Norbec™'s NOROC® & NOREX® *Insulated Metal Panels and NORBEC Camlock Panels*

Norbec™

ENVIRONMENTAL PRODUCT DECLARATION

ISO 14025:2006

Norbec™ is pleased to present this Environmental Product Declaration (EPD) for NOROC® & NOREX® Insulated Metal Panels and NORBEC Camlock Panels. This EPD was developed in compliance with CAN/CSA-ISO 14025 and has been verified by Lindita Bushi, Athena Sustainable Materials Institute.

The LCA and the EPD were prepared by Vertima Inc. The EPD includes cradle-to-gate life cycle assessment (LCA) results.

For more information about Norbec™, visit https://norbec.com/.
For any explanatory material regarding this EPD, please contact the program operator.

Environmental Product Declaration

CSA Group Registered Based on ISO 14025 and Other Requirements

For more information visit csaregistries.ca/epd

#3892-5013
April 2020 - 2025

1 GENERAL INFORMATION

PCR GENERAL INFORMATION			
Reference PCR	PCR Guidance for Building-Related Products and Services - Part B: Insulated Metal Panels, Metal Composite Panels, and Metal Cladding: Roof and Wall Panels UL Environment October 23, 2018 to October 23, 2023		
The PCR review was conducted by:	*Thomas P. Gloria, Industrial Ecology Consultants (Chairperson) t.gloria@industrial-ecology.com*	*Lindita Bushi, Athena Sustainable Materials Institute Lindita.bushi@athenasmi.org*	*Bob Zabcik, NCI Building Systems bobZ@ncigroup.com*

EPD GENERAL INFORMATION			
Program Operator	CSA Group 178 Rexdale Blvd Toronto (Ontario) M9W 1R3 CANADA www.csagroup.org		
Declared Products	Norbec™'s NOROC® & NOREX® Insulated Metal Panels; NORBEC Wall and Ceiling Camlock Panels; NORBEC Floor Camlock Panels		
EPD Registration Number 3892-5013	**EPD Date of Issue** April 20, 2020	**EPD Period of Validity** April 20, 2020 - April 19, 2025	
EPD Recipient Organization	Norbec™ 97 de Vaudreuil Street Boucherville (Quebec) J4B 1K7 CANADA https://norbec.com/		
EPD Type/Scope and Declared Unit Product-specific cradle-to-gate EPD with declared unit of 100 m^2 of insulated metal panel coverage		**Year of Reported Manufacturer primary data** 2018	
LCA Software Open LCA v.1.7.2	**LCI Databases** ecoinvent 3.4 and US LCI	**LCI Methodology** TRACI2.1	
This LCA and EPD were prepared by:	Chantal Lavigne, M.A.Sc. Vertima Inc. www.vertima.ca		
This EPD and LCA were independently verified in accordance with CAN/CSA-ISO 14025:2006 and ISO 14044:2006, respectively. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v3.2 (September 2018), based on ISO 21930:2017 and EN 15804 + A1:2013, serves as the core PCR, with additional considerations from the USBCBC/UL Environment Part A Enhancement (2017). ☐ Internal ☒ External	*Lindita Bushi* _____ Lindita Bushi, Ph.D. Athena Sustainable Materials Institute		

LIMITATIONS

Environmental declarations from different programs (ISO 14025) may not be comparable [4].

"Comparison of the environmental performance of metal panel and cladding products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building use phase as instructed under this PCR [1].

Full conformance with the PCR for metal panels and cladding allows EPD comparability only when all stages of a life cycle have been considered when they comply with all referenced standards, use the same sub-category PCR, and use equivalent scenarios with respect to construction works. However, variations and deviations are possible". Example of variations: Different LCA software and background LCI datasets may lead to differences in results upstream or downstream of the life cycle stages declared [1]. ***Given this EPD is cradle-to-gate in scope, comparisons of EPD data from one product to another are not allowed.***

2 PRODUCT SYSTEM DESCRIPTION

2.1 DESCRIPTION OF COMPANY/ORGANIZATION

Norbec™ is a North American leader in manufacturing insulated metal panels for building envelopes as well as for walk-in coolers & freezers and doors. Founded in 1982, Norbec™ has earned an enviable reputation as a leader in many sectors: supermarkets, restaurants, food processing plants, refrigerated warehouses, hospitals and research centres. Its manufacturing facilities are based in Boucherville (Quebec) and Saint-Hyacinthe (Quebec).

2.2 PRODUCT DESCRIPTION

2.2.1 PRODUCT DESCRIPTION AND IDENTIFICATION

NOROC® PANELS

NOROC® Panels, manufactured at the Saint-Hyacinthe (Quebec) facility, are high-performance fire-rated metal insulated architectural panels with a thermal resistance value expressed in metric units, RSI, of 0.28 m^2 °K/W/cm or expressed in imperial units, R-value, of 4.00 ft^2 °F h/BTU/in. NOROC® has a rock-wool mineral core made of a rigid stone-fiber insulation board composed of natural basalt rock and recycled slag. In addition to being non-combustible, it offers excellent fire resistance properties. NOROC® panels are available in different thicknesses and with L-joint, a vertical mounting made for outdoor walls, interior partitions and interior ceilings.

Figure 1 provides an illustration of Norbec™'s NOROC® Panel.

Figure 1: NOROC®-L Panel. [Photo courtesy of Norbec™]

NOREX® PANELS

NOREX® Panels, manufactured at the Saint-Hyacinthe (Quebec) facility, are insulated metal panels with a polyisocyanurate (PIR) core designed for highly effi cient buildings. In addition to offering an unparalleled thermal resistance value with an RSI of 0.51 m^2 °K/W/cm (R-value: 7.41 ft^2 °F h/BTU/in), this panel provides fi re and rain protection barriers in addition to being wind and tear resistant due to its exclusive anchoring system. This product is designed with an equalization compartment that prevents water from being aspired inward, therefore reducing the risk of penetration and moisture. NOREX® Panels are available in three (3) different joint configurations (NOREX® - L, NOREX® - H, and NOREX® - S) and various thicknesses.

Figure 2 provides an illustration of NOREX® Panels.

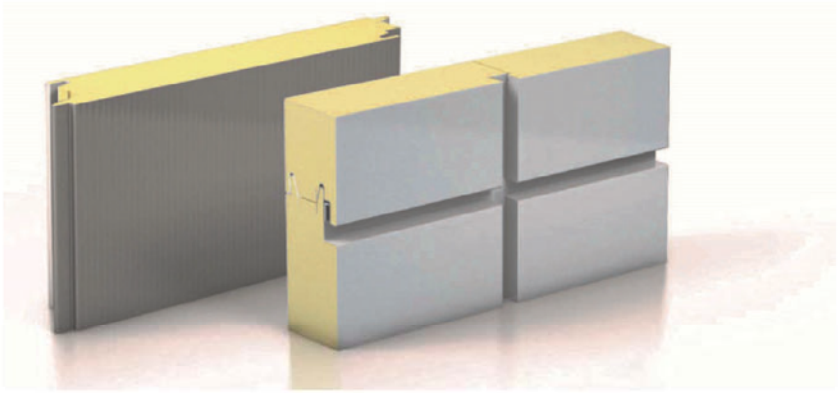


Figure 2: NOREX®-L and NOREX® -H Panels. [Photo courtesy of Norbec™]

NORBEC CAMLOCK PANELS

NORBEC Camlock Panels, manufactured at the Boucherville (Quebec) facility, are insulated metal panels made up of a closed-cell polyurethane core that eliminates any possible moisture accumulation. The panels offers a thermal resistance value of 0.47m^2 °K/W/cm (R-value: 6.75 ft^2 °Fh/BTU/in). Panel joints used along with integrated camlocks provide a water and vapor-proof seal required for all types of environments. The elimination of thermal bridges also improves insulation efficiency, leading to reduced energy costs. NORBEC Camlock Panels are custom-made for walk-in freezers. In this EDP, NORBEC Camlock Panels are grouped into: NORBEC Wall and Ceiling Camlock Panels, and NORBEC Floor Camlock Panels.

