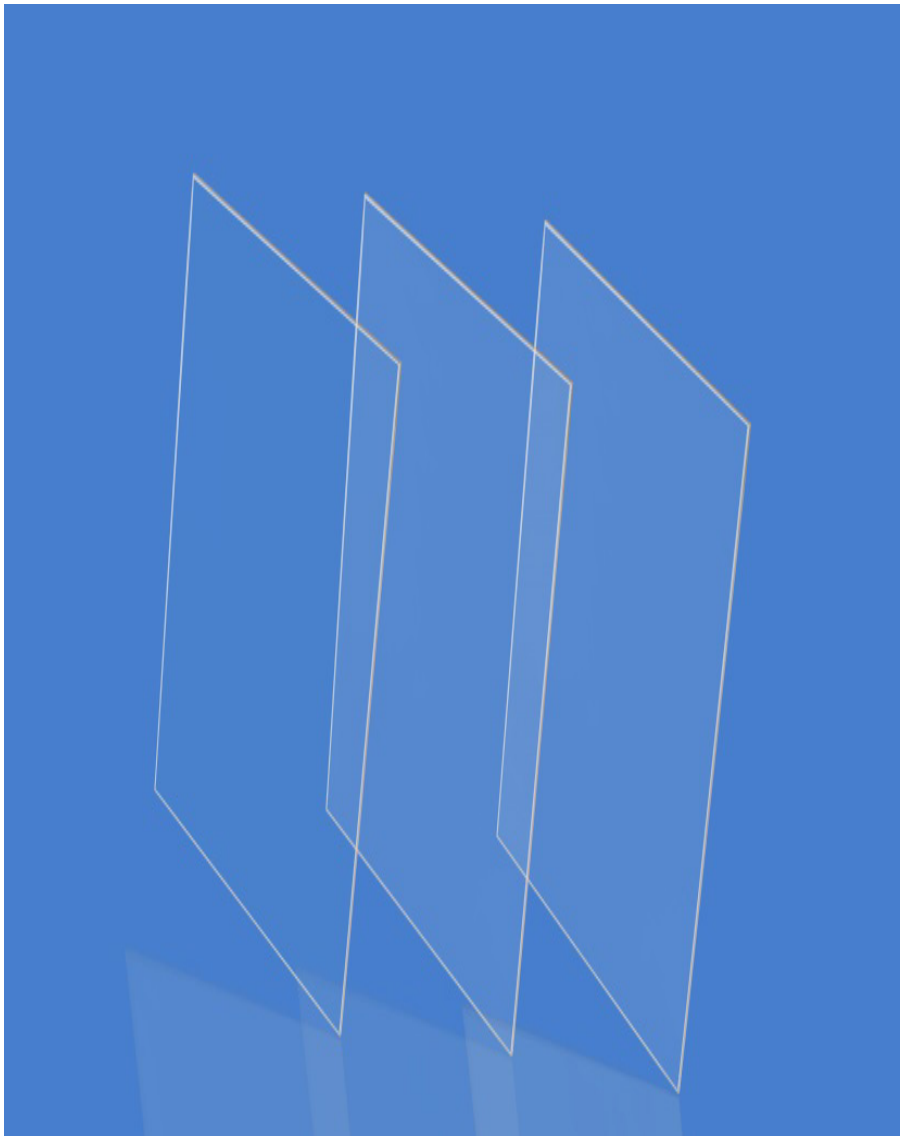
Environmental Product Declaration

KERALITE® L, KERALITE® F, KERALITE® Select L, KERALITE® Select F

FIRE RATED SAFETY GLASS CERAMIC



KERALITE, a glass ceramic that installs into fire-rated frames, protects building occupants from smoke and flames and fulfills impact safety requirements.

vetrotech SAINT-GOBAIN

Protecting people and property from the hazard of fire is the key objective for our fire-resistant glass solutions. However, our glass also harnesses natural daylight in open-plan building designs – reducing the need for artificial light, and cutting heating and cooling costs.

In exterior applications, our products may be incorporated into double and triple glazing with solar control or low emissivity (low-e) features, contributing to maximizing the energy performance of a building.

UL CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
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ENVIRONMENTAL PRODUCT DECLARATION

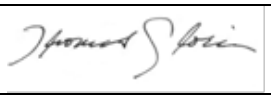
vetrotech SAINT-GOBAIN

KERALITE® L, KERALITE® F, KERALITE® Select L, KERALITE® Select F
Fire Rated Safety Glass Ceramic

According to ISO 14025

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. 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, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. 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.

PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	Vetrotech Saint-Gobain
DECLARATION NUMBER	4786048398.101.1
DECLARED PRODUCT	KERALITE® L, KERALITE® F, KERALITE® Select L, KERALITE® Select F
REFERENCE PCR	GANA PCR for Flat Glass: UN CPC 3711
DATE OF ISSUE	May 31, 2014
PERIOD OF VALIDITY	5 years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications

The PCR review was conducted by:	NSF International
	Accepted by PCR Review Panel
	ncss@nsf.org
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories X INTERNAL EXTERNAL	
	Wade Stout, ULE
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	
	Thomas Gloria, Life-Cycle Services, LLC

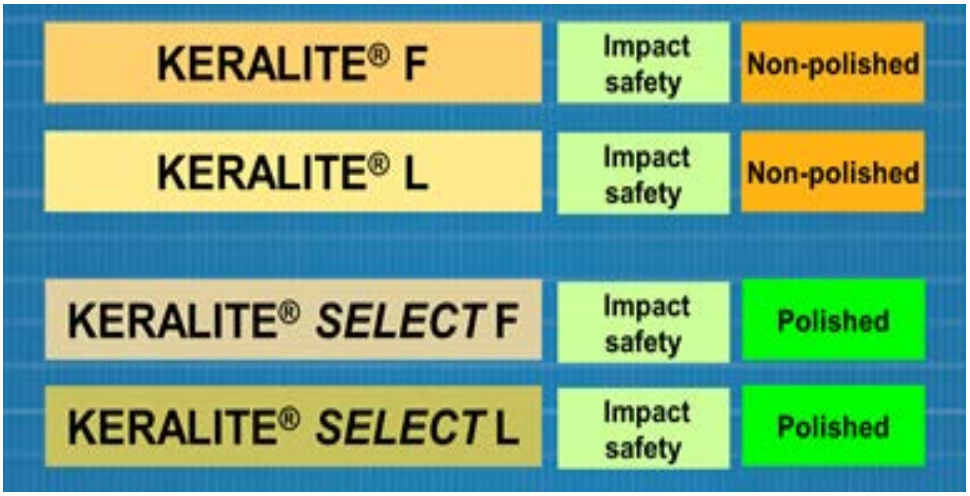
Product Definition and Information

Product Description

Vetrotech Saint-Gobain's fire-resistant glass KERALITE® offers the ultimate protection for people and property, while providing the aesthetic and multi-functional qualities you expect from architectural glass. Our fire-rated glass is manufactured to provide multi-functional benefits, e.g. human impact, safety, security, etc. Parent company, Saint-Gobain, ENERGY STAR Partner of the Year for environmental responsibility, is the world's largest building products manufacturer.

The functional unit of the products reported in this document is 1 metric tonne of flat glass with a service life of 30 years.

Product line



FEATURES AND BENEFITS

KERALITE® is a 3/16" or 5/16" thick glass ceramic offered in 20-180 minute fire ratings. The products install into standard fire rated frames.

- Surface applied film or fully laminated options
- Protects against smoke and flame
- Fulfills maximum human impact safety requirements per CPSC 16, CFR Part 201 CAT II.

Manufacturing Locations

The manufacturing facilities that are involved in the production of the KERALITE product line are:

Bagneaux/Loing, France	Condren, France	Auburn, Washington, USA

These facilities provided the primary data for this assessment and the results are based on the weighted average of production.

Applications and Uses

Vetrotech KERALITE® products are for commercial use. Filmed, laminated and polished versions of KERALITE® are used in fire rating installs to contain smoke and flames. KERALITE® fulfills maximum human impact safety requirements.

