Environmental Product Declaration

Guardian Glass Laminated Flat Glass

LamiGlass® Asia-Pacific Flat Glass

Guardian Glass is committed to the efficient use of natural resources while operating in a way that protects the safety, health, and well-being of its employees, customers, the environment, and society.

As a manufacturing leader of high performance, energy-efficient glass products for commercial, residential, interior, transportation, solar, and specialty applications, Guardian Glass makes products that help improve people's lives. By allowing abundant natural light into homes, offices, and vehicles, glass products can help contribute to occupants' well-being and low-emissivity glass helps reduce energy consumption for heating and cooling.

By publishing this EPD, Guardian Glass intends to support architects and designers who strive to enhance the environmental profiles of the buildings they design through the products they specify. The goal is to provide them with the information needed to achieve credits in global building rating systems.

Photo Credit: Studio Fränk Weber

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

The values stated in this environmental product declaration (EPD) are reported in accordance with ISO 14025 and ISO 21930:2017. EPDs rely on a Life Cycle Assessment (LCA) and associated Product Category Rules (PCR) to estimate various environmental impacts of products over their life cycle. Environmental impact data and other metrics reported in this EPD may differ from values reported elsewhere as there may be differences in reporting expectations, methodology, assumptions, and allocation methods. 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 other 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, thus the level of accuracy for any estimated effect may differ between product lines and reported impacts. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Solutions 2211 Newmarket Pkwy, Marietta, GA 30067 USA
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	UL Solutions: General Program Instructions v2.7. 2022.
MANUFACTURER NAME AND HEADQUARTERS ADDRESS	Guardian Glass Asia-Pacific Headquarters 622 Sukhumvit Rd, Khlong Tan, Khlong Toei, Bangkok 10110, Thailand
DECLARATION NUMBER	4791714121.103.1
DECLARED PRODUCT & FUNCTIONAL UNIT OF DECLARED UNIT	Guardian LamiGlass (APAC Products) Declared Unit = 1 m^2 of 44.2 Laminated Glass
REFERENCE PCR AND VERSION NUMBER	ISO 21930:2017
DESCRIPTION OF PRODUCT(S) APPLICATION/USE	Building/Construction Sector in the Asia Pacific Market
PRODUCT RSL DESCRIPTION	N/A
MARKETS OF APPLICABILITY	Asia Pacific
DATE OF ISSUE	March 14, 2025
PERIOD OF VALIDITY	5 years
EPD TYPE	Product Specific
DATASET VARIABILITY	N/A
EPD SCOPE	Cradle-to-Gate
YEAR(S) OF REPORTED PRIMARY DATA	Calendar Year 2022
LCA SOFTWARE & VERSION NUMBER	LCA for Experts (formerly GaBi) 10.6
LCI DATABASE(S) & VERSION NUMBER	Sphera Managed LCA Content (formerly GaBi) databases
LCIA METHODOLOGY & VERSION NUMBER	EN15804+A2
The sub-category PCR review was conducted by:	International Standards Organization - TC 59/SC 17
This declaration was independently verified in accordance with ISO 14025: 2006. EN17074, based on the EN15804+A2 standard, serves as the core PCR. ☐ INTERNAL ☒ EXTERNAL	Cooper McCollum, UL Solutions
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecology Consultants

Comparison of the environmental performance using EPD information shall consider all relevant information modules over the full life cycle of the products within the building. It should be noted that different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared. Comparison of the environmental performance of construction works and construction products using EPD information shall be based on the product's use and impacts at the construction works level. In general, EPDs may not be used for comparability purposes when not considered in a construction works context. Given this PCR ensures products meet the same functional requirements, comparability is permissible provided the information given for such comparison is transparent and the limitations of comparability explained.

Summary of Declaration and Global Warming Potential Results

This Environmental Product Declaration covers laminated flat glass produced in Asia-Pacific. The following manufacturing facilities are included within this declaration.

Manufacturing Facilities Covered:

- NongKhae, Thailand
- Rayong, Thailand (float glass only, no lamination process)

Product Description

This EPD is valid for the Guardian Lamiglass™ product line.

Global Warming Potential Cradle-to-Gate Impact Assessment Results:

The following table details the A1-A3 Global Warming Potential (GWP) results as found in Table 11 but scaled to each thickness available. The results are presented below per square meter of laminated flat glass. The calculation by given thickness is from scaling factors found in Table 14 and Table 15 which are based on the weight per square meter of glass and PVB interlayer at each available thickness. CML Baseline methodology global warming potential (IPCC AR5) impact assessment values are provided.

