agricultural markets.

2.3 Technical Data

Table 1. *TechPanel™ Technical Data*

Property	Unit	Value
Weight	lb/ft^2 kg/m^2	4.46 21.8
Thickness	Inches Centimeter	6.5 16.5

2.4 Base Materials

Table 2. *TechPanel™ Material Components per m^2 of RSI=1m^2K/W*

Product	Amount (kg)	Percentage of Total Mass
TechBoard Sheathing	3.19	72.1%
Lumber	0.836	18.9%
Expanded Polystyrene (EPS) Insulation	0.318	7.2%
Loctite Adhesive	0.045	1.0%
Titebond	0.023	0.5%
Staples	0.006	0.1%
Adfast Adhesive	0.003	0.1%
Total	**4.42**	**100%**
Packaging	**Amount (kg)**	**Percentage of Total Mass**
Woven coated polyethylene & polypropylene	0.014	100%

2.5 Manufacture

TechPanel™ products are manufactured by laminating a rigid core insulation material between two high strength facings. Lumber is used to form a frame around the edges and top and bottom of the panel. Additional adhesive and staples are used to connect panels.

2.6 Flow Diagram

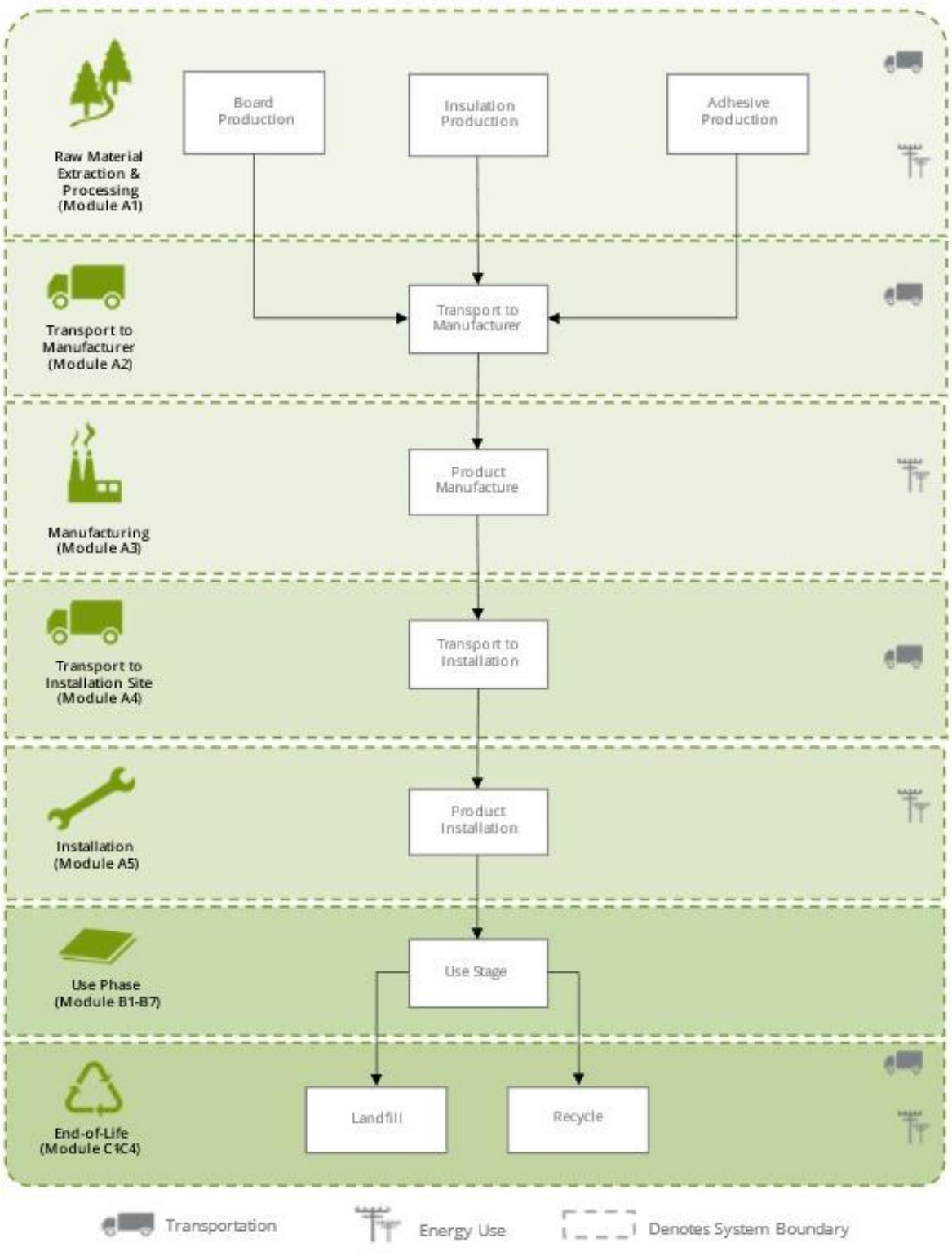


Figure 1. *Flow diagram and system boundaries for the TechPanel™ Structural Insulated Panel product.*

2.8 Product Processing/ Installation

Typical installation is completed using manual labor but may require additional adhesive and staples that are left over from the manufacture process and shipped with the final product.

2.9 Packaging

TechPanel™ products are packaged for shipment using a woven coated polyethylene and polypropylene material.

2.10 Condition of Use

No special conditions of use are noted.

2.11 Reference Service Life

The Reference Service Life (RSL) of the TechPanel™ products is 75-years.

2.12 Re-Use Phase

There are currently no scenarios for re-use of TechPanel™ Structural Insulated Panel products at end-of-life.

2.13 Disposal

At end-of-life, the TechPanel™ Structural Insulated Panel products may be disposed of in a landfill or via incineration, following local regulations.

3. LCA: CALCULATION RULES

3.1 Functional Unit

The functional unit used in the study, 1 m^2 of installed product with a thickness that gives an average thermal resistance RSI = 1m^2K/W over a building service life of 75 years.