Environment

Material Inputs

Material Components	Weight Percent	Mineral Resource	Renewable	Origin	Transportation Distance (km)
Flat Glass					
Silica	40% - 80%	Y	N	Belgium	250 - 750
Alumina	5% - 40%	Y	N	France	250 - 750
Lithium Carbonate	<15%	Y	N	Chile	50 - 500
Zinc Oxides	<5%	Y	N	Belgium	50 - 500
Titanium Dioxide	<5%	Y	N	France	50 - 500
Soda Ash	<1%	Y	N	Germany	250 - 750
Zirconium Dioxide	<5%	Y	N	South Africa	10,000 - 20,000
Barium Carbonate	<5%	Y	N	USA	7,000 - 10,000
Feldspar	<5%	Y	N	France	50 - 500
Magnesium Oxide	<5%	Y	N	Netherlands	250 - 750
Arsenic Acid	<1%	Y	N	USA	7,000 - 10,000
Film/Laminate					
Film	<1%	N	N	France	50 - 500
Laminating Film	<5%	N	N	United Kingdom	250 - 750

Table 1: Product Formulation

The KERALITE® Flat Glass is comprised of a variety of minerals. Lamination or film is added onto the flat glass for the specified laminated products (KERALITE® L, KERALITE® Select L) or filmed products (KERALITE® F, KERALITE® Select F).

Manufacturing Process

The flat glass is produced at the Bagneaux facility. Raw materials are mixed into a batch and then melted into glass sheets of specified thicknesses. The glass sheets are then conveyed through a cooling tunnel. Upon cooling, the flat glass is cleaned and sent through a ceramizing tunnel. The flat glass is then packaged for post-processing. At this location, scrap glass is crushed and reused in the process to make new product.

Post-processing occurs at the Condren-Tergnier facility. The product is trimmed on the edges and washed. A filming or laminating process occurs for the KERALITE® glass. For lamination, two glass sheets are laminated together. For filming, film is applied to a side of glass. The polished products of KERALITE® receive polishing at the Condren facility. The product is packaged and shipped to the Vetrotech facility in Auburn. In Auburn, the KERALITE® product is cut per custom orders and distributed to customers. The average scrap rate at the Auburn finishing site is 18% since the product is trimmed per customer order. KERALITE® is also shipped to 15-25 glass distributors/wholesalers throughout the US, where it is cut and delivered locally per custom orders.

