MIRAGLASS™ Glass Powders and MIRAGRIT Glass Granulates

Verglass Products Inc.

ENVIRONMENTAL PRODUCT DECLARATION

ISO 14025:2006 and ISO 21930:2017

ASTM INTERNATIONAL

Verglass Products Inc. is pleased to present this Environmental Product Declaration (EPD) for MIRAGLASS™ glass powders and MIRAGRIT glass granulates. This EPD was developed in compliance with ISO 14025 and ISO 21930 and has been verified by Lindita Bushi, Ph.D., 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 Verglass Products Inc., visit www.produitsverglass.ca/en/.

For any explanatory material regarding this EPD, please contact the program operator.

1. GENERAL INFORMATION

PCR GENERAL INFORMATION	
Reference PCR	ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services
The PCR Part-B review was conducted by:	*Technical Committee ISO/TC 59, Buildings and civil engineering works, Subcommittee SC 17, Sustainability in buildings and civil engineering works*

EPD GENERAL INFORMATION		
Program Operator	ASTM International 100 Barr Harbor Drive, West Conshohocken, PA 19428 www.astm.org	
Declared Product	**MIRAGLASS™ glass powders, which includes Miraplast, Miracem and Mirapaint** **MIRAGRIT glass granulates**	
EPD Registration Number EPD-716	**EPD Date of Issue** June 6, 2024	**EPD Period of Validity** June 6, 2024 to June 5, 2029
EPD Recipient Organization	Verglass Products Inc. 621, rue de la Sablière, Bois-des-Fillion (Quebec) J6Z 4T2 Canada www.produitsverglass.ca/en/	

EPD Type/Scope and Declared Unit Product-specific cradle-to-gate EPD with declared unit of 1 kg.			**Year of Reported Manufacturer Primary Data** October 1, 2022 to September 30, 2023
Geographical Scope North America	**LCA Software** Open LCA v.2.03	**LCI Databases** Ecoinvent and US LCI	**LCIA Methodology** TRACI 2.1 and CED LHV v.1.0

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 ISO 14025:2006, ISO 14040:2006 and ISO 14044:2006, as well as the SO 21930:2017. ☐ Internal ☒ External	Lindita Bushi Lindita Bushi, Ph.D. Athena Sustainable Materials Institute

LIMITATIONS

Environmental declarations within the same product category but from different programs may not be comparable. [1]

Comparison of construction products using an EPD shall be carried out in the context of the construction works. Consequently, comparison of the environmental performance of construction products using the EPD shall consider all the relevant information modules over the full life cycle of the products within the construction works. Such a comparison requires scenarios in the construction works context.[2]

[Photo courtesy of Verglass Products Inc.]

2. PRODUCT SYSTEM DESCRIPTION

Verglass Products Inc. is a manufacturer of glass powders intended for the Portland cement concrete, paints, plastics and other construction products markets. Their manufacturing facility is based in Mirabel (Quebec).

2.1. PRODUCT DESCRIPTION

MIRAGLASS™ and MIRAGRIT, respectively glass powders (D50 of 4-12 microns) and glass granulates (6-40 mesh sieve opening), are designed to improve the physical and chemical performance of a variety of formulations and products. There are three types of MIRAGLASS™: Miracem for Portland cement-based concrete, mortars and grouted cements (D50 of 12 microns), Miraplast for plastics and rubbers (D50 of 4-40 microns), and Mirapaint for paints, varnishes, adhesives and other coating mixes (D50 of 4-40 microns). Miraplast and Mirapaint are branding designations specific to applications in the paint and plastics markets.

Figure 1 provides illustrations of the MIRAGLASS™ glass powder.

Figure 1: MIRAGLASS™ glass powder [courtesy of Verglass Products Inc.].

2.2. PRODUCTION AVERAGE

No production average is used. All three MIRAGLASS™ glass powder types have the same material content (100% pre-consumer recycled glass) and undergo the same manufacturing unit processes. All products are produced at one facility based in Mirabel (Quebec).

2.3. PRODUCT APPLICATION

Miraplast products are additives for plastic and rubber formulations, offering, among other things, better dimensional stability for products.

Miracem products are additives for concrete, mortars and grouts to provide better chemical and physical performance.