Table 3. *TechPanel™ Structural Insulated Panel Functional Unit Properties*

Property	Unit	Value
Mass	kg	4.42
Thickness to achieve RSI = 1 m^2K/W	cm	7.48

3.2 Estimates and Assumptions

- Specific data were not available for the linking composite included in the TechBoard™ raw material. The secondary dataset for acrylic binder from the Ecoinvent database was used.
- Specific data were not available for the fiberglass mesh included in the TechBoard™ raw material. The secondary dataset for glass fibre from the Ecoinvent database was used.
- The secondary dataset for methylene diphenyl diisocyanate was used to represent the methylene bisphenyl isocyanate and polymeric diphenylmethane diisocyanate in the Loctite Adhesive.
- The transportation distance for the lumber raw material was assumed at 200 kilometers by truck.
- The Reference Service Life (RSL) of the products was modeled as 75 years, as indicated by product experts at ZS2 Technologies.
- Packaging material described as woven coated polyethylene and polypropylene was modeled as 50% packaging film, low density polyethylene and 50% textile, non-woven polypropylene.
- Transportation distance of packaging material to manufacture site is assumed to be 100 kilometers by truck.
- Transportation distance of manufacturer waste to disposal is assumed to be 50 kilometers by truck.

- Installation waste is assumed to be 10%.
- Transportation distance of the installation waste to disposal is assumed to be 100 kilometers.
- The use phase (Modules B1-B7) is assumed to have no impacts, as there is no energy or water use associated with these modules.
- For the product end-of-life, disposal of the product is assumed to be 4.1% recycle and the remainder in a landfill.
- Transportation distance of the product at the end-of-life to disposal is assumed to be 100 kilometers.

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.

3.3 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.

3.4 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.