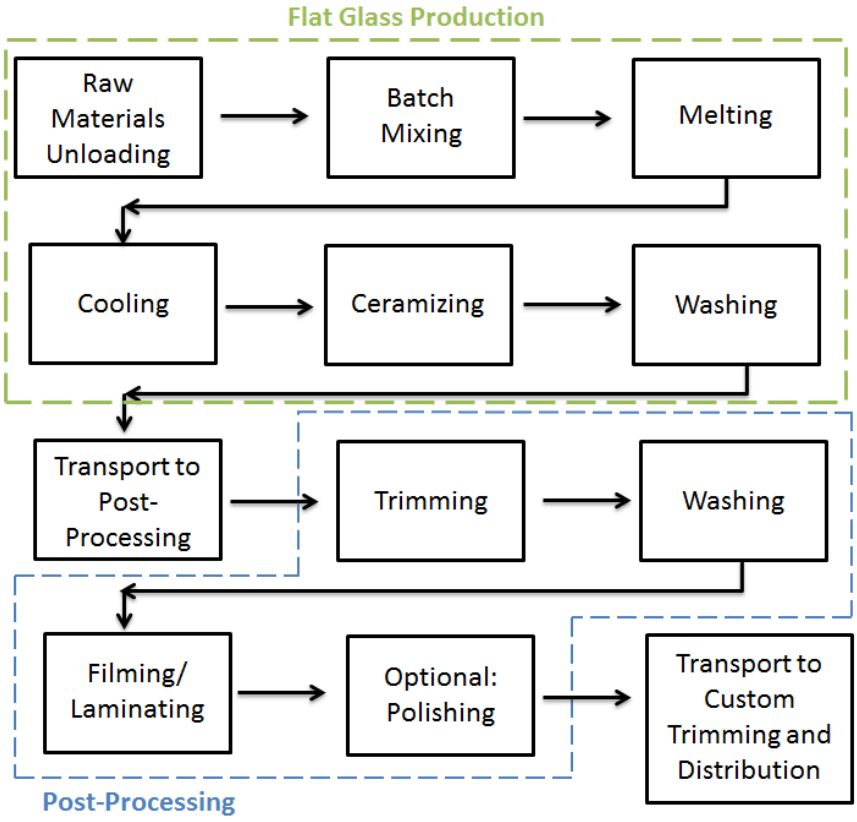


Figure 1: Manufacturing process flow of Vetrotech KERALITE® products

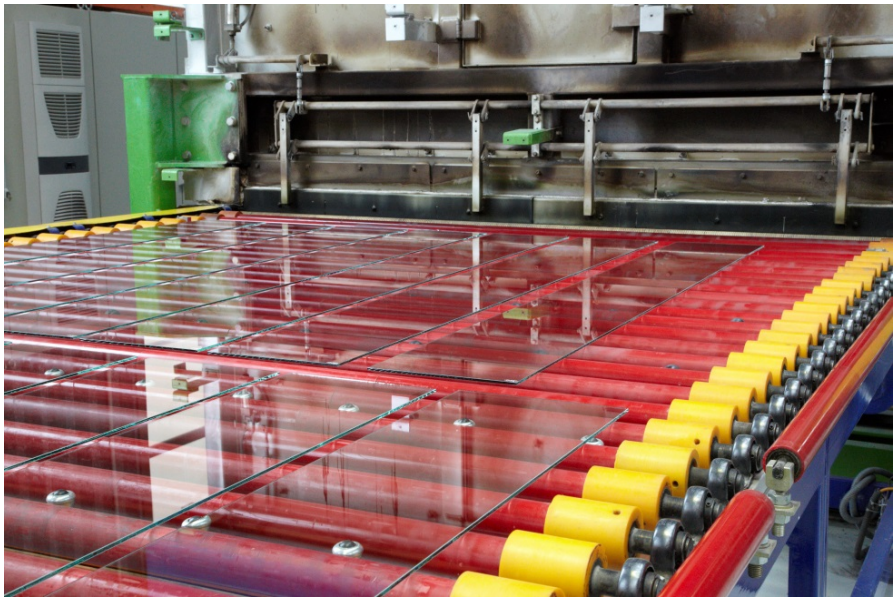


Figure 2: Photograph of KERALITE® manufacturing process

Life Cycle Assessment Description

Functional Unit

Environmental impacts are reported per functional unit of a product and the functional unit is the basis for comparison in an LCA. For flat glass, the functional unit is defined as 1 metric tonne of flat glass and a service life of 30 years.

As KERALITE® is produced in standard thicknesses, the following table shows the product area per the functional unit.

KERALITE® Product	Area per Functional Unit	Unit
KERALITE® F	81.3	m^2/ tonne
KERALITE® L	51.3	m^2/ tonne
KERALITE® Select F	81.3	m^2/ tonne
KERALITE® Select L	51.3	m^2/ tonne

Table 2: Glass area per metric tonne

Life Cycle Stages Assessed

Life Cycle Boundary	EPD Life Cycle Stage
KERALITE® Flat Glass Cradle-to-Gate	Material Acquisition and Pre-processing
	Production
	Packaging/Storage
KERALITE® Gate-to-Grave	Post-Processing
	Product Transport
	End of Life

Table 3: Life cycle stages assessed

The use phase is excluded from this study.

System Boundary

The life cycle analysis for KERALITE comprises the boundary stages from cradle-to-grave, excluding the use phase. It includes the flat glass production (extraction of raw materials, product manufacturing and packaging), product shipping to installation, and end-of-life stages, as shown in Figure 3. Manufacturing overhead (heating & lighting) was excluded in the system boundary. The life cycle impact assessment results are disclosed for separately for cradle-to-gate and gate-to-grave stages.

