Environmental Product Declaration

TRANSLUCENT SKYROOFS

FRP COMPOSITE SANDWICH PANELIZED ROOFLIGHT

Kalwall's translucent Skyroofs offer the ultimate in energy-efficient, diffuse top-lighting. Available flat or curved, all are designed to withstand high wind and snow loads and comply with OSHA fall-through requirements.

KALWALL®
high performance translucent building systems

Kalwall Corporation has been delivering museum-quality daylighting™ to building occupants all over the world since inventing the original translucent sandwich panel in 1955. Over the last 65+ years, no other company has dedicated more resources, creativity, and innovation into perfecting the art and science of diffuse, balanced daylighting. Kalwall's mission is to empower both building owners and designers to fulfill their visions and create healthier buildings that balance performance, comfort, beauty and value.

All of Kalwall's daylighting systems utilize its lightweight, structural composite FRP panels that are unique in the fenestration industry for their combined light quality, thermal performance and solar control properties. Today, Kalwall remains as committed as ever to offering real solutions that reduce both operational and embodied carbon and harvest free daylight to support all human functions and endeavors.

UL
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ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

Environmental Product Declaration

KALWALL®

high performance translucent building systems

Translucent Skyroofs with Thermal Break

FRP Composite Sandwich Panelized Rooflights

According to ISO 14025 and ISO 21930:2017

EPD Program and Program Operator Name, Address, Logo, and Website	UL Environment 333 Pfingsten Road Northbrook, IL 60611 https://www.ul.com/ https://spot.ul.com
General Program Instructions and Version Number	General Program Instructions v.2.5 March 2020
Manufacturer Name and Address	Kalwall Corporation 1111 Candia Road, Manchester NH 03109
Declaration Number	4790187800.104.1
Declared Unit	100 m^2 of translucent building panel
Reference PCR and Version Number	ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
Description of Product Application/Use	Translucent daylighting systems offering diffused, balanced daylighting, insulative properties, and structural capacity.
Product RSL Description (if Appl.)	n/a
Markets of Applicability	Commercial, residential, industrial
Date of Issue	April 1, 2022
Period of Validity	5 years
EPD Type	Product-specific
Range of Dataset Variability	n/a
EPD Scope	Cradle-to-gate, with installation and EoL
Year(s) of Reported Primary Data	June 2020 – June 2021
LCA Software & Version Number	GaBi 10.6.0.110
LCI Database(s) & Version Number	GaBi Database 2021.2
LCIA Methodology & Version Number	CML 2001, Aug 2016

The PCR review was conducted by:	ISO Standards iso.org ISO / TC 59 / SC 17 central@iso.org
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Cooper McCollum, UL Environment
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	James Mellentine, Thrive ESG

Limitations

Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible". Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

1. Product Definition and Information

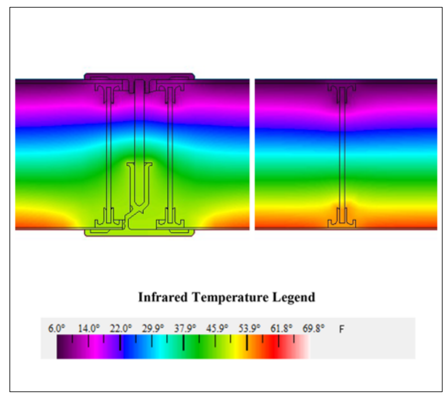
1.1. Description of Company/Organization

Kalwall is the industry leader in diffuse natural daylighting systems and is recognized for its innovative, energy efficient and sustainable products. Its rugged and beautiful translucent building products provide a more predictable, better quality of usable natural light with superior thermal properties and best-in-industry solar heat gain control. Kalwall was founded in 1955, is headquartered in Manchester, N.H., and all of its daylighting systems are made in the USA.

1.2. Product Description

Typical translucent skyroof – exterior view

Typical translucent skyroof – interior view



Thermal break option (panel & system details)

Product Identification

Translucent skyroofs incorporate FRP composite structural sandwich panels and an aluminum fastening system that can be installed on over an existing substructure. They can be individual rooflights, pre-engineered roofs, or custom roofs. They are easy to install, can be flat or curved, and provide exceptional thermal performance and solar control.

Thermally broken panels are designed to utilize aluminum framing and grids with thermal breaks, preventing the transfer of thermal energy between the interior and exterior environments.