Table 4. *TechPanel™ Structural Insulated Panel System Boundaries.*

Product			Construction Process		Use							End-of-life				Benefits and loads beyond the system boundary
A1	A2	A3	A4	A5	B1	B2	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

X = Included in system boundary
MND = Module not declared

3.5 Background Data

Primary data were provided by ZS2 Technologies for the Calgary, AB facility for the TechPanel™ Structural Insulated Panel products. The sources of secondary LCI data are the Ecoinvent database (v3.8. 2021).

Table 5. *LCI datasets and associated databases used to model the ZS2 TechPanel™ Structural Insulated Panel products.*

Component	Dataset	Data Source	Publication Date
Product			
Adfast Adhesive	market for methylene diphenyl diisocyanate | methylene diphenyl diisocyanate | Cutoff, U	Ecoinvent 3.8	2021
	market for phenyl isocyanate | phenyl isocyanate | Cutoff, U	Ecoinvent 3.8	2021
	market for isobutane | isobutane | Cutoff, U	Ecoinvent 3.8	2021
	market for propane | propane | Cutoff, U	Ecoinvent 3.8	2021
	market for dimethyl ether | dimethyl ether | Cutoff, U	Ecoinvent 3.8	2021
Expanded Polystyrene (EPS) Insulation	market for polystyrene foam slab | polystyrene foam slab | Cutoff, U	Ecoinvent 3.8	2021
Loctite Adhesive	market for polyurethane adhesive | polyurethane adhesive | Cutoff, U	Ecoinvent 3.8	2021
	market for phenyl isocyanate | phenyl isocyanate | Cutoff, U	Ecoinvent 3.8	2021
	market for methylene diphenyl diisocyanate | methylene diphenyl diisocyanate | Cutoff, U	Ecoinvent 3.8	2021
	market for methylene diphenyl diisocyanate | methylene diphenyl diisocyanate | Cutoff, U	Ecoinvent 3.8	2021
Splines	market for sawnwood, board, hardwood, dried (u=10%), planed | sawnwood, board, hardwood, dried (u=10%), planed | Cutoff, U	Ecoinvent 3.8	2021
Staples	market for steel, chromium steel 18/8 | steel, chromium steel 18/8 | Cutoff, U	Ecoinvent 3.8	2021
TechBoard™ Sheathing	market for magnesium oxide | magnesium oxide | Cutoff, U	Ecoinvent 3.8	2021
	market for magnesium sulfate | magnesium sulfate | Cutoff, U	Ecoinvent 3.8	2021
	market for acrylic binder, without water, in 34% solution state | acrylic binder, without water, in 34% solution state | Cutoff, U	Ecoinvent 3.8	2021
	market for perlite | perlite | Cutoff, U	Ecoinvent 3.8	2021
	market for cellulose fibre | cellulose fibre | Cutoff, U	Ecoinvent 3.8	2021
	market for glass fibre | glass fibre | Cutoff, U	Ecoinvent 3.8	2021
Titebond	market for methyl acetate | methyl acetate | Cutoff, U	Ecoinvent 3.8	2021
	market for hexane | hexane | Cutoff, U	Ecoinvent 3.8	2021
	market for vinyl acetate | vinyl acetate | Cutoff, U	Ecoinvent 3.8	2021
Package			
Woven coated polyethylene & polypropylene	market for packaging film, low density polyethylene | packaging film, low density polyethylene | Cutoff, U	Ecoinvent 3.8	2021
	market for textile, nonwoven polypropylene | textile, nonwoven polypropylene | Cutoff, U	Ecoinvent 3.8	2021
Transport			
Ship	market for transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, U	Ecoinvent 3.8	2021
Train	market for transport, freight train | transport, freight train | Cutoff, U	Ecoinvent 3.8	2021
Truck	market for transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | Cutoff, U	Ecoinvent 3.8	2021
Manufacture			
Electricity	market for electricity, medium voltage | electricity, medium voltage | Cutoff, U – CA-AB	Ecoinvent 3.8	2021
Natural Gas	market for heat, district or industrial, natural gas | heat, district or industrial, natural gas | Cutoff, U – CA-QC	Ecoinvent 3.8	2021
Product Disposal			
Landfill	market for inert waste, for final disposal | inert waste, for final disposal | Cutoff, U	Ecoinvent 3.8	2021