Mirapaint products are additives for the formulation of paints, varnishes, adhesives and other liquid coatings or 100% solid mixtures.

MIRAGRIT is used as decorative glass in, for example, landscaping applications.

2.4. TECHNICAL DATA

Miracem complies with CSA A3000-18 - Chemical test methods for cementitious materials for use in concrete and masonry and ASTM C1866 - Standard Specification for Ground-Glass Pozzolan for Use in Concrete.

2.5. PROPERTIES OF DECLARED PRODUCT AS DELIVERED

MIRAGLASS™ is a glass powder (D50 of 4-40 microns) and MIRAGRIT are glass granulates (6-40 mesh sieve opening).

2.6. MATERIAL COMPOSITION

MIRAGLASS™ and MIRAGRIT products are made of 100% pre-consumer recycled glass. The products may also contain post-consumer recycled glass.

2.7. MANUFACTURING

MIRAGLASS™ and MIRAGRIT are manufactured from pre-consumer recycled glass. The glass panels first go through a plate glass pre-breaker, before being pulverized in an impact crusher, screened and ultimately micronized in an Ultra Fine Grinding Mill (UFG). MIRAGLASS™ goes through the entire process, while MIRAGRIT, which is coarser, is screened after the impact mill as intermediate mesh fractions and does not need to be micronized in the UFG mill.

2.8. PACKAGING

MIRAGLASS™ and MIRAGRIT are primarily shipped in bulk pneumatic tanker trailers. They may also be shipped in super sacks (capacity of 450 kg or 1000 kg) or in paper bags (capacity of 25 kg). When packaged in super sacks or paper bags, they are placed on a wooden pallet. There is one wooden pallet per 1000 kg of product packaged. The production average of packaging materials is presented in the table below as are packaging per type of packaging materials.

Table 1: Quantity of packaging materials per quantity of MIRAGLASS™ and MIRAGRIT

Item	MIRAGLASS™ and MIRAGRIT			Unit
	Paper bag	Super sack	Production average	
	per 25 kg	per 1000 kg	per kg	
Wood pallet	4.50E-01	1.80E+01	**1.77E-03**	kg
Paper bag	1.00E-01	-	**3.09E-04**	kg
Super sacks	-	1.90E+00	**3.53E-03**	kg

2.9. TRANSPORTATION

Transportation to the installation site is not accounted for in this study as the system boundaries only include modules A1 to A3, and exclude module A4.

3. LCA CALCULATION RULES

3.1. DECLARED UNIT

The declared unit (DU) for this study is **one kilogram of product (MIRAGLASS™ or MIRAGRIT)**.

3.2. SYSTEM BOUNDARIES

The system boundaries are **cradle-to-gate**, i.e., only cover the production life cycle stage as illustrated in **Table 2**. Within this life cycle stage, three (3) modules are considered, namely A1) Extraction and Upstream Production, A2) Transport to Factory and A3) Manufacturing. Construction (A4; A5), Use (B1 to B7) and End-of-life (C1 to C4) stages are not included in the present study. Figure 2 presents the process flow diagram for Verglass Products Inc. MIRAGLASS™ and MIRAGRIT production. Neither green power nor CO_2 credits are used in the framework of this project. An attributional LCA approach is used.

Table 2: Description of the system boundary life cycle stages and related information modules

PRODUCTION STAGE			CONSTRUC-TION PROCESS STAGE		USE STAGE							END-OF-LIFE STAGE			
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
Extraction and Upstream Production	Transport to Factory	Manufacturing	Transport to Site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction / Demolition	Transport to Waste Processing or Disposal	Waste Processing	Disposal of Waste
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