Table 1 - Global Warming Potential per Thickness of Laminated Glass

Thickness	Cradle to Gate (A1- A3) GWP, Total (kg CO_2 eq/m^2)
Lami 6 mm (33.1)	20.4
Lami 6 mm (33.2)	22.2
Lami 8 mm (44.1)	24.9
Lami 8 mm (44.2)	26.7
Lami 10 mm (55.1)	30.3
Lami 10 mm (55.2)	32.1
Lami 12 (66.1)	35.3
Lami 12 (66.2)	37.1

General Information

Description of Company / Organization

Guardian Glass is one of the largest flat glass producers and innovators in the world. We've been working with glass since 1932 and manufacturing float glass since 1970, and yet the limitless potential of this amazing material still fascinates and inspires us every day. We are committed to advancing glass technology and exploring every application possible. Not only to enhance our customers' well-being with light and space, but to help conserve energy, regulate temperatures, protect privacy, preserve history and help us See What's Possible™.

Through pioneering research, the dedication of our people and a firm belief in close collaboration with our partners and customers, we find new ways to build, design and inspire with glass. We continue to build our expertise on each and every project, whether that's an iconic, energy-efficient building or a new glass coating that will solve the challenges of today and beyond.

Every day, we work to create more value, using fewer resources. We constantly challenge ourselves to identify opportunities to build upon the benefits of glass. We expertly combine glass types to maximize energy savings and bring light and an unrivalled aesthetic to people's lives. We're committed to the efficient use of natural resources while operating in a way that protects the safety, health and well-being of our employees, customers, the environment and society.

For more information visit our website at
www.guardianglass.com

Product Description

This EPD is valid for the Guardian Lamiglass™ product line.

Manufacturer-Specific EPD

This product-specific EPD was developed based on the Guardian Glass APAC Cradle-to-Gate Float and Processed Glass Life Cycle Assessment. The EPD accounts for raw material extraction and processing, transport, and product manufacturing. Manufacturing data were gathered directly from company personnel. When updated company-specific data were not available the ratio of production units, within the calendar year 2022, was used as a proxy. For any product group EPDs, an impact assessment was completed for each product and the highest impacts were reported as conservative representations of the product group. Product grouping was considered appropriate if the individual product impacts differed by no more than ±10% in any impact category.

Figure 1 - LamiGlass

Application

Laminated glass products are used in a variety of applications including commercial, residential, interior, transportation, solar, and specialty applications. Guardian Glass typically supplies float glass and laminated glass products to either its fabricator customers or its own fabrication facilities who further process that glass into the final product by cutting, heat-treating, laminating, insulating, or otherwise fabricating the glass into the desired size and makeup for use in the intended application. The glass makeup is typically specified by architects, glazing contractors, window manufacturers, and other design professionals.

Material Composition

Flat glass is typically manufactured from virgin, non-renewable raw materials such as silica sand, soda ash, dolomite, limestone, and cullet (internal cullet is comprised of the afore-mentioned raw materials). It can also contain recycled cullet. The crystalline raw materials chemically and structurally transform into amorphous glass through a fusion (melting) process, thereby producing a product which is >99.9% glass oxide.

The flat glass product is then processed in the lamination process. The laminated glass products are similar in composition to uncoated / unprocessed flat but include an additional element between the two layers of glass: polyvinyl butyral (PVB). For this LCA study, all PVB types (standard, acoustic, transwhite, colored, etc.) used during one production year (2022) were considered and results brought back per glass thickness and per layer of PVB (results for one layer of PVB representative no matter the PVB type).

Technical Data

Technical data on Guardian Glass products is available on at www.guardianglass.com. The following technical data can be presumed for laminated flat glass.

Table 2 – Guardian LamiGlass™ 08mm 4.4.2 Technical Data

Name	Value	Unit
Thickness	8	mm
Light Transmittance (LT)	90	%
External Light Reflectance (ELR)	8	%
Solar Energy transmittance (ET)	76	%
Solar Energy Reflection	7	%

Placing on the Market / Application Rules

Laminated flat glass is produced according to:
- ABNT NBR NM 294:2004 Float Glass
- ABNT NBR 15198:2005 Silver Mirrors - Fabrication and Installation
- ABNT NBR 14696:2005 Silver Mirrors – Requirements and Test Methods
- ABNT NBR 7199:2016 Design, Execution and Application of Glass in Civil Construction

Properties of Declared Product as Shipped

Product Sizes: While products are primarily produced in Jumbo size (91 in x 144 in), they can also be cut to customers' specified dimensions.

Laminated glass is two or more glass panes adhered together with a PVB interlayer. The thickness of the glass panes and the interlayer may vary based on specific application. The nomenclature to describe the glass build-up is described below.