Figure 3 provides an illustration of NORBEC Camlock Panels.

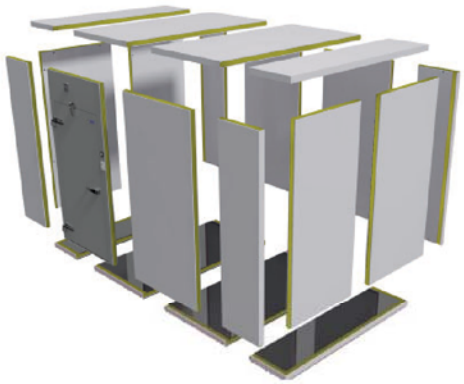


Figure 3: NORBEC Camlock Panels. [Photo courtesy of Norbec™]

2.2.2 PRODUCT SPECIFICATION

NOROC®, NOREX®, and NORBEC™ panels respect the standards listed in Table 1, Table 2 and Table 3, respectively.

Table 1: NOROC® Panel codes, regulations, and test methods.

NOROC® panels	Procedure	Title	Results
Fire Canada	CAN/ULC-S101-14	Fire endurance tests of building construction and materials [7]	10.16 cm (4 in) = 45 min 12.70 cm (5 in) = 60 min 15.24 cm (6 in) = 120 min
	CAN/ULC-S102-10	Surface burning characteristics of building materials and assemblies [8]	Flame spread < 25 Smoke developed < 45
	CAN/ULC-S126 - 14	Standard method of test for fire spread under roof-deck assemblies [9]	Test requirements have been met
Fire US	ASTM E84-19b	Surface burning characteristics of building materials [10]	Flame spread < 25 Smoke developed < 450
Structural	ASTM E72-15	Strength tests of panels for building construction [11]	See load tables (https://norbec.com/document-library/)
Air Infiltration	ASTM E283 - 04(2012)	Rate of air leakage through curtain walls under specified pressure differences [12]	Test requirements have been met
	ASTM E330 - 14	Structural performance of exterior walls by uniform static air pressure difference [13]	Test requirements have been met
Thermal Performance	ASTM C518-17	Steady-state thermal transmission properties by means of heat-flow meter apparatus [14]	0.28 m^2 °K/W/cm (4.00 ft^2 °F h/BTU/in)
Water Infiltration	ASTM E331 – 00(2016)	Water penetration of exterior walls by uniform static air pressure differences [15]	Test requirements have been met
	AAMA 501.1-17	Water penetration of windows, curtain walls and doors using dynamic pressure [16]	Test requirements have been met

Table 2: NOREX® Panel codes, regulations, and test methods.

NOREX® panels	Procedure	Title	Results
Fire Canada	CAN/ULC-S101-14	Fire endurance tests of building construction and materials [7]	Meets 10 minutes stay-in-place requirements
	CAN/ULC-S102-10	Surface burning characteristics of building materials and assemblies [8]	Meets the National Building Code of Canada requirements
	CAN/ULC-S134-13	Fire test of exterior wall assemblies [17]	Complies with the fire-spread and heat-flux limitations required by the National Building Code of Canada
	CAN/ULC-S138-06	Fire growth of insulated building panels in a full-scale room configuration [18]	Test requirements have been met
	CAN/ULC-S126 -14	Standard method of test for fire spread under roof-deck assemblies [9]	Test requirements have been met
Fire US	ASTM E84-19b	Surface burning characteristics of building materials [10]	Flame spread < 25 Smoke developed < 450
	FM 4880	Class 1 fire rating of insulated wall, ceiling and roof panels [19]	Product approved
Structural	ASTM E72-15	Strength tests of panels for building construction [11]	See load tables (https://norbec.com/document-library/)
	FM 4881	Class 1 exterior wall structural performance [20]	See FM Wall load Chart (https://norbec.com/wp-content/uploads/2018/06/FM-Listing-4880-Norex-L-H.pdf_
Air Infiltration	ASTM E283 - 04(2012)	Rate of air leakage through curtain walls under specified pressure differences [12]	Test requirements have been met
	ASTM E330 - 14	Structural performance of exterior walls by uniform static air pressure difference [13]	Test requirements have been met
Thermal Performance	ASTM C518-17	Steady-state thermal transmission properties by means of heat-flow meter apparatus [14]	0.51 m^2 °K/W/cm (7.41 ft^2 °F h/BTU/in)
	CAN/ULC-S770-09	Long-term thermal resistance [21]	Testing requirements have been met per CAN/ULC-S704-11
Water Infiltration	ASTM E331 – 00(2016)	Water penetration of exterior walls by uniform static air pressure differences [15]	Test requirements have been met
	AAMA 501.1-17	Water penetration of windows, curtain walls and doors using dynamic pressure [16]	Test requirements have been met

Table 3: NORBEC™ Panel codes, regulations, and test methods.

NORBEC™ panels	Procedure	Title	Results
Fire Canada	CAN/ULC-S102-10	Surface burning characteristics of building materials and assemblies [8]	Meets the National Building Code of Canada requirements
	CAN/ULC-S138-06	Fire growth of insulated building panels in a full-scale room configuration [18]	Test requirements have been met
Fire US	ASTM E84-19b	Surface burning characteristics of building materials [10]	Flame spread < 25 Smoke developed < 450
Thermal Performance	ASTM C518-17	Steady-state thermal transmission properties by means of heat-flow meter apparatus [14]	0.47 m^2 °K/W/cm (6.75 ft^2 °F h/BTU/in)

The most up-to-date test results are available at https://norbec.com/document-library/.

2.2.3 PRODUCTION AVERAGE

The average panel weight for each product has been calculated using a 2018 production average based on panel area production data for each product.

Products of various insulation thicknesses, inner and outer steel thicknesses and, for NORBEC Floor Camlock Panels, plywood thickness, were averaged by product categories, i.e. NOROC® & NOREX® Panels, NORBEC Wall and Ceiling Camlock Panels, and NORBEC Floor Camlock Panels. As the environmental impacts vary by more than 10% depending on the insulation thickness as well as for inner and outer steel thickness, potential environmental impact results are presented for the average and, using an equation, for the range of thicknesses.

2.3 PRODUCTION APPLICATION

NOROC® and NOREX® Panels insulate and provide interior and exterior all-in-one construction material for industrial and commercial constructions as well as food processing plants, refrigerated and atmosphere-controlled rooms. The panels can also be used for interior partitions or as suspended ceilings.

NORBEC Camlock Panels are custom-made for Norbec™'s turnkey solution for walk-in and refrigeration equipment. Multiple enclosure configurations are available for coolers, freezers, combos and refrigerated or dry storage. Solutions are tailored to any needs to allow the maximal use of any space. More precisely, NORBEC Wall and Ceiling Camlock Panels provide an insulated interior and exterior wall or roof component for enclosures, while NORBEC Floor Camlock Panels provide insulated interior and exterior floor components for enclosures.