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

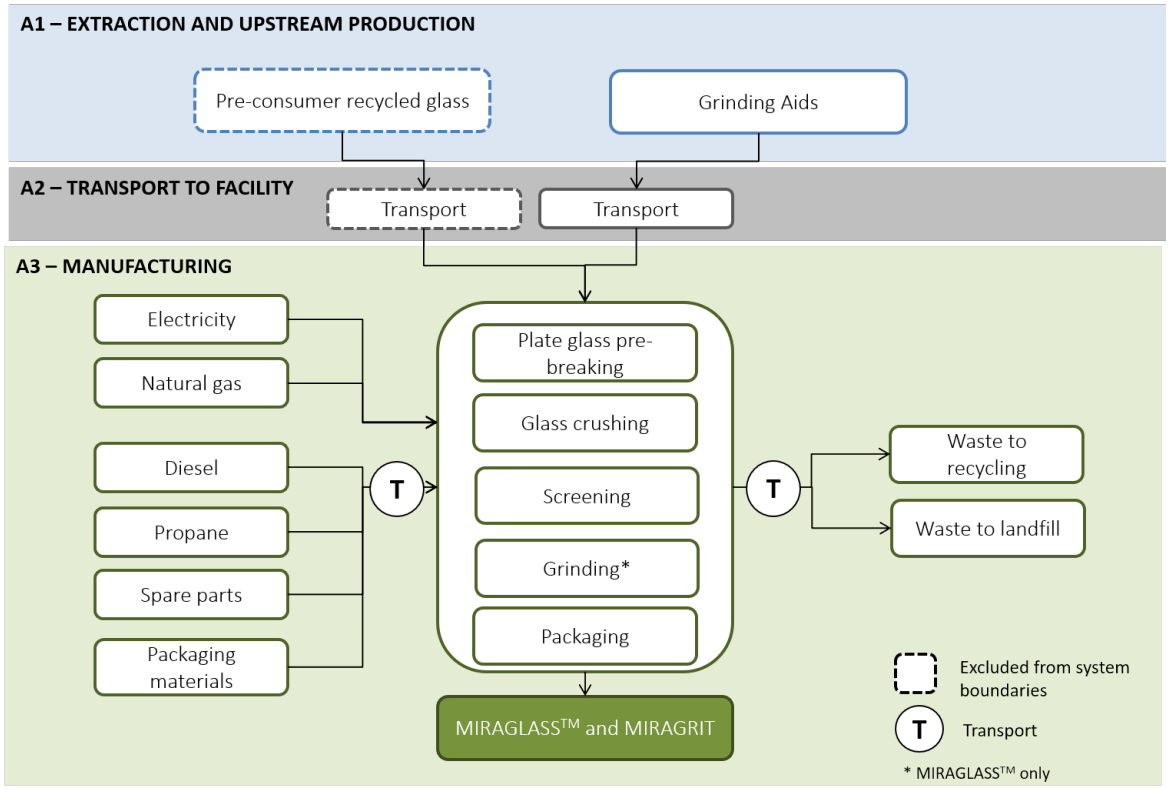


Figure 2: Cradle-to-gate system boundaries of Verglass Products Inc. MIRAGLASS™ and MIRAGRIT. "T" refers to transport.

Extraction and upstream production: This module includes the extraction and processing of the raw materials needed to manufacture the MIRAGLASS™ and MIRAGRIT products. Pre-consumer glass scrap is a secondary material. Generating it and transporting it to Verglass is part of the A3 primary glass manufacturer's product system and hence excluded here.

Transport to facility: This module includes the transportation of grinding aids from the suppliers to the Verglass Products Inc. facility located in Mirabel (Quebec).

Manufacturing: This module includes energy consumption used in the manufacturing processes, heating of the building, as well as the use of wheel loaders and fork-lifts on site. Transport of waste to waste treatment is also included, as is the production and transport of ancillary materials, such as grinding and conveying equipment parts that wear off during the process.

Finally, packaging materials to make products ready for shipment, as well as their transport to Verglass Products Inc.'s facility, are covered by this stage.

3.3. CUT-OFF CRITERIA

Cut-off rules shall not be applied in order to hide data.[5]

In the present study, no known mass nor energy flows were excluded from the system boundaries.

For this study, no data on the construction, maintenance or dismantling of the capital assets, daily transport of the employees, office work, business trips and other activities from Verglass Products Inc. were included in the model. The model only takes into account the processes associated with infrastructure that are already included in the ecoinvent unit processes.

3.4. ALLOCATION

The ISO 14040 allocation procedure states that whenever possible, allocation should be avoided by collecting data related to the process under study or by expanding the product system.

According to ISO 14040, step 2 consists of partitioning the inputs and outputs between the different products in a way that reflects the physical relationship between them.