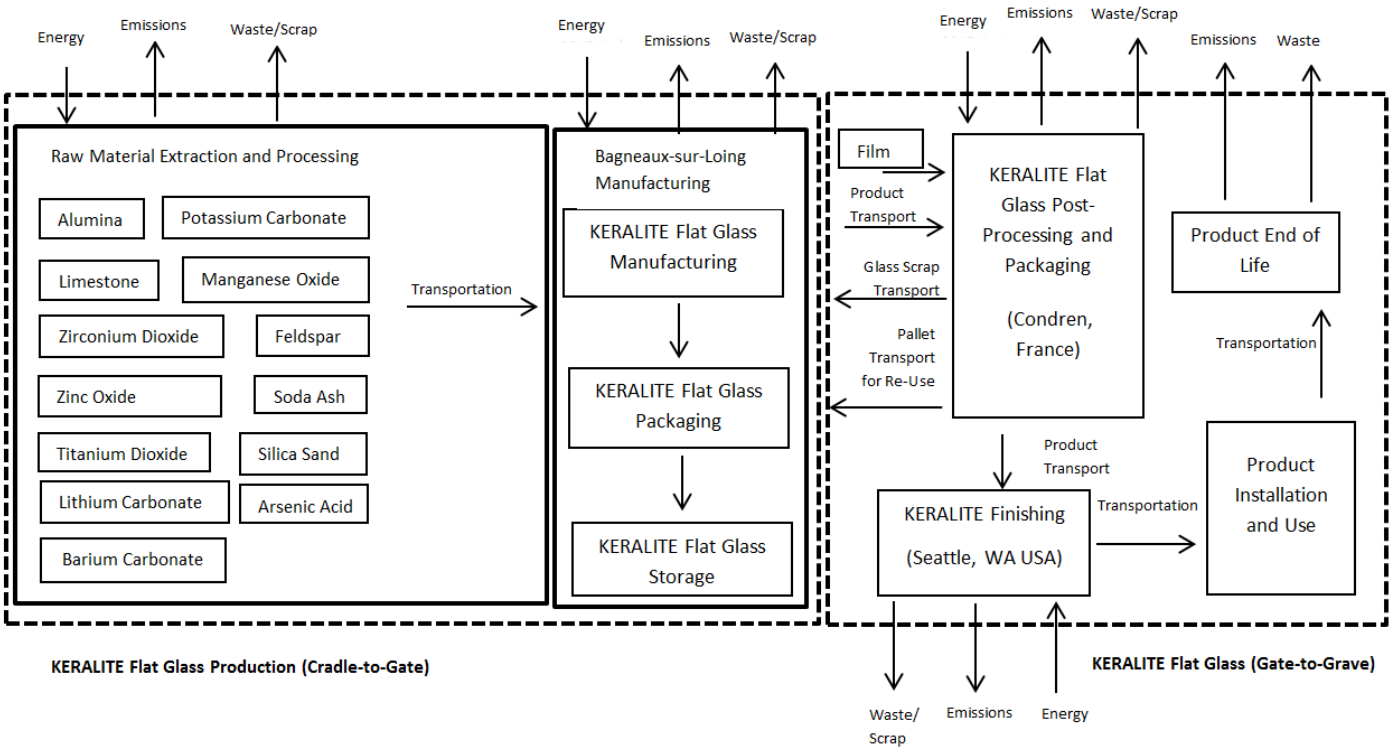


Figure 3: System Boundaries

Cut-off Criteria

Mass and energy flows that consist of less than 1% may be omitted from the inventory analysis. Cumulative omitted mass or energy flows shall not exceed 5%. Mass or energy flows that contribute more than 10% to an impact category shall be included.

This EPD is in compliance with the cut-off criteria. No processes were neglected or excluded. Capital items for the production processes (machines, buildings, etc.) were not taken into consideration.

Period under Consideration

The data used refer to the production processes of the flat glass production facility from January 2011- June 2013 to account for variations in production cycles. The post-processing facility provided data for calendar year 2012, as well as polishing data for late 2013.

Software and Background Data

For life cycle modeling the SimaPro v7.3 Software System for Life Cycle Engineering, a recognized LCA modeling software program, was used. All background data sets relevant for production and disposal were available in this software.

Transportation

Each facility provided shipping distances of all raw materials which were used in this study. Interplant shipping was included. The final product is typically sold within the continental United States and transported by truck. The average distance the product was shipped was accounted for in this study.

Use Stage

The useful service life of the KERALITE product line is 30 years. Any use stage impacts were excluded from this analysis. Fabrication and installation scrap rates were assumed to be 18% and were accounted for in each life cycle stage.

End-of-Life

KERALITE is usually removed and loaded onto a truck or dumpster at the decommissioning of a building. The product was modeled as being disposed of in a landfill. There are currently no end-of-life recycling programs formally established across the industry for fire rated glass.