2.4 PROPERTIES OF DECLARED PRODUCT AS DELIVERED

Table 4: NOROC® Panel properties as delivered

Specifications	NOROC® Panels					
Width (1)	1.08 m (42 1/2 in.)					
Length	2.1 to 12.2 m (7 to 40 ft.)					
Insulation Thickness	0.10, 0.13, 0.15 and 0.20 m (4, 5, 6 and 8 in.)					
RSI	0.28 m^2 °K/W/cm (R-value: 4.00 ft^2 °F h/BTU/in) 2018 Production average RSI: 3.88 m^2 °K/W					
Steel Inner and Outer Faces	0.483 mm (0.019 in.) standard thickness – 26 Ga 0.584 mm (0.023 in.) other available thickness – 24 Ga 0.724 mm (0.0285 in.) other available thickness – 22 Ga 2018 production average (sum of inner and outer faces): 1.043 mm					
Total Weight (2) (3)	**Parameter**	**Range**				**2018 Production Average**
	Insulation Thickness (m)	0.10 (4 in.)	0.13 (5 in.)	0.15 (6 in.)	0.20 (8 in.)	0.14 (5.5 in.)
	Weight (kg/m^2)	23.1 – 27.4	26.6 – 30.9	30.1 – 34.3	37.0 – 41.2	28.9

(1) The final panel width may change due to variations in fabrication and installation. Norbec™ does not recommend designing a panel arrangement in which the panel dimension plays a critical role.
(2) Panel weight for a NOROC® -L 42 ½ wide panel.
(3) Data calculated using rock-wool insulation with a density of 136 kg/m^3.

Table 5: NOREX® Panel properties as delivered

Specifications	NOREX®-H(8)	NOREX ®-L(8)	NOREX ®-S(8)
Width (1) (2)	0.61, 0.76, 0.91, 1.05 m (24, 30, 36, 41 ½ in.)	0.61, 0.76, 0.91, 1.08 m (24, 30, 36 or 42 ½ in.)	1.12 m (44 in.)
Length	2.1 to 15.8 m (7 to 52 ft.)		
Insulation Thickness	0.05, 0.08 and 0.10 m (2, 3 and 4 in.)	0.05, 0.08, 1.10, 0.13 and 0.15 m (2, 3, 4, 5 and 6 in.)	0.05, 0.08, 0.10 and 0.13 m (2, 3, 4 and 5 in.)
RSI	0.51 m^2 °K/W/cm (R-value:7.41 ft^2 °F h/BTU/in) 2018 Production average RSI: 4.46 m^2 °K/W		
Steel Inner and Outer Faces	0.483 mm (0.019 in.) – 26 Ga (5) (7) 0.584 mm (0.023 in.) – 24 Ga 0.724 mm (0.0285 in.) – 22 Ga (6) 2018 production average (sum of inner and outer faces): 1.012 mm		

Total Weight (3) (4)	**meter**	**Range – All Panels**					**2018 Production Average**
	Insulation Thickness (m)	0.05 (2 in.)	0.08 (3 in.)	0.10 (4 in.)	0.13 (5 in.)	0.15 (6 in.)	0.09 (3.4 in.)
	Weight (kg/m²)	10.6 – 14.8	11.7 – 16.8	12.5 – 17.8	13.5 –18.7	14.5 – 19.7	12.4

(1) The final panel width may change due to variations in fabrication and installation. Norbec™ does not recommend designing a panel arrangement in which the module width plays a critical role.
(2) Two-inch panels are not available in 24 and 30-inch widths.
(3) Panel weight for a NOREX®-L 42 ½ in. wide panel.
(4) Calculations based on insulated density of 38.44 kg/m^3.
(5) Standard thickness for steel inner face of all three models.
(6) Standard thickness for NOREX®-H steel outer face.
(7) Standard thickness for NOREX®-L and NOREX®-S steel outer face.
(8) "H", "L" and "S" represent different mounting joint configurations .

Table 6: NORBEC Camlock Panel properties as delivered

Specifications		NORBEC Camlock Panels							
		Wall and Ceiling				Floor			
Width (1)		Up to 1.19 m (47 in.)							
Length		Up to 5.49 m (18 ft.)							
Insulation Thickness		0.08, 0.10, 0.13 m (3, 4 and 5 in.)							
RSI		0.55 m^2 °K/W (R-value: 8 ft^2 °F h/BTU/in) (2)							
		2018 production average RSI: 4.71 m^2 °K/W				2018 production average RSI: 4.60 m^2 °K/W			
Steel	**Inner Face**(3)	0.483 mm (0.019 in.) standard thickness – 26 Ga, or 0.724 mm (0.0285 in.) – 22 Ga				1.32 mm (0.052 in.) standard thickness – 18 Ga, or 1.52 mm (0.0598 in.) – 16 Ga			
	Outer Face(3)	0.483 mm (0.019 in.) standard thickness – 26 Ga, or 0.724 mm (0.0285 in.) – 22 Ga				0.483 mm (0.019 in.) standard thickness – 26 Ga, or 0.724 mm (0.0285 in.) – 22 Ga			
	2018 Production Average	Sum of inner and outer faces: 1.184 mm				Sum of inner and outer faces: 1.985 mm			
Plywood Nominal Thicknesses		n/a				0, 0.013, 0.019 m (0", ½" or ¾") 2018 production average: 0.008m			
Total Weight(4)	**Parameter**	**Range – All Applications**			**2018 Production Average**	**Range – All Applications**			**2018 Production Average**
	Insulation Thickness (m)	0.08 (3 in.)	0.10 (4 in.)	0.13 (5 in.)	0.085 (3.3 in.)	0.08 (3 in.)	0.10 (4 in.)	0.13 (5 in.)	0.083 (3.3 in.)
	Weight (kg/m^2)	12.9 – 17.5	13.8 – 18.4	14.6 – 19.3	15.3	19.8 – 34.2	20.7 – 35.1	21.6 - 36.0	26.0

(1) Width of panels will vary based on walk-in cooler/freezer installation layout
(2) Tested in accordance with ASTM C518-17 with a temperature gradient of 40°F/in (freezer conditions)
(3) Other finishes and thicknesses are available (see www.norbec.com for more information), however, not applicable for the 2018 production average.
(4) Insulation density is of 35.24 kg/m^3.

2.5 MATERIAL COMPOSITION

The raw materials input for NOROC® & NOREX® Panels and NORBEC Camlock Panels are detailed in Table 7. As for details on material content, refer to the health product declaration (HPD) that can be found at http://www.hpd-collaborative.org/hpd-public-repository/ [22].

Table 7: Material composition of 100 m² of average NOROC® Panels, NOREX® Panels, NORBEC Wall and Ceiling Camlock Panels, and NORBEC Floor Camlock Panels.

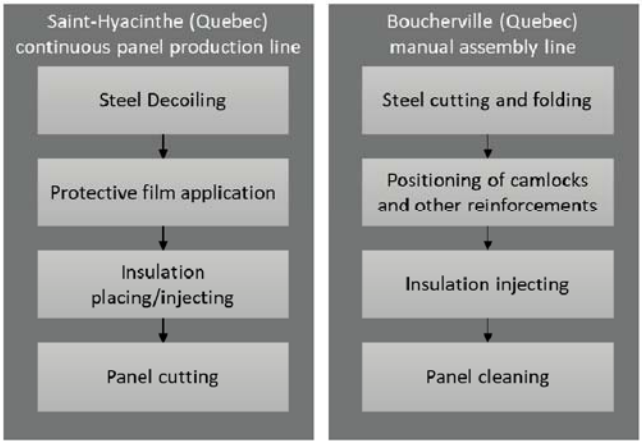
Components	Material	Mass in Average Final Product (%)			
		NOROC® Panels	NOREX® Panels	NORBEC Wall and Ceiling Camlock Panels	NORBEC Floor Camlock Panels
Metal panel	Galvanized steel	32.0%	71.7%	74.9%	69.0%
Insulation(1)	Rock-wool	65.3%	-	-	-
	Polyol	-	8.2%	9.2%	5.3%
	Isocyanates	-	17.2%	10.4%	6.0%
	Blowing agent	-	1.2%	-	-
	Catalyst	-	0.2%		
Wood panel	Plywood	-	-	-	16.4%
Sealant 1 / Butyl		0.4%	1.1%	-	-
Sealant 2 / Side tape		-	0.1%	-	-
Adhesive		2.2%	0.4%	-	-
Camlocks		-	-	4.3%	2.7%
Pillars		-	-	0.1%	-
Supports		-	-	1.0%	0.6%
TOTAL		**100.00%**	**100.00%**	**100.00%**	**100%**

2.6 MANUFACTURING

The Saint-Hyacinthe (Quebec) plant, which produces NOROC® and NOREX® Panels, has a continuous panel production line. The insulation is placed/injected between the metal panels prior to being cut to size. The panels are then covered with a protective film and packaged for shipping. Panels that do not meet the product specifi cations are offered in a line of B-quality panels, thus reducing production waste. Scrap steel is also 100% recycled.