MIRAGRIT and MIRAGLASS™ production process steps are slightly different as grinding is not needed to produce MIRAGRIT; hence, electricity consumption between the two product groups should differ. However, it was not possible to obtain electricity consumption by process steps. Additionally, the Quebec grid mix is largely based on hydroelectricity; hence, the impact result difference would not be significant. Therefore, this study assumes the same environmental profile for MIRAGLASS™ and MIRAGRIT, based on mass allocation rules.

In sum, energy consumption and packaging were allocated to the products on a **mass basis**.

Waste processing of the material flows undergoing **recycling** processes are included up to the system boundary of the end-of-waste state.[5] 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).

3.5. DATA SOURCES AND QUALITY REQUIREMENTS

Data Quality Parameter	Data Quality Discussion
Source of manufacturing data	Manufacturing data was collected from the manufacturing plant located in Mirabel (Quebec) for one production year starting October 1, 2022, and ending September 30, 2023. This data represents 100% of product production and includes total annual mass of products produced at the manufacturing plant; energy entering the product production process; and the transport distance of materials, ancillary materials, waste, and packaging.
Source of secondary data	Background data were taken from ecoinvent 3.9.1 "cut-off" datasets. Datasets were selected based on their representativeness of the products' composing materials. When appropriate, the dataset's grid mix was changed for the grid mix of the province or country where production takes places. Otherwise, ecoinvent data representative of the global market or "rest-of-the-world" were selected as proxies. Wood and transport data were taken from the US LCI Database, which is specific to a North American context.
Geographical representativeness	Verglass Products Inc.'s manufacturing facility is based in the province of Quebec; hence electricity consumption is based on the Quebec grid mix. Geographical correlation of the material supply and the selected datasets are largely representative of the same area. When this was not possible, datasets representing a larger geographical area were used.
Temporal representativeness	Primary data was collected so as to be representative the production year. Datasets selected from ecoinvent and US LCI were not always published within the last ten years. Nevertheless, ecoinvent and US LCI remain 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 modelled to satisfy the goal and scope. No known flows were cut off.

4. LIFE CYCLE ASSESSMENT RESULTS

4.1. RESULTS TABLES

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

Any comparison of EPDs shall be subject to the requirements of ISO 21930.

Environmental Indicator	Unit	MIRAGLASS™ and MIRAGRIT			
		A1	A2	A3	A1 - A3
		(per kg)	(per kg)	(per kg)	(per kg)
TRACI 2.1					
GWP_{100}-AR5(1)	kg CO_2 eq.	1.02E-03	9.72E-06	1.09E-01	1.10E-01
GWP_{100}-AR4(2)	kg CO_2 eq.	9.99E-04	9.68E-06	1.08E-01	1.09E-01
AP	kg SO2 eq.	3.76E-06	8.02E-08	1.61E-04	1.65E-04
EP	kg N eq.	2.00E-06	6.11E-09	4.26E-05	4.46E-05
ODP	kg CFC-11 eq.	5.57E-12	3.48E-14	8.10E-10	8.15E-10
SFP	kg O_3 eq.	4.80E-05	2.19E-06	4.28E-03	4.33E-03
FFD	MJ Surplus	3.23E-03	2.00E-05	2.17E-01	2.20E-01
GWP: Global Warming Potential; **AP**: Acidification Potential; **EP**: Eutrophication Potential; **ODP**: Ozone Layer Depletion Potential; **SFP**: Smog Formation Potential; **FFD**: Fossil Fuel Depletion Potential.					

(1) GWP 100, excludes biogenic CO2 removals and emissions associated with biobased products and packaging; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5).
(2): GWP 100, excludes biogenic CO2 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).

Environmental Indicator	Unit	MIRAGLASS™ and MIRAGRIT			
		A1	A2	A3	A1-A3
		(per kg)	(per kg)	(per kg)	(per kg)
Resource use					
RPR_E[1]	MJ, LHV	1.42E-03	2.62E-07	1.22E+00	1.22E+00
RPR_M[2]	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_T	MJ, LHV	1.42E-03	2.62E-07	1.22E+00	1.22E+00
$NRPR_E$[3]	MJ, LHV	1.69E-02	1.44E-04	1.55E+00	1.57E+00
$NRPR_M$[4]	MJ, LHV	9.60E-03	0.00E+00	0.00E+00	9.60E-03
$NRPR_T$	MJ, LHV	2.65E-02	1.44E-04	1.55E+00	1.58E+00
SM	MJ, LHV	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
NRSF	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW[6]	m^3	1.75E-05	1.67E-09	6.15E-03	6.17E-03