3.6 Data Quality

Table 6. *Data quality assessment for TechPanel™ Structural Insulated Panel product.*

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 5 years old. All of the data used represented an average of a least one year's work of data collection. Manufacturer-supplied data are based on 6-months of production from June through November 2021. The time period over which inputs to and outputs from the system are accounted for is 100 years from the year for which the data set is deemed representative.
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. Electricity use for product manufacture is modeled using representative data for the regional grid in Canada. Surrogate data used in the assessment are representative of global 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 component datasets, specific to the type of material, are used to represent the actual processes, as appropriate.
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 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 product. 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 v3.8 data where available. Different portions of the 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 the 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 ZS2's manufacturing facilities represent a 6-month average and are considered of good 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. Due to the age of the manufacturing operations, data representing a longer time period were not available. For secondary LCI data, Ecoinvent v3.8 data are used.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the 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 methodology includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

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3.7 Period under review

The period of review is based on a 6-month period from June 2021 through November 2021.

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.

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 stage (A4)

Distribution of the TechPanel™ products to the point of installation was provided by the manufacturer.

Table 7. *Module A4 Technical Information*

Truck Transport	Unit	Value
Fuel type	-	Diesel
Fuel utilization	L/100 km	18.7
Distance	km	463
Capacity utilization	-	37%

Installation stage (A5)

Installation of the products is completed using manual labor. Panels are connected using the leftover staples and adhesive raw materials provided with the final product. As these materials are already modelled in the raw material (A1) module, the impacts for the installation phase include only the installation and packaging waste. Installation waste is assumed to be 10% of the product

Table 8. *Module A5 Technical Information per functional unit*

Installation Parameters	Unit	Value
Ancillary materials	kg	0
Water consumption specified by water source and fate	m^3	0
Other resources	kg	0
Electricity consumption	kwh	0
Other energy carriers	MJ	0
Product loss per functional unit	kg	0.442
Waste materials at the construction site before waste processing, generated by product installation	kg	0
Output materials resulting from on-site waste processing	kg	0
Mass of packaging waste specified by type	kg	0.014
Landfill	kg	0.014
Biogenic carbon contained in packaging waste	kg CO_2	0
Direct emissions to ambient air, soil, and water	kg	0

Use stage (B1)

No impacts are associated with the use of the product over the reference service lifetime.

Maintenance stage (B2)

No maintenance is required with the use of the product over the reference service lifetime.

Repair stage (B3)

No repair is required with the use of the product over the reference service lifetime.

Replacement stage (B4)

No replacement is required with the use of the product over the reference service lifetime.

Refurbishment stage (B5)

No refurbishment is required with the use of the product over the reference service lifetime.

Table 9. *Modules B1-B5 Technical Information per functional unit*

Use Phase Parameters	Unit	Use (B1)	Maintenance (B2)	Repair (B3)	Replacement (B4)	Refurbishment (B5)
Description of process	-	N/A	N/A	N/A	N/A	N/A
Direct emissions to ambient air, soil, and water	kg	0.00	0.00	0.00	0.00	0.00
Number of cycles per RSL	-	0	0	0	0	0
Number of cycles per ESL	-	0	0	0	0.5	0
Ancillary materials	kg	0.00	0.00	0.00	0.00	0.00
Energy consumption	kwh	0.00	0.00	0.00	0.00	0.00
Water consumption	m^3	0.00	0.00	0.00	0.00	0.00
Waste	kg	0.00	0.00	0.00	567 - 669	0.00

Building operation stage (B6 – B7)

There is no operational energy or water use associated with the use of the product over the reference service lifetime.