The Boucherville (Quebec) plant, which produces the NORBEC Camlock Panels, has a manual assembly line. The metal inner and outer faces are cut and folded on an automatic station prior to being mounted onto injection tables where camlock fasteners and other reinforcements are pre-positioned. Panels are then injected with polyurethane prior to being sent to cleaning stations where operators ensure the panels meet the functional and esthetic requirements. Panels are then stacked onto a pallet and sent to the shipping department to complete the fi nal inspection and panel wrapping. Scrap steel is 100% recycled.

Figure 4: Norbec™ insulated metal panel manufacturing flow diagram.



2.7 TRANSPORTATION

As the system boundaries of the Environmental Product Declaration (EPD) are cradle-to-gate, transport after the manufacturing gate is excluded from the study.

2.8 PRODUCT INSTALLATION

Please refer to the specific guidelines for the handling, installation and cleaning of the various panels. Documentation may be accessed using the following link: https://norbec.com/document-library.

NOROC® and NOREX® Panels are delivered with screws to secure the fasteners that attach the panels on the structure. Silicone (e.g. Adseal 4550) is used to seal the joints when the panels are not used as exterior wall panels.

NORBEC Camlock Panels need silicone (e.g. Adseal 4550) and plugs to seal the joints and camlock operationg holes, respectively. Plugs are supplied with the panels.

Installation screws, silicone sealant and camlock plugs were not included in the EPD.

2.9 PACKAGING

Norbec™'s NOROC® and NOREX® Panels are packaged on wooden crates produced at their facilities. Surface panels are protected with a polyethylene protective film as they are produced. A polystyrene sheet is glued to the wood crate and the product is piled onto the crates and separated with polystyrene sheets and blocks. The pile is topped with an OSB panel before being shrink wraped and held together with polyester straps.

NORBEC Camlock Panels are piled onto a wood pallet on top of which a wooden crate is built. Panels are separated by polyethylene foam in addition to polystyrene sheets and blocks to prevent breakage and the the entire pallet is shrink-wrapped and tied down with steel straps.

Wood pallets can be reused, while plastics can be recycled where services are available.

2.10 USE CONDITIONS

For this EPD, the system boundaries encompass a cradle-to-gate scope. Environmental impacts of the product in the use phase are excluded from this declaration, per UL Environment PCR Guidance for Building-Related Products and Services – Part B: Insulated Metal Panels, Metal Composite Panels, and Metal Cladding [1].

Norbec™, as a manufacturer, assures that the product subject to this licence is free from defects and manufacturing defects, including delamination, for a period of five (5) years from the date of product installation or within 45 days following delivery, whichever is the earliest. Details on warranties and maintenance can be found online at https://norbec.com/document-library/.

2.11 PRODUCT REFERENCE SERVICE LIFE AND BUILDING ESTIMATES SERVICE LIFE

As the system boundaries of the Environmental Product Declaration (EPD) are cradle-to-gate, this information is excluded from the study.

2.12 RE-USE PHASE

As the system boundaries of the Environmental Product Declaration (EPD) are cradle-to-gate, this information is excluded from the study.

2.13 DISPOSAL

Panel recycling is technically possible [24], but might not be available in your location. Metal facings can be recycled and the foam element of the panels can be used as a fuel source in cement kilns or incinerated (with energy recovery): please check your local regulations. As a last resort, panels and/or individual components (after either non-hazardous or hazardous panel processing has taken place) can be disposed to landfill.

3 LCA CALCULATION RULES

3.1 REFERENCE FLOW AND DECLARED UNIT

The selected declared unit (DU) for this study is 100 m^2 of insulated metal panel coverage. Table 8 presents all products targeted by this report and their respective DUs.

Table 8: Declared Unit of studied products, including mass per m^2 of insulated metal panel, conversion factor to 1 kg, insulation and steel thicknesses.

Item	Unit	NOROC® Panels	NOREX® Panels	NORBEC Wall and Ceiling Camlock Panels	NORBEC Floor Camlock Panels
Declared unit	m^2	100	100	100	100
Mass per piece	kg	2,887	1,241	1,526	2,597
Conversion factor to 1 kg	m^2 / kg	0.0003	0.0008	0.0007	0.0004
Insulation thickness	m	0.139	0.087	0.085	0.083
Steel thickness (*Sum of inner and outer layers)*	mm	1.043	1.012	1.184	1.985

3.2 SYSTEM BOUNDARIES

System boundaries are cradle-to-cate, i.e., they only cover the production life cycle stage as illustrated in Table 9. Within this life cycle stage, three (3) modules are considered, namely A-1) Raw materials supply, A-2) Raw materials transportation to the manufacturing plant and A-3) Manufacturing. Construction (A-4; A-5), use (B-1 to B 7) and end-of-life (C-1 to C-4) stages are not included in this EPD. Figure 5 presents the process flow diagram for NOROC® Panels, NOREX® Panels and NORBEC Camlock Panels.

Table 9: Description of the system boundary modules

PRODUCT STAGE			CONSTRUC-TION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				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 supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential	**Reference Service Life**
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Legend: X = included; MND = module not declared (excluded)

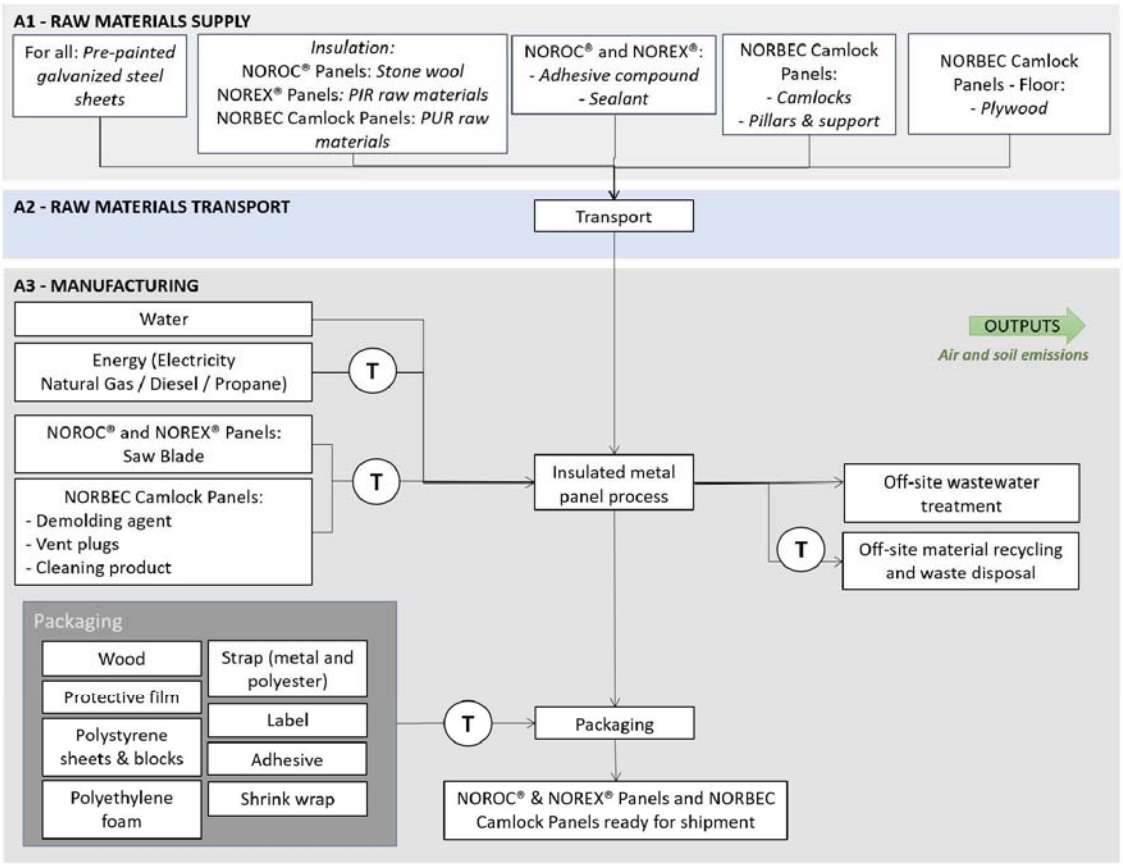


Figure 5: System boundaries of Cradle-to-Gate LCA (module A1 to A3) of Norbec™'s NOROC® Panels, NOREX® Panels and NORBEC Camlock Panels produced in Boucherville and Saint-Hyacinthe. "T" refers to transport.