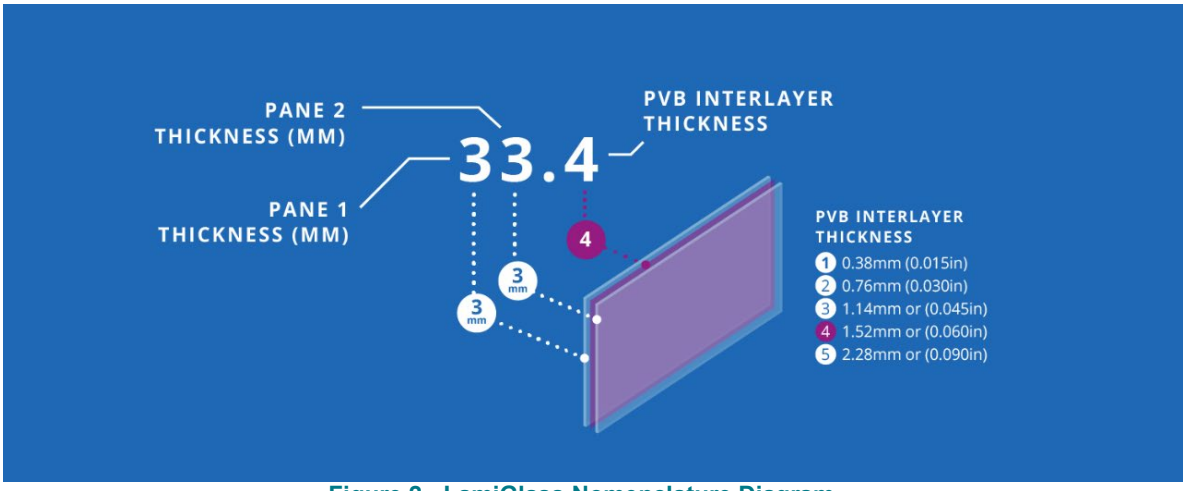

Figure 2 - LamiGlass Nomenclature Diagram

For this study, a LamiGlass 8mm 4.4.2 product (that is, two 4 mm thick glass panes adhered with a 0.76 mm PVB interlayer) is assumed. While thickness of glass also varies based on customer needs, some standard thicknesses for flat glass available for lamination include:

- 33.1 (6 mm)
- 33.2 (6 mm)
- 44.1 (8 mm)
- 44.2 (8 mm)
- 55.1 (10 mm)
- 55.2 (10 mm)
- 66.1 (12 mm)
- 66.2 (12 mm)

Please contact a local sales representative for available sizes in your area.

Declaration Type: Business-to-Business

Geographic Scope: This declaration is valid for products produced in the Asia Pacific region from Guardian Glass.

Additional Notes: This analysis represents the performance of a production-weighted average of Guardian glass products, based on 2022 calendar year production volumes.

Methodological Framework

Declared Unit

The declaration refers to the declared unit of one square meter of an 8 mm 44.2 laminated flat glass product.

Table 3 – Declared Unit Description

Name	Value	Unit
Declared Unit	1	m^2
Mass Covered by Declared Unit	20.8	kg
Thickness	8.76 (44.2* profile)	mm

** Two 4 mm glass panes with a 0.76 mm PVB interlayer*

System Boundary

This a cradle-to-gate environmental product declaration. The following life cycle phases were considered:

Table 4 - Description of the System Boundary

Product			Construction Installation		Use							End-of-Life*				Benefits of loads beyond the system boundary		
Raw Material Extraction and Processing	Transport	Manufacturing	Transport	Construction/ Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport	Waste Processing	Disposal	Reuse	Recovery	Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Description of the System Boundary Stages Corresponding to the PCR
(X = Included; MND = Module Not Declared)
*This includes provision of all materials, products and energy, packaging processing and its transport, as well as waste processing up to the end-of waste state or disposal of final residues.

Allocation

Where manufacturing inputs, such as electricity use, were not sub-metered, allocation was determined on a per metric tonne basis for primary data for float glass production. For the processing of the glass (that is, the lamination process), allocation per area was conducted as lamination is contingent on the surface area being treated. For secondary data, cut-off methodology was used.

Cut-off Criteria

Processes whose total contribution to the final result, with respect to their mass and in relation to all considered impact categories, is less than 1% can be neglected. The sum of the neglected processes may not exceed 5% by mass of the considered impact categories. For that a documented assumption is admissible.