Table 10. *Modules B6-B7 Technical Information per functional unit*

Use Phase Parameters	Unit	Operational Energy Use (B6)	Operational Water Use (B7)
Type of energy carrier	-	N/A	N/A
Energy consumption	kwh	0.00	0.00
Water consumption	m^3	0.00	0.00

Disposal stage (C1 - C4)

The disposal stage includes demolition of the products (*C1*); transport of the plasterboard products to waste treatment facilities (*C2*); waste processing (*C3*); and associated emissions as the product degrades in a landfill (*C4*).

For the TechPanel™ product, no emissions are generated during demolition (*C1*) and no waste processing (*C3*) is required for disposal. This study assumes transportation of waste materials at end-of-life (*C2*) to be 100 km. Construction waste in Canada is modelled with a recycle rate of 4.1% with the remainder being disposed of in a landfill.

Table 11. *Modules C1-C4 Technical Information per 92.9 m^2*

End-of-Life Phase Parameters	Unit	Value
Deconstruction (C1) Energy Use	kwh	0.00
Waste Transport (C2) Distance	km	100
Waste Processing (C3) Energy Use	kwh	0.00
Final Disposal (C4) Landfill		
Landfill	kg	3.81
Recycle	kg	0.161
Biogenic Carbon Content	kg CO_2	0.645

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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. All LCA results are stated to three significant figures and therefore the sum of the total values may not exactly equal 100%.

The following environmental impact category indicators are reported using characterization factors using the TRACI 2.1 and CML-IA impact assessment method.

TRACI 2.1 Impact Category	Unit	CMLI-A Impact Category	Unit
GWP: Global Warming Potential	kg CO_2 eq	**GWP:** Global Warming Potential	kg CO_2 eq
ODP: Ozone Depletion Potential	kg CFC 11 eq	**ODP:** Ozone Depletion Potential	kg CFC 11 eq
AP: Acidification Potential of soil and water	kg SO_2 eq	**AP:** Acidification Potential of soil and water	kg SO_2 eq
EP: Eutrophication Potential	kg N eq	**EP:** Eutrophication Potential	kg PO_4^{3-} eq
POCP:: Photochemical Oxidant Creation Potential	kg O_3 eq	**POCP:** Photochemical Oxidant Creation Potential	kg C_2H_4 eq
FFD: Fossil Fuel Depletion	MJ Surplus	**ADPE:** Abiotic Depletion Potential - Elements	kg Sb eq
		ADPF: Abiotic Depletion Potential – Fossil Fuels	MJ

These impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes. The following inventory parameters, specified by the PCR, are also reported.

Resources	Unit	Waste and Outflows	Unit
RPR_E: Renewable primary resources used as energy carrier (fuel)	MJ, LHV	**HWD:** Hazardous waste disposed	kg
RPR_M: Renewable primary resources with energy content used as material	MJ, LHV	**NHWD:** Non-hazardous waste disposed	kg
$NRPR_E$: Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	**RWD:** Radioactive waste, conditioned, to final repository	kg
$NRPR_M$: Non-renewable primary resources with energy content used as material	MJ, LHV	**CRU:** Components for re-use	kg
SM: Secondary materials	MJ, LHV	**MR:** Materials for recycling	kg
RSF: Renewable secondary fuels	MJ, LHV	**MER:** Materials for energy recovery	kg
NRSF: Non-renewable secondary fuels	MJ, LHV	**EE:** Recovered energy exported from the product system	MJ, LHV
RE: Recovered energy	MJ, LHV		
FW: Use of net freshwater resources	m^3		
Biogenic Carbon	**Unit**		
$BCRE_P$: Removals and emissions associated with biogenic carbon of bio-based products	kg CO_2 eq	**$BCEW_R$:** Biogenic carbon emissions from combustion of waste from renewable sources used in production	kg CO_2 eq
$BCRE_{PKG}$: Removals and emissions associated with biogenic carbon content of bio-based packaging	kg CO_2 eq	**$BCEW_{NR}$:** Biogenic carbon emissions from combustion of waste from non-renewable sources used in production	kg CO_2 eq
ECUC: Emissions from calcination and uptake from carbonation	kg CO_2 eq		