Raw materials acquisition: This module includes the extraction and transformation of raw materials included in the panels.

Raw materials transportation: This module includes the transportation of raw materials from Norbec™'s suppliers to Norbec™'s facilities.

Manufacturing: This module includes energy and water consumption for the manufacturing processes and includes heating of the building, but excludes air conditioning. Emissions to air from fuel combustion as well as emissions to air and soil from the application of insulation in the production of panels, in particular NOREX® Panels, have been considered. There are no water emissions. This module also includes process ancillary materials needed to produce the products (e.g. saw blade consumption and cleaning products), but excludes products needed for product installation such as screws, additional sealant and camlock plugs.

There is line loss (e.g. trims, purge) during the process, as well as panel loss. These losses vary per product and have been determined by production weight. Steel and plywood waste are sent to a recycling center while unreacted polyol, isocyanate and used cleaning product residues are sent for hazardous waste treatment. All other wastes are considered sent to landfill.

Finally, packaging materials to make products ready for shipment, as well as their transport to Norbec™'s manufacturing plants, are covered by this module.

3.3 CO_2 CERTIFICATES

Norbec™ does not have any CO_2 certificates and none are reported here.

3.4 CUT-OFF CRITERIA

In this EPD, no known flows or primary data (input material, energy consumption) were deliberately excluded from the system boundaries.

For this EPD, no data on the construction, maintenance or dismantling of the capital assets, daily transport of employees, office work, business trips and other activity from Norbec™'s employees was included in the model. The model only takes into account the processes associated with infrastructures that are already included in the ecoinvent unit processes.

3.5 CALCULATION METHOD

The openLCA software v1.7.2 [25], an open source software, was used to calculate the inventory and to assess potential environmental impacts associated with the inventoried emissions.

3.6 DATA SOURCES AND QUALITY REQUIREMENTS

A summary of the data sources and quality assessment is presented in Table 10.

Table 10: Data sources and quality evaluation of life cycle inventory panels.

Data Quality Parameter	Data Quality Discussion
Source of manufacturing data: Description sources of data	Manufacturing data was collected from Norbec™'s manufacturing plants located in Boucherville (Quebec) and Saint-Hyacinthe (Quebec) for the 2018 production year. This data included: total annual area and mass of products produced at the manufacturing plant, as well as the total annual mass and area of products under study; raw materials entering the production of the products under study, losses of materials, transport distance of materials, energy consumption, water consumption, emissions to the environment at the manufacturing plant, waste treatment, and packaging
Source of secondary data: Description sources of raw material, energy source, waste and packaging data	Data used for steel manufacturing and rock-wool were taken from published EPDs [26], [27]. In priority, background data was taken from ecoinvent "cut-off" datasets representative of Quebec, Canada, the United-States or North America [28]. When appropriate, the grid mix was changed for the grid mix of the province or country where the production takes places. Otherwise, ecoinvent data representative of the global market or "rest-of-the-world" were selected as proxies. Wood data, transport data, polyol and MDI for polyisocyanurate foam data were taken form the US LCI database [29], which is specific to a North American context.
Geographical representativeness	Manufacturing facilities are based in the province of Quebec; hence electricity consumption is based on the Quebec grid mix and natural gas consumption on Quebec's natural gas supply. Geographical correlation of the material supply and the selected datasets are mainly representative of the same area. When this was not possible, datasets that represent a larger geographical area were taken.
Temporal representativeness	Primary data was collected so as to be representative of the full 2018 year. Life cycle inventory datasets selected from published EPDs were published within the last ten years, but this was not always the case for ecoinvent and US LCI datasets. Nevertheless, ecoinvent and US LCI remain the reference LCI databases.
Technological representativeness	Primary data, obtained from the manufacturer, is representative of the current technologies and materials used by this company.
Completeness	All relevant process steps were considered and modeled to satisfy the goal and scope. No known flows were cut-off.

3.7 REFERENCE PERIOD

Life cycle inventory data is representative of Norbec™'s NOROC® & NOREX® Panels, NORBEC Wall and Ceiling Camlock Panels, and NORBEC Floor Camlock Panels for the year 2018.

3.8 ALLOCATION

Data relative to energy consumption (electricity, natural gas, propane and diesel), water consumption, emissions flows, process ancillary materials, waste and packaging was provided for the whole manufacturing plant. In this EPD, mass allocation was used for input energy flows, water flows, process ancillary materials flows, waste flows and packaging flows. Emissions flows were attributed only to the product responsible for their emission.

Waste processing of the material flows undergoing recycling processes are included up to the system boundary of the end-of-waste state. In other words, a cut-off approach was used as further processing of the recycled material is part of raw material preparation of another product system (open-loop recycling).

4 LCA RESULTS AND INTERPRETATION

4.1 DISCLAIMER

LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

4.2 LCA RESULTS

Table 11: LCA results for 100 m² of insulated metal panel coverage

Environmental indicator		Unit	NOROC® panels (per 100 m²)	NOREX® panels (per 100 m²)	NORBEC Wall and Ceiling Camlock Panels (per 100 m²)	NORBEC Floor Camlock Panels (per 100 m²)
TRACI 2.1						
GWP[1][2]	Global warming potential	kg CO_2 eq.	5.78E+03	3.66E+03	4.59E+03	6.67E+03
ODP[1]	Stratospheric ozone layer depletion potential	kg CFC-11 eq.	1.06E-04	1.01E-04	1.03E-04	1.31E-04
AP[1]	Acidification potential	kg SO_2 eq.	3.50E+01	1.85E+01	2.35E+01	3.49E+01
EP[1]	Eutrophication potential	kg N eq.	6.78E+00	1.86E+00	3.93E+00	5.16E+00
SFP[1]	Smog formation potential	kg O_3 eq.	3.84E+02	2.98E+02	3.86E+02	6.00E+02
ADP-f[1]	Abiotic resource depletion potential - fossil fuels	MJ Surplus	5.28E+04	2.59E+04	3.48E+04	5.41E+04

(1): Calculated as per U.S EPA TRACI 2.1 [31], OpenLCA v 1.7.2 [25].
(2): GWP 100, excludes biogenic CO_2 removals and emissions associated with biobased products and packaging; 100-year time horizon GWP factors are provided by the IPCC 2007 Fourth Assessment Report (AR4).