Product Specification

Kalwall skyroofs have been evaluated under EN 14963, including Reaction to Fire testing under EN 13801 and various other national standards.

Product Average

Each product is a custom configuration depending on the parameters of the building. The scenario selected represents a typical panel with perimeter dimensions of 10’ x 5’ (3.05 m x 1.52 m), cell dimensions of 2’ x 1’ (61.0 cm x 30.0 cm , and thickness of 2-¾” (70 mm).

1.3. Application

Kalwall Roof panels can be used in a variety of building applications, including commercial, residential, and industrial.

1.4. Declaration of Methodological Framework

The LCA follows an attributional approach

1.5. Technical Requirements

The U-factor, Solar Factor and light transmittance have been evaluated by various EU standards. Values for a particular project should be verified with the manufacturer

1.6. Material Composition

The product consists of a thermally broken aluminum grid and frame with fiberglass batts in each cell, sandwiched between two fiber reinforced polymer (FRP) sheets.

Table 1: Product composition

NAME	ROOF PANEL, TB
Fiber reinforced polymer (FRP) sheet	45%
I-beam, aluminum	-
I-beam, thermally-broken (TBI) (39% FRP)	19%
Framing, aluminum extrusion	-
Framing, thermally-broken aluminum extrusion (industry average)	29%
Fiberglass batt insulation	3%
Coating (acrylic / fluoropolymer mix)	3%
Other (including adhesives, paint, gaskets, sealants)	<2%

1.7. Manufacturing

Kalwall operations consist of three facilities in New Hampshire. The Bow, NH facility manufacturers the fiber reinforced polymer panels. Resins, glass fibers, pigments, and other additives are mixed on site and sheets are manufactured in a continuous process. VOCs from the ingredients are captured by a thermal oxidizer unit that combusts these emissions using propane. Spools of the FRP are then sent to one of two Manchester, NH facilities, either the Candia Road facility where the majority of panels are assembled, or the Pine Street facility where the thermally broken I-beams (TBI) and specialized curved panels are assembled. For the purposes of this study, inputs and outputs from these two facilities were summed and treated as one facility. The panel assembly process involves hand assembling the perimeter framing and interior I-beams with extrusions that have been cut to size on site. Insulation is cut to cell size and placed in manually. An adhesive is applied to edges of the extrusions, the FRP placed on top, and the adhesive cured. Excess FRP is trimmed. The final product has a clear weatherable surface applied to further protect against UV damage and provide a self-cleaning function. Painting and priming of the perimeter framing are also done on site.

1.8. Packaging

Packaging materials are minimal and are reused multiple times, therefore packaging impacts would be negligible and were excluded from this study.

1.9. Transportation

It is assumed that all raw materials are distributed by truck or ship, based on global region.

A typical shipping distance from the manufacturing location to the customer was used. The product is trucked to Montreal (515 km), shipped to Rotterdam (6100 km), and assumed to be transported 500 km within Europe. The transportation distance for all waste flows is assumed to be 32 km based on best available data.

1.10. Product Installation

All product installation is done using hand tools. As the products are designed to fit the specified space, no installation waste is created. Energy for installation was conservatively estimated to be 2 kWh based on the guidance PCR for insulated metal panels.

The manufacturing of the installation equipment is not included in the study as these are multi-use tools and the impacts per functional unit are considered negligible. As no packaging is included, disposal of packaging is not required.

1.11. Use

The use stage is excluded from the scope of this assessment.

1.12. Reference Service Life and Estimated Building Service Life

As the use stage is excluded, no reference service life is declared.

1.13. Disposal

At end-of-life, panels are removed manually from the building and the aluminum frame is separated out to be recycled while the panel is conservatively assumed to be sent to incineration. The transport distance to recycling and incineration is assumed to be 161 km.

2. Life Cycle Assessment Background Information

2.1. Functional or Declared Unit

The declared unit according is 100 m^2 of covered area.

Table 2: Declared unit

	UNIT	ROOF PANEL, TB
Declared Unit	m^2	100
Mass per functional unit	*kg*	977
Conversion factor to 1 kg	-	1.02×10^{-3}

2.2. System Boundary

The type of EPD is cradle-to-gate with options. Included stages are summarized in Figure 1.