RPR_E: Renewable Primary Resources Used as Energy Carrier (Fuel); **RPR_M**: Renewable Primary Resources with Energy Content Used as Material; **RPR_T**: Renewable Primary Resources Total; **$NRPR_E$**: Non-Renewable Primary Resources Used as Energy Carrier (Fuel); **$NRPR_M$**: Non-Renewable Primary Resources with Energy Content Used as Material; **$NRPR_T$**: Non-Renewable Primary Resources Total; **SM**: Secondary Materials; **RSF**: Renewable Secondary Fuels; **NRSF**: Non-Renewable Secondary Fuels; **FW**: Use of Net Fresh Water Resources.

(1): $RPR_E = RPR_T - RPR_M$, where RPR_T is equal to the value for renewable energy obtained using the CED methodology (LHV).

(2) Calculated as per ACLCA ISO 21930 Guidance, 6.2 Renewable primary resources with energy content used as a material, RPR_M.

(3): $NRPR_E = NRPR_T - NRPR_M$, where $NRPR_T$ is equal to the value for non-renewable energy obtained using the CED methodology (LHV).

(4): Calculated as per ACLCA ISO 21930 Guidance, 6.4 Non-renewable primary resources with energy content used as a material, $NRPR_M$.

(5): Represents the use of net fresh water calculated from life cycle inventory results, i.e., water consumption.

Environmental Indicator	Unit	MIRAGLASS™ and MIRAGRIT			
		A1	A2	A3	A1-A3
		(per kg)	(per kg)	(per kg)	(per kg)
Output flows and waste categories					
HWD(1)	kg	1.31E-03	8.80E-08	1.84E-02	1.97E-02
NHWD(2)	kg	3.51E-05	1.32E-07	5.10E-03	5.14E-03
HLRW(3)	m^3	6.68E-13	1.02E-17	2.21E-10	2.22E-10
ILLRW(4)	m^3	2.69E-12	6.01E-17	1.78E-10	1.81E-10
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	8.80E-04	8.80E-04
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00

HWD: Hazardous Waste Disposed; **NHWD**: Non-Hazardous Waste Disposed; **RWD**: Radioactive Waste Disposed; **HLRW**: High-Level Radioactive Waste, Conditioned, to Final Repository; **ILLRW**: Intermediate and Low-Level Radioactive Waste, Conditioned, to Final Repository; **CRU**: Components for Re-Use; **MFR**: Materials for Recycling; **MER**: Materials for Energy Recovery; **EE**: Exported Energy.

(1): Calculated from life cycle inventory results, based on datasets classified under "treatment and disposal of hazardous waste." The manufacturer does not generate hazardous waste.