Modules B1 through B7 are not associated with any impact and are therefore declared as zero. In addition, module C1 and C3 are likewise not associated with any impact as the TechPanel™ products are manually deconstructed. Module D is not declared. In the interest of space and table readability, these modules are not included in the results presented below. The TRACI 2.1 and CML Life Cycle Impact Assessment (LCIA) methods were selected for this study as required by the core PCR, ISO 21930 for North American and international markets. The CML and TRACI 2.1 global warming potential (GWP) characterization methods do not include biogenic carbon uptake or biomass CO2 emissions, so the additional indicators for biogenic carbon specified in ISO 21930 §7.2.12 are not assessed. Results for the TechPanel™ Structural Insulated Panel products are shown per 1 m^2 of product with a thickness that gives an average thermal resistance of RSI=1m^2K/W. All values are rounded to three significant digits.

Table 12. *Impact indicator results for TechPanel™ Structural Insulated Panel products.*

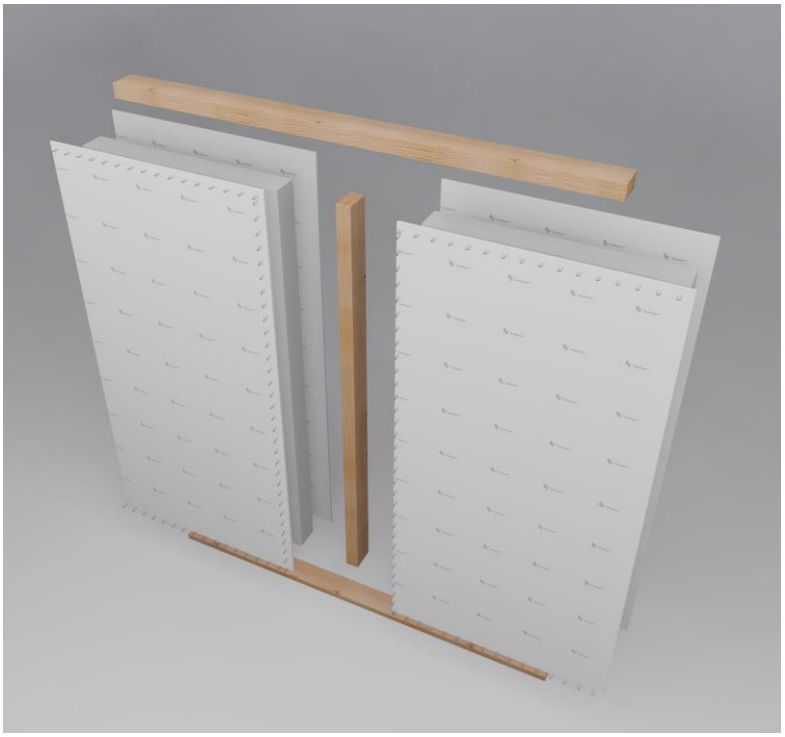
TRACI	Unit	A1	A2	A3	A1-A3 Total	A4	A5	C2	C4
GWP	kg CO_2 eq.	6.04	1.23	0.412	7.69	0.349	0.021	0.068	0.032
ODP	kg CFC-11 eq.	$3.86x10^{-7}$	$2.79x10^{-7}$	$3.25x10^{-8}$	$6.98x10^{-7}$	$8.09x10^{-8}$	$3.10x10^{-9}$	$1.57x10^{-8}$	$1.10x10^{-8}$
AP	kg SO_2 eq	0.025	0.013	0.001	0.039	0.002	$6.65x10^{-5}$	$3.10x10^{-4}$	$2.30x10^{-4}$
EP	kg N eq	0.011	0.001	0.004	0.017	$3.80x10^{-4}$	$6.10x10^{-4}$	$7.39x10^{-5}$	$4.90x10^{-5}$
POCP	kg O_3 eq	0.423	0.258	0.017	0.697	0.038	0.002	0.007	0.006
FFD	MJ Surplus	9.53	2.55	0.584	12.7	0.739	0.029	0.143	0.105
CML	**Unit**	**A1**	**A2**	**A3**	**A1-A3 Total**	**A4**	**A5**	**C2**	**C4**
GWP	kg CO_2 eq.	6.10	1.24	0.413	7.74	0.349	0.021	0.068	0.032
ODP	kg CFC-11 eq.	$3.13x10^{-7}$	$2.10x10^{-7}$	$2.58x10^{-8}$	$5.48x10^{-7}$	$6.07x10^{-7}$	$2.33x10^{-9}$	$1.18x10^{-8}$	$8.27x10^{-9}$
AP	kg SO_2 eq	0.024	0.012	0.001	0.037	0.001	$5.52x10^{-5}$	$2.60x10^{-4}$	$2.00x10^{-4}$
EP	kg PO_4^{3-} eq	0.006	0.002	0.002	0.010	$3.10x10^{-4}$	$2.30x10^{-4}$	$6.09x10^{-5}$	$4.44x10^{-5}$
POCP	kg C_2H_4 eq.	0.003	$3.30x10^{-4}$	$7.54x10^{-5}$	0.004	$4.57x10^{-5}$	$5.25x10^{-6}$	$8.87x10^{-6}$	$7.84x10^{-6}$
ADPE	kg Sb eq.	$4.72x10^{-5}$	$3.66x10^{-6}$	$7.13x10^{-7}$	$5.15x10^{-5}$	$1.21x10^{-6}$	$3.76x10^{-8}$	$2.35x10^{-7}$	$8.88x10^{-8}$
ADPF	MJ	73.3	17.7	5.47	96.5	5.17	0.201	1.00	0.727