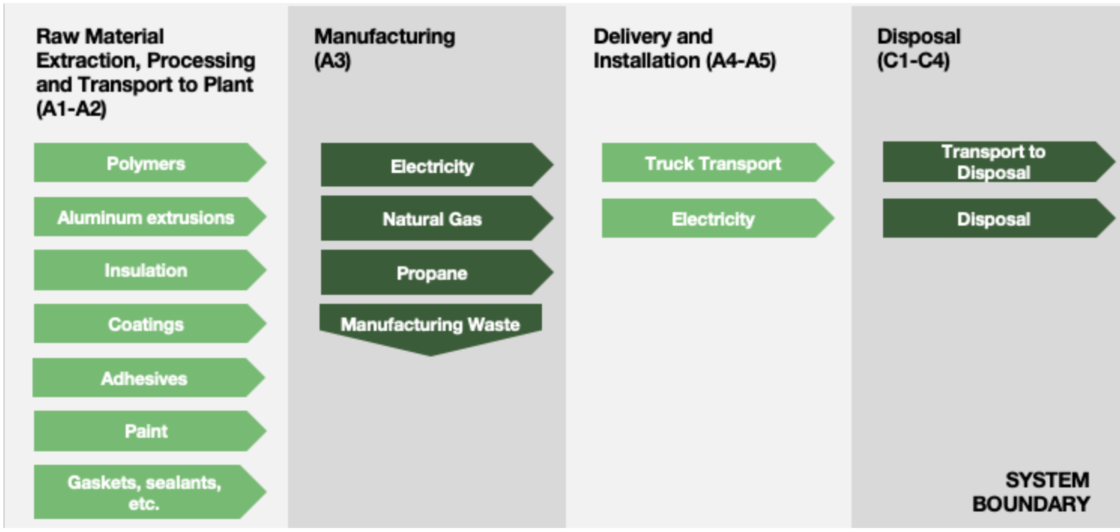


Figure 1: System boundary

2.3. Estimates and Assumptions

Transport to customer will vary and was therefore assumed based on Kalwall's estimate of typical shipping routes. Inbound transport distances of raw materials comprising less than 10% of the mass were also assumed to be transported 2414 km by truck. Overhead energy consumption was included in the manufacturing data as it was unable to be separated out. Finally, the end-of-life scenario presented in section 1.13 is an assumption based on typical construction waste treatment in Europe.

2.4. Cut-off Criteria

Material inputs greater than 1% (based on total mass of the final product) were included within the scope of analysis. Material inputs less than 1% were included if sufficient data was available to warrant inclusion and/or the material input was thought to have significant environmental impact. Cumulative excluded material inputs and environmental impacts are less than 5% based on total weight of the functional unit.

2.5. Data Sources

Primary data were collected by facility personnel and from utility bills and was used for all manufacturing processes. Secondary data for raw material production was utilized from the GaBi Database 2021.2.

2.6. Data Quality

The geographical scope of the manufacturing portion of the life cycle is North America. All primary data were collected from the manufacturer. The geographic coverage of primary data is considered excellent. The geographical scope of the raw material acquisition is primarily North America, though some materials are purchased from international suppliers. Customer distribution and disposal is assumed to be within Europe. Primary data were provided by the manufacturer and represent all information for June 2020 through June 2021. Time coverage of this primary data is considered excellent. Primary data provided by the manufacturer is specific to the technology the company uses in manufacturing their product. It is site-specific and considered of good quality.

In selecting secondary data (i.e., GaBi Datasets), priority was given to the accuracy and representativeness of the data. When available and deemed of significant quality, country-specific data was used. However, priority was given to technological relevance and accuracy in selecting secondary data. This often led to the substitution of regional and/or global data for country-specific data. Overall geographic data quality is considered good. Time coverage of the GaBi datasets varies from approximately 2007 to present. All datasets rely on at least one 1-year average data. Overall time coverage of the datasets is considered good.

2.7. Period under Review

The period under review is June 2020 through June 2021.

2.8. Allocation

General principles of allocation were based on ISO 14040/44. Where possible, allocation was avoided. There are no products other than the product under study that are produced as part of the manufacturing processes. Since there are no co-products, no allocation based on co-products is required.

To derive a per-unit value for manufacturing inputs such as electricity, thermal energy and water, allocation based on total production by area was adopted. As a default, secondary GaBi datasets use a physical basis for allocation.

Throughout the study, recycled materials were accounted for via the cut-off method.