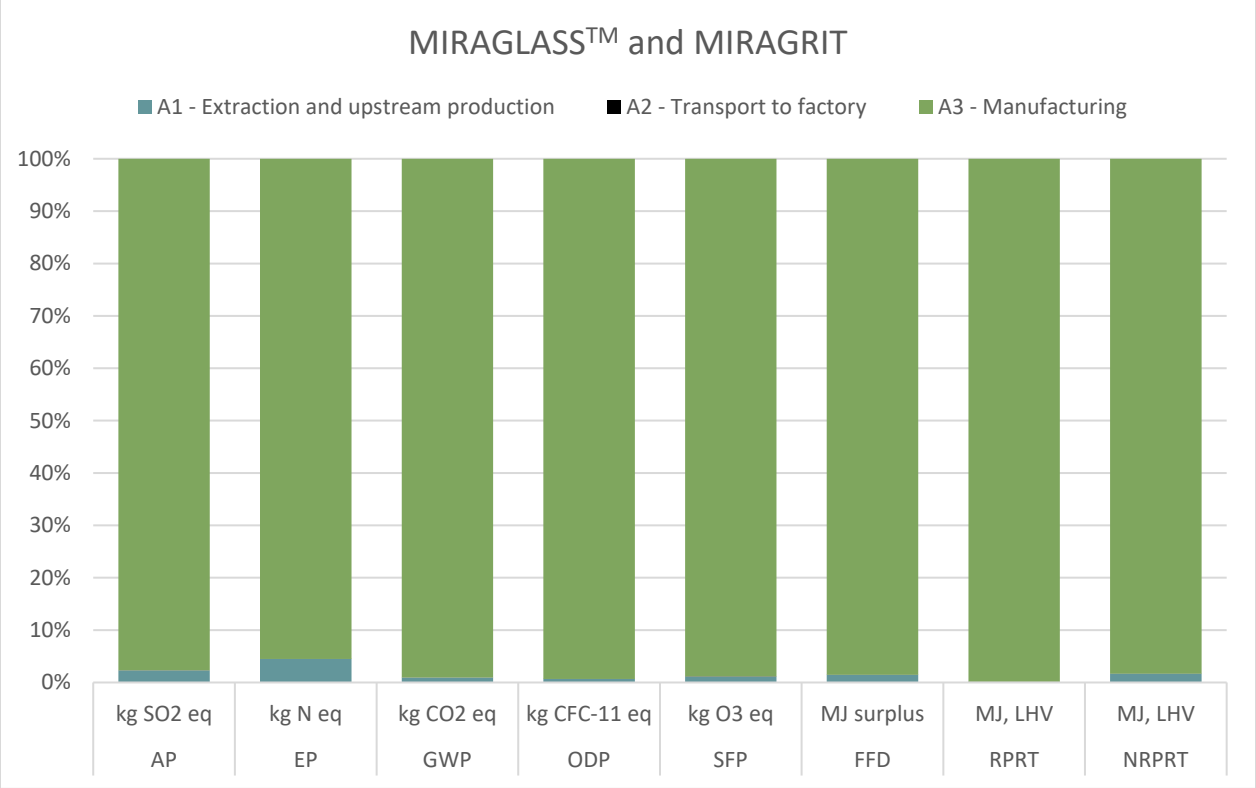
(2): Calculated from life cycle inventory results, based on waste that is neither "hazardous" nor "radioactive" and EPD values.

(3): Calculated from life cycle inventory results, based on ecoinvent waste flow "high-level radioactive waste for final repository." The manufacturer does not generate radioactive waste.

(4): Calculated from life cycle inventory results, based on ecoinvent waste flow "low-level radioactive waste for final repository." The manufacturer does not generate radioactive waste.

4.2. CONTRIBUTION ANALYSIS

As can be seen from the figure below, manufacturing (A3) is the main contributor to all potential impact categories, as well as renewable and non-renewable resource consumption.



GWP: Global Warming Potential; **AP**: Acidification Potential; **EP**: Eutrophication Potential; **ODP**: Ozone Layer Depletion Potential; **SFP**: Smog Formation Potential; **FFD**: Fossil Fuel Depletion Potential; **RPRT**: Renewable Primary Resources – Total; **NRPRT**: Non-Renewable Primary Resources – Total.

5. ADDITIONAL ENVIRONMENTAL INFORMATION

5.1. REGULATED HAZARDOUS SUBSTANCES

MIRAGLASS™ and MIRAGRIT are composed of 100% glass (CAS RN 65997-17-3). It is not considered a hazardous product.

5.2. DANGEROUS SUBSTANCES

The products are not known to release dangerous substances.

6. REFERENCES

[1] International Organization for Standardization (ISO), "ISO 14025 Environmental labels and declarations - Type III environmental declarations - Principles and procedures," 2006.

[2] International Organization for Standardization (ISO), "ISO 21930:2017(E) Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services," 2017.

[3] International Organization for Standardization (ISO), "ISO 14040:2006/AMD 1:2020 Environmental management - Life cycle assessment - Principles and framework," 2020.

[4] International Organization for Standardization (ISO), "ISO 14044:2006/AMD1:2017/AMD 2:2020 Environmental management - Life cycle assessment - Requirements and guidelines," 2006.

[5] Vertima, "Life Cycle Assessment of Verglass Products Inc.'s Miraglass and Miragrit," 2024.

[6] ASTM International, "ASTM Program Operator Rules. Version: 8.0, Revised 04/29/20," 2020[Online]. Available: www.astm.org.

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