For Hazardous Substances the following requirements apply:

- The Life Cycle Inventory (LCI) of hazardous substances will be included, if the inventory is available.
- If the LCI for a hazardous substance is not available, the substance will appear as an input in the LCI of the product, if its mass represents more than 0.1% of the product composition.
- If the LCI of a hazardous substance is approximated by modeling another substance, documentation will be provided.

This EPD is in compliance with the cut-off criteria. No processes were neglected or excluded. Capital items for the

production processes (machine, buildings, etc.) were not taken into consideration.

Data Sources

Primary data were collected for every process in the product system under the control of Guardian Glass. Secondary data from the LCA for Experts (formerly GaBi) LCA Managed Content database were utilized. These data were evaluated and have temporal, geographic, and technical coverage appropriate to the scope of the product.

Data Quality

The data sources used are complete and representative of Asia-Pacific in terms of the geographic and technological coverage and are a recent vintage (i.e., less than ten years old). The data used for primary data are based on direct information sources of the manufacturer. Secondary data sets were used for raw materials extraction and processing, end of life, transportation, and energy production flows. Wherever secondary data is used, the study adopts critically reviewed data for consistency, precision, and reproducibility to limit uncertainty.

Comparability and Benchmarking

A comparison or an evaluation of EPD data is only possible if all data sets to be compared were created according to ISO 21930 and the building context, respectively the product-specific characteristics of performance, are taken into account. Environmental declarations from different programs may not be comparable. Full conformance with the ISO 21930 allows EPD comparability only when all stages of the product's life cycle have been considered. However, variations and deviations are possible.

Estimates and Assumptions

Due to limitations in data availability, assumptions were made in allocating important manufacturing inputs and outputs including process materials, natural gas, and facility emissions. The allocation approaches taken may therefore overestimate the environmental burden for glass production.

Additionally, the “average” glass pane used in modeling is a calculated average and does not represent a specific product manufactured by Guardian Glass.

Units

The LCA results within this EPD are reported in the International System (SI) units.

Additional Information

Background data

For life cycle modeling of the considered products, the LCA for Experts for Life Cycle Engineering, developed by Sphera, is used. The LCA Managed Content database, as developed by Sphera, contains consistent and documented datasets which are documented in the online LCA for Experts- documentation. To ensure comparability of results in the LCA, the basic data of the LCA for Experts database were used for energy, transportation and auxiliary materials.

Manufacturing

Flat glass production involves heating the raw materials to a liquid state and then floating the subsequent ribbon of glass atop a bath of molten tin. Once the ribbon has sufficiently cooled, it is transferred onto rollers and annealed to limit residual stresses, its edges are trimmed and the ribbon is cut to the desired sizes. The finished flat glass products are stored for additional processing (e.g., lamination, acid-etched or coating) or directly packaged and shipped to customers or Guardian’s other sites for further processing.