Table 12: Resource Use results for 100 m² of insulated metal panel coverage

Environmental indicator		Unit	NOROC® Panels (per 100 m²)	NOREX® Panels (per 100 m²)	NORBEC Wall and Ceiling Camlock Panels (per 100 m²)	NORBEC Floor Camlock Panels (per 100 m²)
Resource use						
RPR_E[(1)]	Renewable primary resources used as energy carrier (fuel)	MJ, LHV	2.19E+04	6.87E+03	1.05E+04	1.71E+04
RPR_M[(2)]	Renewable primary resources with energy content used as material	MJ, LHV	3.31E+03	-	-	5.88E+03
$NRPR_E$[(3)]	Non-renewable primary resources used as energy carrier (fuel)	MJ, LHV	2.16E+04	5.06E+04	5.78E+04	8.31E+04
$NRPR_M$[(4)]	Non-renewable primary resources with energy content used as material	MJ, LHV	4.53E+03	8.77E+03	8.10E+03	8.11E+03
SM[(5)]	Secondary materials	kg	4.43E+02	3.11E+02	4.31E+02	6.75E+02
RSF	Renewable secondary fuels	MJ, LHV	-	-	-	-
NRSF	Non-renewable secondary fuels	MJ, LHV	-	-	-	-
FW[(6)]	Use of net fresh water resources	m³	6.90E+00	1.21E+00	3.25E+00	3.97E+00

(1): $RPE_E = RPR_T - RPR_M$, where RPR_T is equal to the value for renewable energy obtained using the CED LHV methodology.
(2): Calculated as per ACLCA ISO 21930 Guidance [32], 6.2 Renewable primary resources with energy content used as a material, RPR_M. N/A for the NOREX® panels and NORBEC Wall and Ceiling Camlock Panels.
(3): $NPRE_E = NRPR_T - NRPR_M$, where $NRPR_T$ is equal to the value for non- renewable energy obtained using the CED LHV methodology.
(4): Calculated as per ACLCA ISO 21930 Guidance [32], 6.4 Non-renewable primary resources with energy content used as a material, $NRPR_M$.
(5): Calculated as per ACLCA ISO 21930 Guidance [32], 6.5 Secondary materials, SM: includes steel and stone wool insulation materials.
(6): Calculated according to ISO 14046 [33].

Table 13: Output flows and waste categories results for 100 m² of insulated metal panel coverage

Environmental indicator		Unit	NOROC® Panels (per 100 m²)	NOREX® Panels (per 100 m²)	NORBEC Wall and Ceiling Camlock Panels (per 100 m²)	NORBEC Floor Camlock Panels (per 100 m²)
Output flows and waste categories						
HWD[1]	Hazardous waste disposed	kg	3.07E+01	2.59E+01	3.34E+01	5.07E+01
NHWD[2]	Non-hazardous waste disposed	kg	1.15E+03	3.95E+02	1.17E+03	1.46E+03
HLRW[3]	High-level radioactive waste, conditioned, to final repository	m^3	3.94E-03	1.24E-03	1.71E-03	2.69E-03
ILLRW[4]	Intermediate- and low-level radioactive waste, conditioned to final repository	m^3	5.54E-06	3.89E-06	4.59E-06	6.75E-06
CRU	Components for re-use	kg	-	-	-	-
MFR[5]	Materials for recycling	kg	2.24E+02	1.29E+02	2.69E+02	5.49E+02
MER	Materials for energy recovery	kg	-	-	-	-
EE	Exported energy	MJ, LHV	-	-	-	-

(1): Calculated from life cycle inventory results, based on datasets marked as "hazardous" and EPD values.
(2): Calculated from life cycle inventory results, based on waste that is neither "hazardous" nor "radioactive" and EPD values.
(3): Calculated, as per ACLCA ISO 21930 Guidance section 10.3 High-level radioactive waste, conditioned, to final repository [32], from life cycle in-ventory results, based on datasets "treatment of high-level radioactive waste, conditioned, to final repository" and EPD values. It should be noted that NOREC panel production does not generate any high-level radioactive waste (HLRW). HLRW, e.g., when generated by electricity production, consists mostly of spent fuel from reactors. (ISO 21930:2017, clause 7.2.14 [3]).
(4): Calculated, as per ACLCA ISO 21930 Guidance [32] section 10.4 Intermediate- and low-level radioactive waste, conditioned, to final repository. from life cycle inventory results, based on datasets "treatment of low-level radioactive waste, plasma torch incineration cut-off" and "treatment of low-level radioactive waste, surface or trench deposit cut-off". It should be noted that NOREC panel production does not generate any low- and intermediate-level radioactive wastes (ILLRW). ILLRW, e.g., when generated by electricity production, arise mainly from routine facility maintenance and operations (ISO 21930:2017, clause 7.2.14 [3]).
(5): Calculated based on the amounts leaving the system boundary when they have reached the end-of-waste state.

4.3 CALCULATING IMPACT CATEGORY RESULTS FOR PRODUCTS WITH SPECIFIC PHYSICAL PROPERTIES

The impact category values found in Table 11 are for the declared unit of metal insulated panels, i.e. 2018 production averages. Insulated metal panels are available in different insulation thicknesses and steel inner and outer face thicknesses. In order to calculate impact category values for the Norbec™'s NOROC® & NOREX® Panels, NORBEC Wall and Ceiling Camlock Panels, and NORBEC Floor Camlock Panels with different insulation and steel thickness (I_F), the following equation and chart can be used:

$$I_F = I_{DU} + m_i(i_F - i_{DU}) + m_s(s_F - s_{DU})$$

Where

I_F: Final impact value per 100 m^2 of panel
I_{DU}: Impact value for declared unit, i.e. 2018 production average (found in Table 11)
i_F: Final insulation thickness
i_{DU}: Insulation thickness for the declared unit, i.e. 2018 production average (found in Table 8)
s_F: Final steel thickness
s_{DU}: Steel thickness for the declared unit, i.e. 2018 production average (found in Table 8)
m_i: Insulation gradient (found in Table 14)
m_s: Steel gradient (found in Table 14)

For example, to calculate the GWP of NOROC® panels with an insulation thickness of 0.152 m (6") and steel thickness of 1.448 mm (inner and outer layer of 0.0285"), the calculation is as follows:

I_F =5.78E+03 + 1.89E+04*(0.152 - 0.139) + 2.70E+03*(1.448 - 1.043) = 7.13E+3 kg CO_2 eq/100m^2.

Table 14: Insulation and steel gradient for final impact category values

Environmental indicator		Unit	NOROC® Panels		NOREX® Panels	
			m_i	m_s	m_i	m_s
GWP(1)(2)	Global warming potential	kg CO2 eq.	1.89E+04	2.70E+03	1.21E+04	2.46E+03
ODP(1)	Stratospheric ozone layer depletion potential	kg CFC-11 eq.	4.57E-04	2.83E-05	6.87E-04	2.89E-05
AP(1)	Acidification potential	kg SO2 eq.	1.39E+02	1.36E+01	6.27E+01	1.24E+01
EP(1)	Eutrophication potential	kg N eq.	3.59E+01	1.14E+00	7.17E+00	1.05E+00
SFP(1)	Smog formation potential	kg O3 eq.	7.36E+02	2.48E+02	7.12E+02	2.27E+02
ADP-f(1)	Abiotic resource depletion potential - fossil fuels	MJ Surplus	1.75E+05	2.64E+04	1.11E+04	2.42E+04

Table 14: Insulation and steel gradient for final impact category values (cont'd)

Environmental indicator		Unit	NORBEC Wall and Ceiling Camlock Panels		NORBEC Floor Camlock Panels	
			m_i	m_s	m_i	m_s
GWP(1)(2)	Global warming potential	kg CO2 eq.	1.16E+04	2.74E+03	1.15E+04	2.56E+03
ODP(1)	Stratospheric ozone layer depletion potential	kg CFC-11 eq.	7.23E-04	1.92E-05	7.20E-04	1.74E-05
AP(1)	Acidification potential	kg SO2 eq.	6.61E+01	1.37E+01	6.55E+01	1.28E+01
EP(1)	Eutrophication potential	kg N eq.	7.38E+00	1.11E+00	7.54E+00	1.04E+00
SFP(1)	Smog formation potential	kg O3 eq.	7.19E+02	2.57E+02	7.13E+02	2.39E+02
ADP-f(1)	Abiotic resource depletion potential - fossil fuels	MJ Surplus	1.04E+04	2.83E+04	1.03E+04	2.65E+04

(1): Calculated as per U.S EPA TRACI 2.1 [31], OpenLCA v 1.7.2 [25].
(2): GWP 100, excludes biogenic CO_2 removals and emissions associated with biobased products and packaging; 100-year time horizon GWP factors are provided by the IPCC 2007 Fourth Assessment Report (AR4).