3. Life Cycle Assessment Scenarios

Table 3. Transport to the building site (A4)

NAME	LEG 1	LEG 2	LEG 3	UNIT
Fuel type	Diesel	Heavy fuel oil	Diesel	
Liters of fuel	42	9410 (total ship)	42	l/100km
Vehicle type	Truck	Ship	Truck	
Transport distance	515	6100	500	km
Capacity utilization (including empty runs, mass based)	67%	53%	67%	%
Gross density of products transported	68	68	68	kg/m^3

Table 4. Installation into the building (A5)

NAME	VALUE	UNIT
Ancillary materials	-	kg
Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)	-	m^3
Other resources	-	kg
Electricity consumption	2	kWh
Other energy carriers	-	MJ
Product loss per functional unit	-	kg
Waste materials at the construction site before waste processing, generated by product installation	-	kg
Output materials resulting from on-site waste processing (specified by route; e.g. for recycling, energy recovery and/or disposal)	-	kg

NAME	VALUE	UNIT
Biogenic carbon contained in packaging	-	kg CO_2
Direct emissions to ambient air, soil and water	-	kg
VOC content	-	µg/m^3

Table 5. End of life (C1-C4)

NAME		ROOF PANEL ROOF PANEL, TB	UNIT
Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method and transportation)		Manual removal 100% of aluminum frame recycled, remaining incinerated 160 km (100 mi) transport distance	
Collection process (specified by type)	Collected separately	-	%
	Collected with mixed construction waste	100%	%
Recovery (specified by type)	Reuse	-	%
	Recycling	26%	%
	Landfill	-	%
	Incineration	74%	%
	Incineration with energy recovery	-	%
	Energy conversion efficiency rate	-	%
Disposal (specified by type)	Product or material for final deposition	-	%
Removals of biogenic carbon (excluding packaging)		-	kg CO_2

4. Life Cycle Assessment Results

Table 6. Description of the system boundary modules

	PRODUCT STAGE			CONSTRUCT-ION 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	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
EPD Type	X	X	X	X	X	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	ND

4.1. Life Cycle Impact Assessment Results

Table 7. European Impact Assessment Results, Roof Panel, TB

CML 2001, AUG 2016	A1-A3	A4	A5	C1	C2	C3	C4
GWP 100 [kg CO_2 eq]	7.66E+03	1.00E+02	7.88E-01	0.00E+00	1.26E+01	0.00E+00	7.71E+02
ODP [kg CFC-11 eq]	4.68E-06	1.90E-14	2.54E-14	0.00E+00	2.51E-15	0.00E+00	3.55E-06
AP [kg SO_2 eq]	2.95E+01	8.37E-01	1.54E-03	0.00E+00	2.64E-02	0.00E+00	3.99E-01
EP [kg Phosphate eq]	2.47E+00	1.44E-01	1.82E-04	0.00E+00	8.19E-03	0.00E+00	3.42E-02
POCP [kg Ethene eq]	9.49E+00	-6.66E-02	1.12E-04	0.00E+00	-8.88E-03	0.00E+00	1.97E-02
ADPfossil [MJ, LHV]	1.12E+05	1.37E+03	8.85E+00	0.00E+00	1.76E+02	0.00E+00	7.66E+02

4.2. Life Cycle Inventory Results

Table 8. Resource Use, Roof Panel, TB

PARAMETER	A1-A3	A4	A5	C1	C2	C3	C4
RPR_E [MJ, LHV]	2.00E+04	4.78E+01	6.52E+00	0.00E+00	7.32E+00	0.00E+00	8.86E+01
RPR_M [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$ [MJ, LHV]	1.10E+05	1.38E+03	1.41E+01	0.00E+00	1.78E+02	0.00E+00	9.39E+02
$NRPR_M$ [MJ, LHV]	1.12E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM [kg]	1.51E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m^3]	7.87E+01	2.01E-01	6.35E-03	0.00E+00	3.13E-02	0.00E+00	2.95E+00

Table 9. Output Flows and Waste Categories, Roof Panel, TB

PARAMETER	A1-A3	A4	A5	C1	C2	C3	C4
HWD [kg]	3.28E-01	1.08E-07	3.74E-09	0.00E+00	1.48E-08	0.00E+00	5.04E-08
NHWD [kg]	1.07E+03	1.14E-01	1.00E-02	0.00E+00	1.63E-02	0.00E+00	6.96E+01
HLRW [kg]	4.46E-03	4.57E-06	1.67E-06	0.00E+00	5.99E-07	0.00E+00	8.51E-05
ILLRW [kg]	3.70E+00	3.84E-03	2.10E-03	0.00E+00	5.04E-04	0.00E+00	5.50E-02
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR [kg]	5.91E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.78E+02	0.00E+00
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.99E+02
EEE [MJ, LHV]	9.36E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.60E+03
EET [MJ, LHV]	3.76E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.88E+03

5. LCA Interpretation

Figure 2 presents the relative contribution of each life cycle stage to the LCIA results. Raw material extraction (A1) and manufacturing (A3) are the dominant contributors.