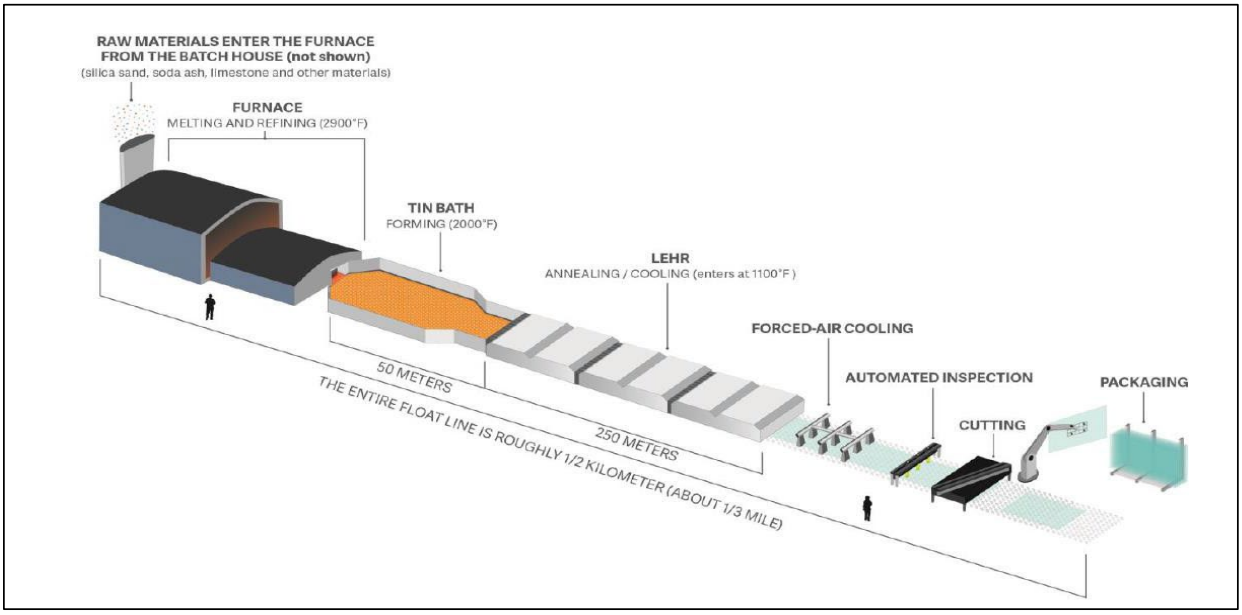

Figure 3 - Flat Glass Production

To complete the lamination process, flat glass is selected and staged. The glass is bonded using an interlayer sheet of PVB (polyvinyl butyral) that adheres the two panes together. High temperature and pressure are applied to eliminate bubbling between the two glass layers forming a seal. The product is inspected, packaged, and then shipped to customers or Guardian's other sites for further processing.

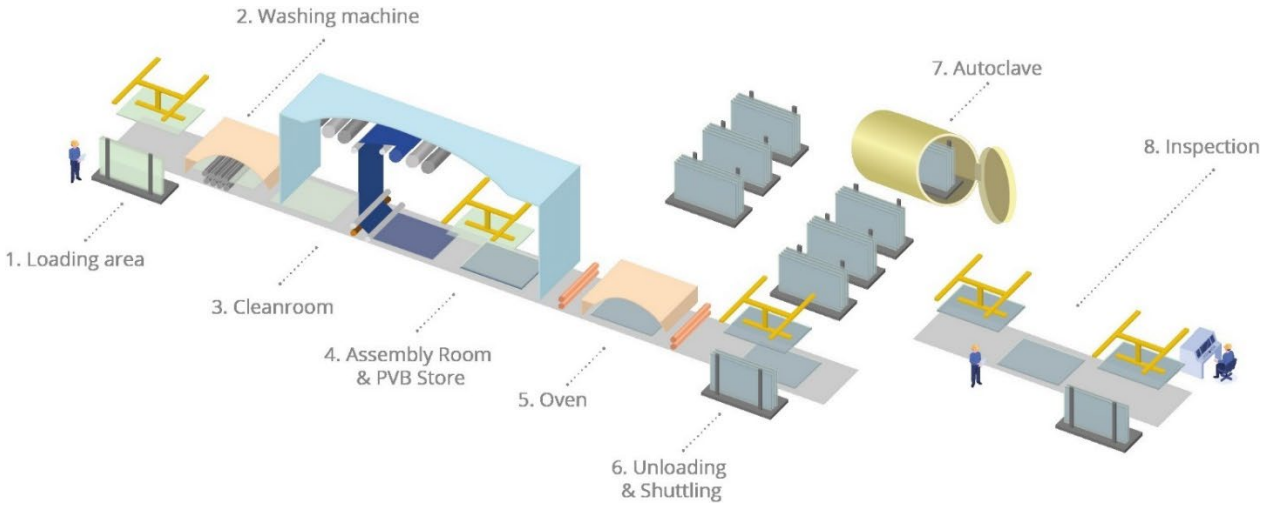

Figure 4 - Lamination Process

LamiGlass Results per Square Meter

Results below show the life cycle impact assessment results throughout the product per ISO 21930.

Table 5 - Life Cycle Impact Assessment Results per Square Meter of LamiGlass™ 08mm 4.4.2

Rest of World: CML Impact Assessment							
Parameter Name		**Unit**	**Flat Glass**	**A1***	**A2**	**A3**	**Total**
GWP	Global warming potential	kg CO_2-Eq.	1.91E+01	3.60E+00	1.08E+00	2.86E+00	**2.67E+01**
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	9.83E-10	2.11E-09	4.02E-11	4.05E-12	**3.14E-09**
AP Air	Acidification potential for air emissions	kg SO_2-Eq.	3.56E-02	1.96E-02	1.51E-02	6.37E-03	**7.66E-02**
EP	Eutrophication potential	kg PO_4-Eq.	5.18E-03	-5.78E-05	2.89E-03	5.08E-04	**8.52E-03**
POCP	Photochemical ozone creation potential	kg C_2H_4-Eq.	2.73E-03	1.17E-03	1.28E-03	3.93E-04	**5.57E-03**
ADPE	Abiotic depletion (elements) [1]	kg Sb Eq.	6.19E-05	-1.54E-06	4.42E-10	1.12E-07	**6.05E-05**
ADPF	Abiotic depletion (fossil)	MJ	2.27E+02	8.72E+01	1.36E+01	1.23E+01	**3.40E+02**

* A1 is the sum of the flat glass cradle to gate impacts plus the raw materials processing of additional processing materials. As the wet coated materials applied to the product are many magnitudes lower than the flat glass, due to rounding the values of the processing materials are negligible or cut-off.
[1] Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Results below contain the resource use throughout the life cycle of the product.