4.4 REGULATED HAZARDOUS SUBSTANCES

No substances required to be reported as hazardous are associated with the production of this product.

4.5 DANGEROUS SUBSTANCES

For all panels, if silicone sealant is applied (Adseal 4450), volatile organic compounds (VOCs) are emitted at 49 g/L.

4.6 INTERPRETATION

Figure 6, Figure 7, Figure 8 and Figure 9 present the environmental impacts and energy consumption of NOROC® panels, NOREX® panels, NORBEC Wall and Ceiling Camlock Panels and NORBEC Floor Camlock Panels, respectively.

For NOROC® panels, raw materials have the highest contribution to 5 out of 6 environmental impact indicators, and to the total use of renewable and non-renewable primary energy resources (RPR_T, $NRPR_T$). Manufacturing is the main contributor to stratospheric ozone layer depletion potential (ODP), while it is the second largest contributor for cradle-to-gate total use of renewable primary energy resources (RPR_T).

For NOREX® panels, NORBEC Floor Camlock Panels and NORBEC Wall and Ceiling Camlock Panels, raw materials have the highest contribution to all environmental impact indicators, and to the total use of non-renewable primary energy resources ($NRPR_T$). Manufacturing is the main contributor to the total use of renewable primary energy resources (RPR_T), except for NORBEC Floor Camlock Panels, where raw material acquisition and manufacturing contribute equally.

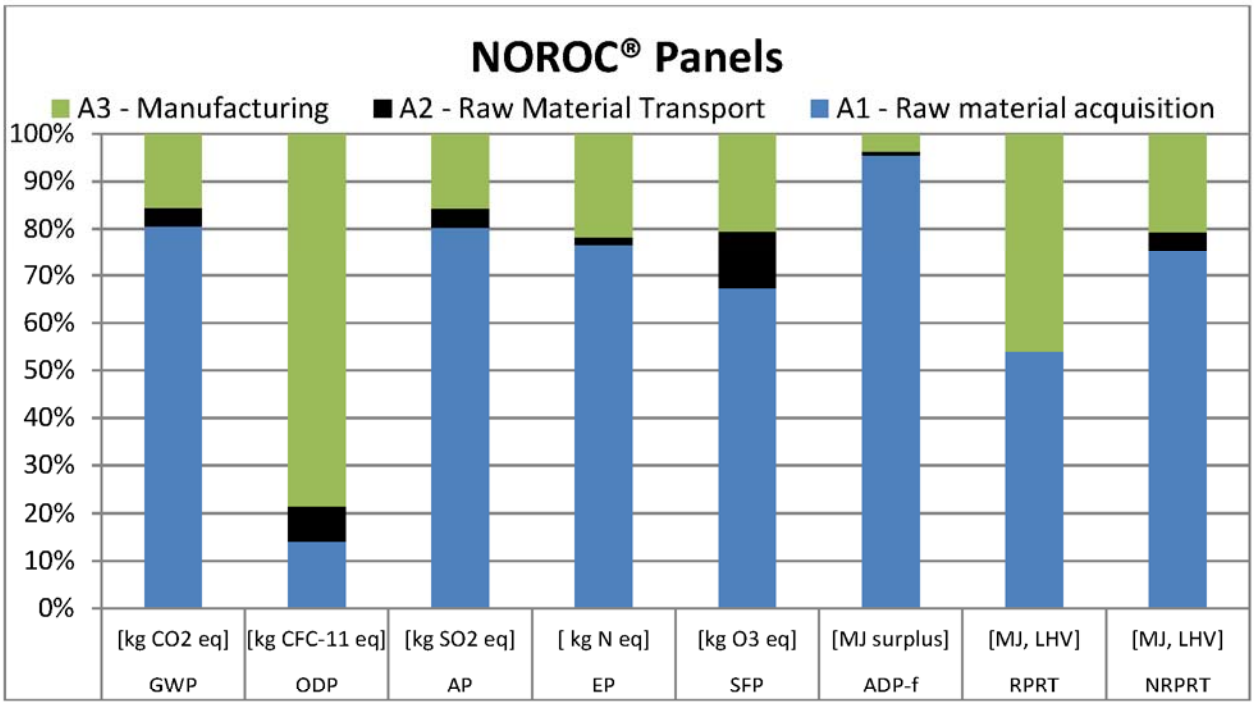


Figure 6: Contribution of production life cycle stage modules to the environmental impacts of 100 m² of NOROC® insulated metal panel coverage – TRACI, & CED LHV indicators.

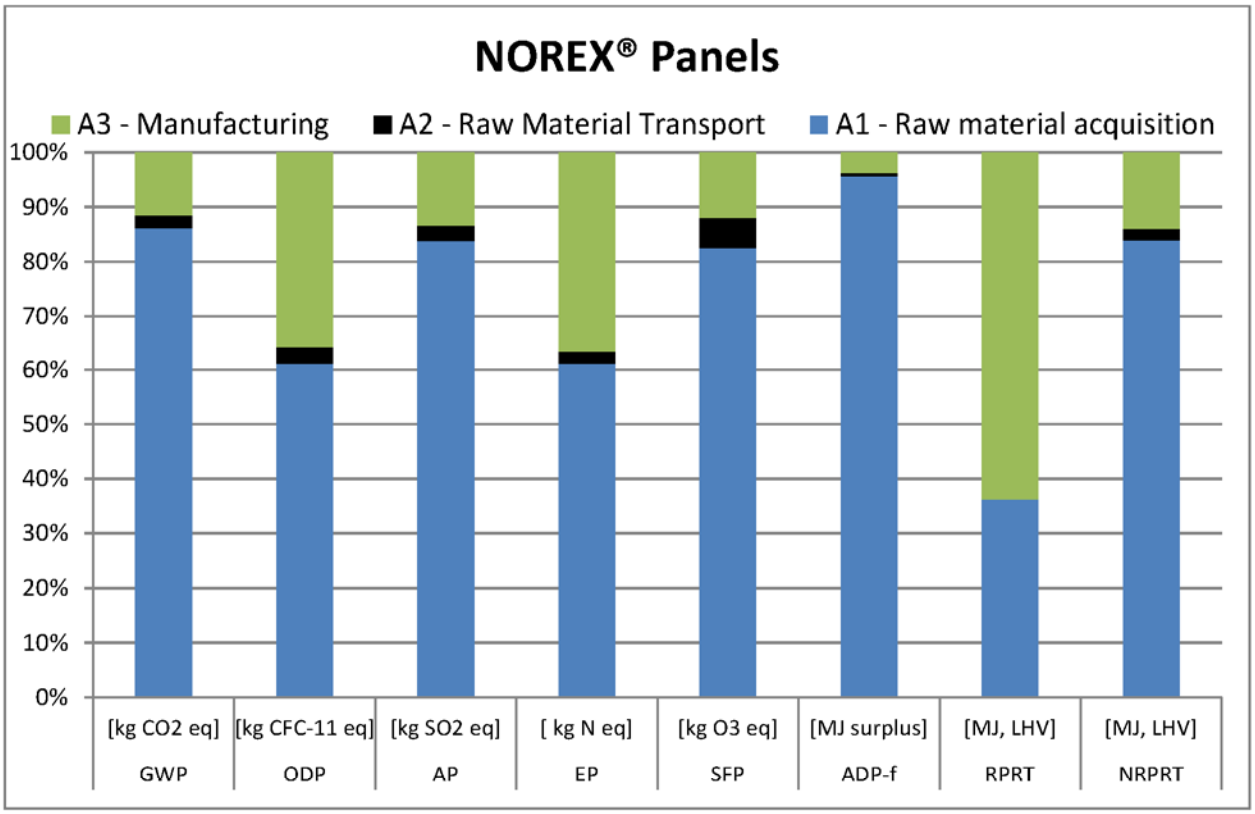


Figure 7: Contribution of production life cycle stage modules to the environmental impacts of 100 m² of NOREX® insulated metal panel coverage – TRACI, & CED LHV indicators.