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Table 13. *Resource use, waste, and biogenic carbon indicators for TechPanel™ Structural Insulated Panel products.*

Resource Use	Unit	A1	A2	A3	A1-A3 Total	A4	A5	C2	C4
RPR_E	MJ	34.9	0.189	0.317	35.4	0.060	0.002	0.012	0.009
RPR_M	MJ	0.995	0.00	0.00	0.995	0.00	0.00	0.00	0.00
$NRPR_E$	MJ	78.8	17.9	5.56	102	5.24	0.204	1.02	0.737
$NRPR_M$	MJ	INA	INA	INA	INA	INA	INA	INA	INA
SM	kg	0.541	0.00	0.00	0.541	0.00	0.00	0.00	0.00
RSF	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
NRSF	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
RE	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
FW	m^3	0.057	0.002	0.002	0.061	0.001	$9.01x10^{-5}$	$1.30x10^{-4}$	0.001
Waste and Output	**Unit**	**A1**	**A2**	**A3**	**A1-A3 Total**	**A4**	**A5**	**C2**	**C4**
HWD	kg	$6.97x10^{-5}$	$4.06x10^{-5}$	$2.87x10^{-6}$	$1.13x10^{-4}$	$1.38x10^{-5}$	$4.67x10^{-7}$	$2.69x10^{-6}$	$1.31x10^{-6}$
NHWD	kg	0.562	0.717	0.413	1.69	0.266	0.449	0.052	3.99
RWD	kg	$1.50x10^{-4}$	$1.20x10^{-4}$	$2.99x10^{-6}$	$2.73x10^{-4}$	$3.42x10^{-5}$	$1.33x10^{-6}$	$6.64x10^{-6}$	$4.80x10^{-6}$
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MR	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.161
MER	kg	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
EE	MJ, LHV	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Biogenic Carbon	**Unit**	**A1**	**A2**	**A3**	**A1-A3 Total**	**A4**	**A5**	**C2**	**C4**
$BCRE_P$	kg CO_2 eq	INA	INA	INA	INA	INA	INA	INA	INA
$BCRE_{PKG}$	kg CO_2 eq	INA	INA	INA	INA	INA	INA	INA	INA
ECUC	kg CO_2 eq	INA	INA	INA	INA	INA	INA	INA	INA
$BCEW_R$	kg CO_2 eq	INA	INA	INA	INA	INA	INA	INA	INA
$BCEW_{NR}$	kg CO_2 eq	INA	INA	INA	INA	INA	INA	INA	INA

INA = Indicator not assessed, | Neg.= Negligible



6. LCA: INTERPRETATION

The interpretation phase conforms to ISO 14044.The interpretation included the use of evaluation and sensitivity checks to steer the iterative process during the assessment, and a final evaluation including completeness, sensitivity, and consistency checks, at the end of the study.