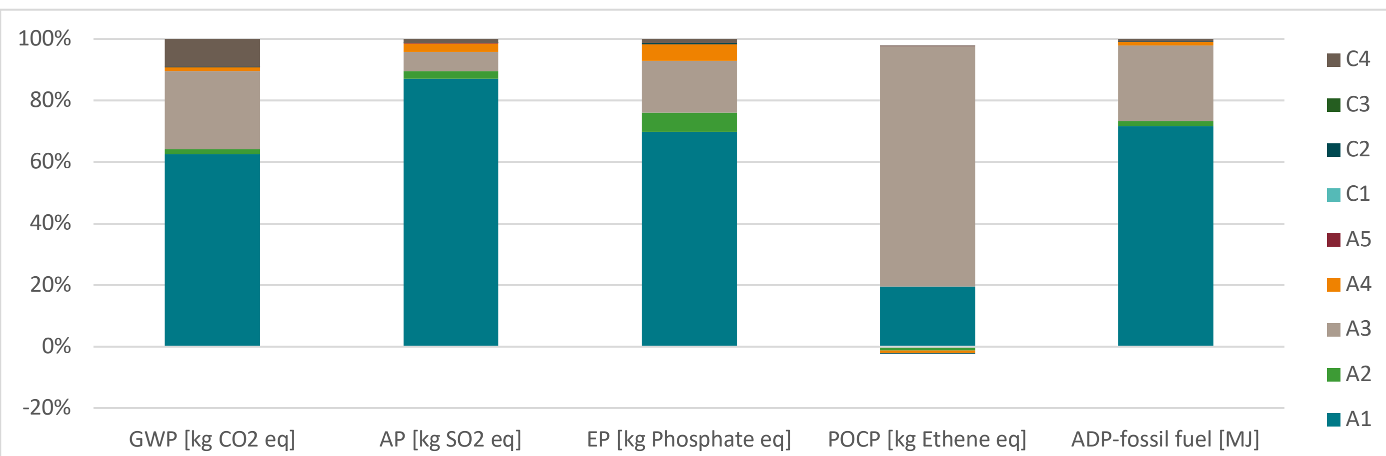


Figure 2: Relative LCIA Results, Roof Panel, TB

6. Additional Environmental Information

6.1. Environment and Health During Manufacturing

No hazardous substances are used in the manufacturing process. There are no hazardous emissions to air or ground water.

6.2. Environment and Health During Installation

No hazardous materials are required for the installation process. Standard jobsite safety protocols should be followed.

6.3. Extraordinary Effects

Fire

Kalwall panels are comprised of a thermoset FRP/aluminum composite that will not melt. Upon request, specifications on flame spread, time to ignition, and fuel contribution can be supplied.

Kalwall panels have been evaluated under EN13501 as well as British Standard 476, Parts 3, 6, 7.

Water

Kalwall panels are designed to create a weather-tight seal between panel and panel, as well as between the panel and the rest of the building.

Mechanical Destruction

The shatterproof, super-weathering FRP face will withstand a 70 ft-lbs (95 J) impact. Optional high impact FRP faces will withstand 230 ft-lbs (95 J) impact by UL 972; also rated for windborne debris protection up to large missile D. Kalwall products are shatterproof and can be designed to mee the requirements of UFC 4-010-01 for many applications.

7. References

- ISO 14025:2006 Environmental labels and declarations - Type III environmental declarations - Principles and procedures. Geneva: International Organization for Standardization.
- ISO 14040:2006/Amd 1:2020 Environmental management - Life cycle assessment - Principles and framework. Geneva: International Organization for Standardization.
- ISO 14044:2006/Amd 2: 2020 Environmental Management - Life cycle assessment - Requirements and Guidelines. Geneva: International Organization for Standardization.
- ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services. Geneva: International Organization for Standardization.
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