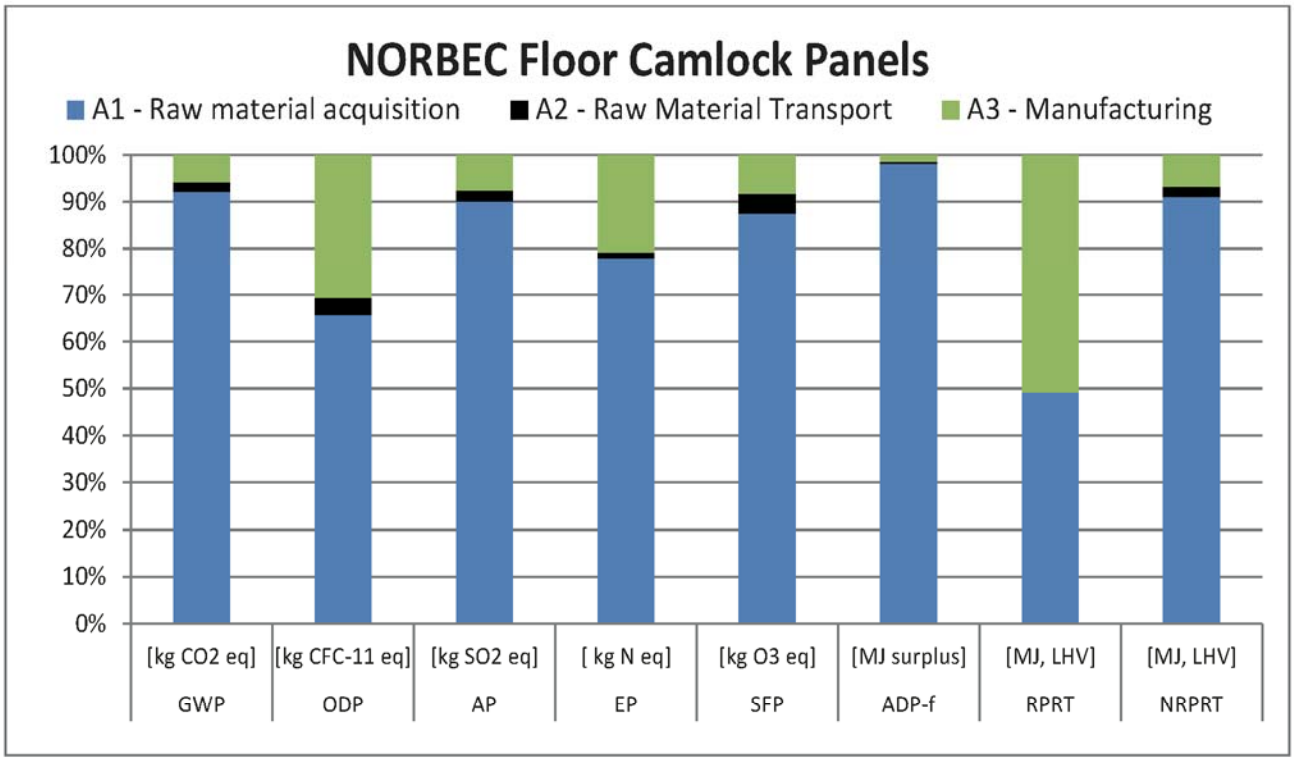


Figure 8: Contribution of production life cycle stage modules to the environmental impacts of 100 m² of NORBEC Wall and Ceiling Camlock Panel coverage – TRACI, & CED LHV indicators.

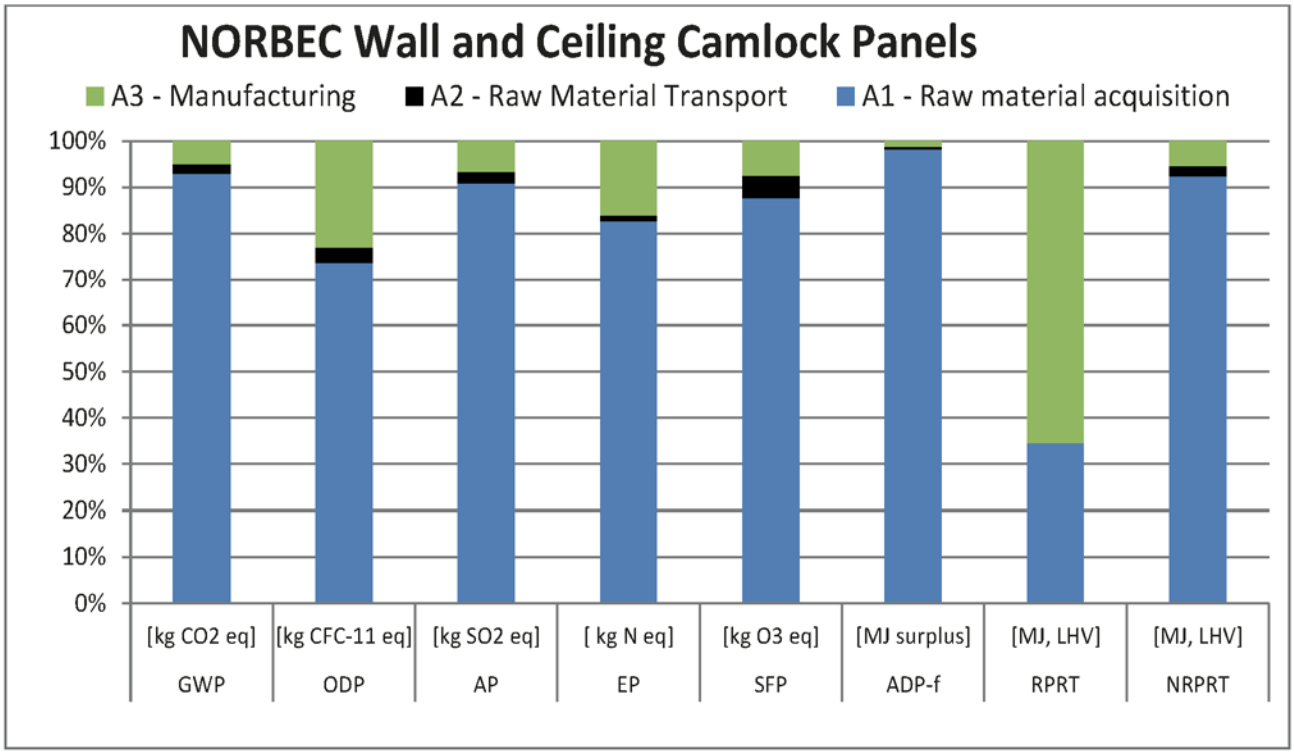


Figure 9: Contribution of production life cycle stage modules to the environmental impacts of 100 m² of NORBEC Floor Camlock Panel coverage – TRACI, & CED LHV indicators.

5 ADDITIONAL ENVIRONMENTAL INFORMATION

In addition, Norbec™ is part of a third-party verifi cation process with Vertima Inc. where Norbec™'s products and its entire supply chain are assessed. At the end of the process, they have received a Validated Eco-Declaration® summarizing verifi ed environmental claims.

Norbec™ has also published Health Product Declaration® for NOROC® & NOREX® insulated metal panels and NORBEC Camlock Panels. More details are available on the HPDC public repository: https://www.hpd-collaborative.org/hpd-public-repository/.

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