Table 6 - Resource Use per Square Meter of LamiGlass™ 08mm 4.4.2

Resource Use							
Parameter		**Unit**	**Flat Glass**	**A1**	**A2**	**A3**	**Total**
PERE	Renewable primary energy as energy carrier	MJ	4.73E+00	0.00E+00	0.00E+00	0.00E+00	**4.73E+00**
PERM	Renewable primary energy resources as material utilization	MJ	1.98E+00	9.74E+01	0.00E+00	0.00E+00	**9.94E+01**
PERT	Total renewable primary energy resources	MJ	6.70E+00	9.74E+01	0.00E+00	0.00E+00	**1.04E+02**
PENRE	Nonrenewable primary energy as energy carrier	MJ	1.32E+02	0.00E+00	0.00E+00	0.00E+00	**1.32E+02**
PENRM	Nonrenewable primary energy as material utilization	MJ	1.90E-01	9.36E+00	0.00E+00	0.00E+00	**9.55E+00**
PENRT	Total nonrenewable primary energy resources	MJ	1.32E+02	9.36E+00	0.00E+00	0.00E+00	**1.42E+02**
SM	Use of secondary material	kg	4.58E-03	2.26E-01	0.00E+00	0.00E+00	**2.30E-01**
RSF	Use of renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
NRSF	Use of nonrenewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
RE	Energy recovered from disposed waste	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
FW	Use of net fresh water	m^3	1.15E-02	0.00E+00	0.00E+00	0.00E+00	**1.15E-02**

Results below contain the output flows and wastes throughout the life cycle of the product.

Table 7 - Waste and Outflows per Square Meter of LamiGlass™ 08mm 4.4.2

Wastes and Outflows						
Parameter	**Unit**	**Flat Glass**	**A1**	**A2**	**A3**	**Total**
Incineration with energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Incineration without energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Landfill (non-hazardous solid waste)	kg	2.52E-02	0.00E+00	0.00E+00	0.00E+00	**2.52E-02**
Hazardous waste	kg	5.43E-09	0.00E+00	0.00E+00	0.00E+00	**5.43E-09**
Recycling (landfill avoidance)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
High-level radioactive waste	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Intermediate- and low-level radioactive waste	kg	4.38E-05	0.00E+00	0.00E+00	0.00E+00	**4.38E-05**
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Biogenic carbon content in product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Biogenic carbon content in packaging	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Calcination Carbon Emissions	kg CO_2	2.20E-01	2.20E-01	0.00E+00	0.00E+00	**2.20E-01**
Carbonation Carbon Removals	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**

LCA Interpretation

The production of float glass dominates the impacts across all impact categories, except ozone depletion. This is due to the electricity and natural gas used to make the float glass. Raw materials (A1) drives ozone depletion impacts.