The main contributions to indicator results are from the raw material extraction and processing phase (A1), and the raw material transportation phase (A2). Of the remaining life cycle stages, manufacture (A3) and product distribution phase (A4) are also significant contributors to the overall impacts for the TechPanel™ Structural Insulated Panel products.

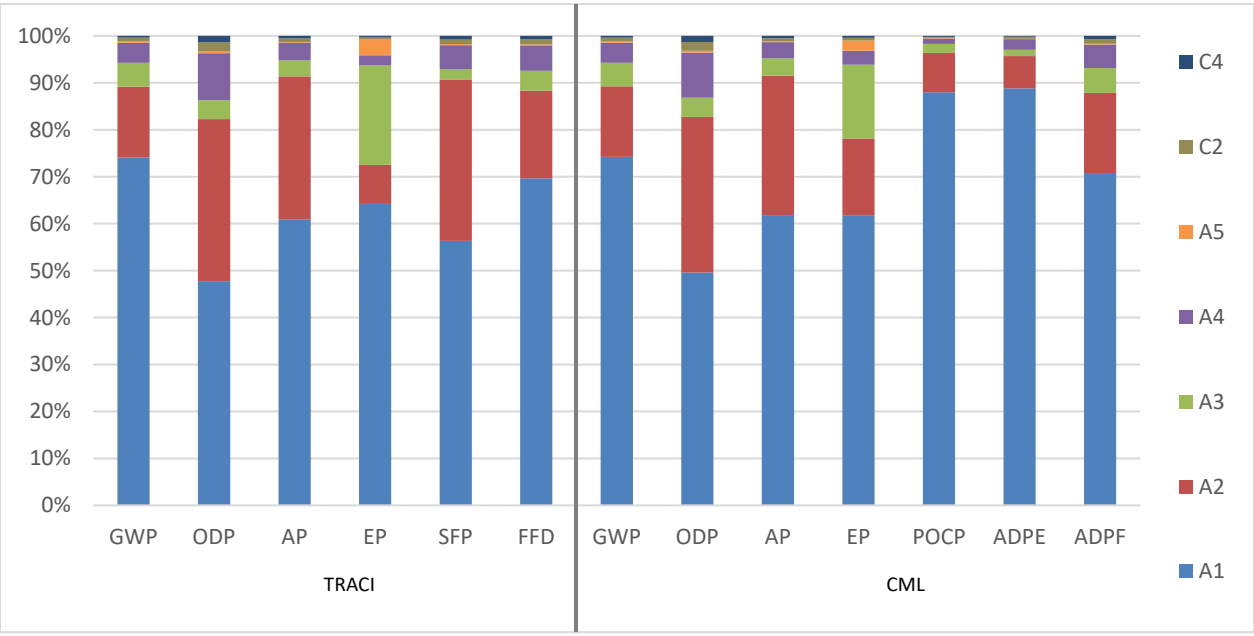


Figure 2. *Contribution analysis for the TechPanel™ Structural Insulated Panel products.*

7. Additional Environmental Information

7.1 Hazardous Substances

Product materials were reviewed for the presence of any toxic or hazardous chemicals. Based on a review of the product components provided by the manufacturer, no regulated chemicals were identified in the product or product components.

7.2 Environment and Health during Manufacture

There are no known environmental or health programs at the manufacturing facilities.

7.3 Environment and Health during Use

No environmental or health impacts are expected due to normal use of the TechPanel™ products.

7.4 Extraordinary Effects

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

7.5 Further Information

Further information on the product can be found on the manufacturer's website at https://zs2technologies.com/.

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