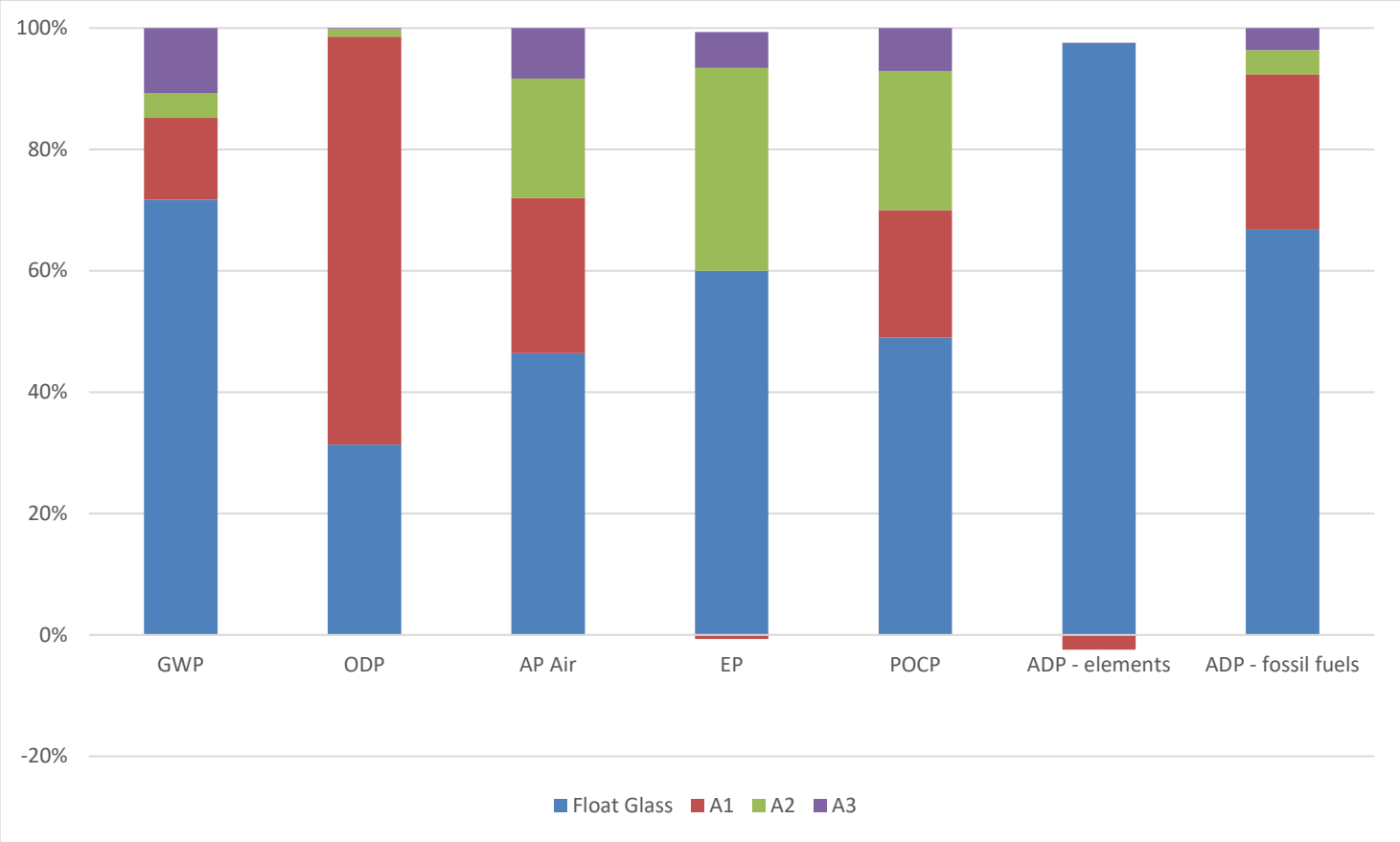

Figure 5 - Relative Contributions of Cradle-to-Gate Life Cycle Stages for of LamiGlass™ 08mm 4.4.2

Scaling To Various Thicknesses

Glass can come in a variety of different sizes, but its impacts can be scaled to different glass thicknesses. For this EPD, results are reported per square meter of 4mm glass. To convert to other given thickness, please see the scaling factor below for different sizes. Multiply the A1-A3 results by the scaling factors below using Equation 1. For all other life cycle stages, multiply by the scaling factor in Table 14.

Equation 1. A1-A3 Scaling Results to an Area at an Assumed Thickness

$$Impact\ Assessment\ Result\ per\ m^2 = Scaling\ Factor\ for\ Total\ Glass\ Thickness\ (Table\ 14)\ x\ Flat\ Glass\ Production\ Impacts\ (Table\ 16) + Interlayer\ Impacts\ (Table\ 16)\ x\ Interlayer\ Factor\ (Table\ 15) + Laminating\ Impacts\ (Table\ 16)$$

Table 8 – Uncoated Flat Glass Scaling Factors Used to Multiply the Results to Various Thicknesses

Thickness	Scaling Factor
2.0 mm	0.500
2.1 mm	0.525
2.85 mm	0.713

Thickness	Scaling Factor
5 mm	1.25
5.85 mm	1.46
6 mm	1.50

Thickness	Scaling Factor
3 mm	0.750
3.15 mm	0.788
3.85 mm	0.963
4 mm	1.00
4.85 mm	1.21

Thickness	Scaling Factor
8 mm	2.00
10 mm	2.50
12 mm	3.00
15 mm	3.75

The interlayer factor corresponds to the value associated with each of the five available thicknesses.

Table 9 - Interlayer Factor

Interlayer Thickness	Factor
0.38 mm	1
0.76 mm	2
1.14 mm	3
1.52 mm	4
1.90 mm	5
2.28 mm	6

Table 10 – Example Impacts by Process

Impact category		Unit	Flat Glass Production	Flat Glass	Interlayer	Interlayer	Laminating Process
Global Warming Potential	Total	kg CO_2 eq	9.94E+00	x Scaling Factor (Table 23) for total glass thickness (all panes) +	1.80E+00	x Interlayer Factor +	3.67E+00
	Excl. Biogenic	kg CO_2 eq	9.91E+00		1.80E+00		3.67E+00
	Biogenic	kg CO_2 eq	3.85E-02		0.00E+00		1.00E-03
Ozone depletion		kg CFC-11 eq	6.53E-10		1.06E-09		3.42E-11
Acidification		kg SO_2 eq.	1.87E-02		9.80E-03		1.77E-02
Eutrophication		kg PO_4 eq.	2.68E-03		-2.89E-05		2.68E-03
Photochemical ozone formation, human health		kg Ethene eq.	1.38E-03		5.85E-04		1.35E-03
Resource Use	Minerals and Metals	kg SB eq	4.12E-05		-7.68E-07		1.12E-07
	Fossils	MJ	1.18E+02		4.36E+01		2.25E+01

Example of Using Scaling Factors

To demonstrate how the above scaling factors work, an example of a LamiGlass 3.3.1 product is provided. The total glass thickness is 06 mm (two 03 mm glass panes) and the interlayer factor is 1. Therefore, the scaling factors are as follows:

Glass Thickness	Scaling Factor
6 mm	1.50

Interlayer	Scaling Factor
1 (0.38 mm)	1

And the equation is:

$$Impact\ Assessment\ Result\ per\ m^2 = 1.5\ x\ Flat\ Glass\ Production\ Impacts\ (Table\ 16) + Interlayer\ Impacts\ (Table\ 16)\ x\ 1 + Laminating\ Impacts\ (Table\ 16)$$

For the global warming potential (total), the total impact is:

$$GWP\ for\ 3.3.1 = 1.5\ x\ 9.94E{+}00\ + 1.80E{+}00\ x\ 1 + 3.67E{+}00 = 20.4\ kg\ CO_2/m^2$$

Additional Environmental Information

Environmental and Health During Manufacturing

At Guardian Glass, our vision is to help people improve their lives by providing the products and services they value more

highly than their alternatives. We do this responsibly, while consuming fewer resources; seeking mutually beneficial outcomes with customers, employees, suppliers, communities, and other key constituencies.

Our Stewardship Framework flows directly from this vision, describing our commitment and priorities around Environmental, Social and Governance (ESG) topics. Stewardship broadly encompasses the responsible management of our actions and the resources entrusted to our care in a manner that respects the rights of others.

Guardian has invested in socially responsible policies and practices to help our businesses embed stewardship into the company culture and business decisions. Through responsible practices in the areas of environmental management and health and safety, Guardian's goal is to reduce potential environmental impacts to the communities in which it operates and create an exceptional workplace for its employees.

The safety and well-being of our employees and communities is our first priority. We build capability through our employees and resilience in our systems to prevent serious outcomes when the unexpected happens. We promote a principle-based, bottom-up approach to safety, involving front-line employees and supervisors in the identification of hazards and implementation of solutions all around the world. Each person is expected to raise concerns and share ideas about opportunities for improvement. Each manufacturing site has completed a risk evaluation that identified priorities with a focus on critical hazards. Action plans are developed, and knowledge networks are leveraged across the organization to better manage risk in those areas.

We pride ourselves on being solution providers, especially in the context of environmental stewardship, which involves considering each stage of the life cycle – from the sourcing of raw materials for each product, through to its production, application and end-of-life. Our approach to environmental stewardship is twofold – we strive to discover new and innovative technologies that improve both the environmental performance and effectiveness of our manufacturing processes and of our products.

We're committed to improving the energy efficiency of our manufacturing processes and reducing our use of resources. One way to achieve these is to maximize the amount of glass cullet (broken or old glass) used. Wider use of cullet in the glass manufacturing process helps to reduce consumption of virgin raw materials, save energy and reduce emissions. In line with our environmental stewardship priorities, Guardian Glass has started various initiatives aiming to use more cullet in glass manufacturing instead of virgin raw materials. The ratio of cullet in batch and glass can vary from site to site and over time, depending on cullet availability.

Extraordinary Effects

There are no known negative effects from the use of this product during fire, water, or mechanical destruction.

Delayed Emissions

Global warming potential is calculated using the CML impact assessment methodology. Delayed emissions are not considered.

Environmental Activities and Certifications

In an effort to provide greater support to the architects and designers who strive to meet increasingly stringent regulations and standards and achieve ratings within various sustainable building rating systems such as LEED and BREEAM, Guardian Glass provides product and regionally specific documents and certifications to communicate transparent information about the life-cycle environmental impact of many of our products.

Contact Information

Study Commissioner and Further Information

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