Life Cycle Inventory

Emissions to Air

Emission	Unit	Raw Material Extraction and Processing	Flat Glass Production	Flat Glass Packaging/ Storage	Total Cradle-to-Gate
SO_x	kg	2.9E+00	2.7E-01	5.3E-04	3.2E+00
NO_x	kg	3.7E+00	2.0E+00	4.6E-04	5.8E+00
CO_2e	kg	9.8E+02	5.1E+02	1.7E-01	1.5E+03
CO	kg	1.7E+00	2.5E-01	3.5E-04	1.9E+00
VOCs	kg	1.9E-04	1.2E-03	1.6E-04	1.5E-03
Fe	kg	1.1E-02	1.9E-02	5.2E-07	3.0E-02
PM	kg	2.4E+00	1.7E-01	2.0E-04	2.6E+00

Table 4: Cradle-to-gate air emissions per metric tonne of unfinished flat glass

Emission	Unit	KERALITE® F Cradle-to-Grave	KERALITE® L Cradle-to-Grave	KERALITE® Select F Cradle-to-Grave	KERALITE® Select L Cradle-to-Grave
SO_x	kg	4.7E+00	4.7E+00	4.8E+00	4.7E+00
NO_x	kg	1.5E+01	1.5E+01	1.5E+01	1.5E+01
CO_2e	kg	2.4E+03	2.4E+03	2.4E+03	2.4E+03
CO	kg	5.4E+00	5.4E+00	5.4E+00	5.4E+00
VOCs	kg	2.9E-01	2.9E-01	2.9E-01	2.9E-01
Fe	kg	3.8E-02	4.4E-02	5.2E-02	5.2E-02
PM	kg	3.5E+00	3.5E+00	3.6E+00	3.6E+00

Table 5: Cradle-to-grave air emissions per metric tonne of finished KERALITE®

Water Use and Emissions to Water

Use/Emission	Unit	Material Acquisition and Pre-Processing	Flat Glass Production	Flat Glass Packaging/ Storage	Total Cradle-to-Gate
Water Use	kg	1.9E+04	8.6E+03	1.6E+00	2.8E+04
Phosphates	kg	1.4E+00	4.9E-02	9.4E-05	1.4E+00
Nitrates	kg	2.2E+00	2.5E-02	4.4E-05	2.2E+00
Dioxin	kg	9.5E-24	0.0E+00	0.0E+00	9.5E-24
Heavy Metals	kg	4.8E-02	4.1E-03	1.6E-06	5.3E-02

Table 6: Total cradle-to-gate water use and emissions per metric tonne of unfinished flat glass

Use/Emission	Unit	KERALITE® F Cradle-to-Grave	KERALITE® L Cradle-to-Grave	KERALITE® Select F Cradle-to-Grave	KERALITE® Select L Cradle-to-Grave
Water Use	kg	3.4E+04	3.7E+04	4.0E+04	4.1E+04
Phosphates	kg	1.8E+00	1.8E+00	1.8E+00	1.8E+00
Nitrates	kg	2.7E+00	2.7E+00	2.8E+00	2.7E+00
Dioxin	kg	4.2E-21	5.3E-21	4.3E-21	5.3E-21
Heavy Metals	kg	6.8E-02	6.8E-02	7.0E-02	7.0E-02

Table 7: Cradle-to-grave water use and emissions per metric tonne of finished KERALITE®

Energy Resources

Primary Energy	Unit	Material Acquisition and Pre-Processing	Flat Glass Production	Flat Glass Packaging/ Storage	Total Cradle-to-Gate
Nonrenewable, fossil	MJ-Eq	1.3E+04	9.5E+03	2.6E+00	2.2E+04
Nonrenewable, nuclear	MJ-Eq	3.6E+03	1.2E+04	2.3E-01	1.5E+04
Renewable, biomass	MJ-Eq	2.1E+02	7.1E+01	8.6E-01	2.8E+02
Renewable wind, solar, geothermal	MJ-Eq	5.2E+01	1.6E+02	3.8E-03	2.1E+02
Renewable, water	MJ-Eq	4.1E+02	4.9E+02	4.7E-02	9.0E+02
Total	**MJ-Eq**	**1.7E+04**	**2.2E+04**	**3.7E+00**	**3.9E+04**

Table 8: Total cradle-to-gate primary energy use per metric tonne of unfinished flat glass

Primary Energy	Unit	KERALITE® F Cradle-to-Grave	KERALITE® L Cradle-to-Grave	KERALITE® Select F Cradle-to-Grave	KERALITE® Select L Cradle-to-Grave
Nonrenewable, fossil	MJ-Eq	3.5E+04	3.5E+04	3.5E+04	3.5E+04
Nonrenewable, nuclear	MJ-Eq	2.0E+04	2.3E+04	2.8E+04	2.8E+04
Renewable, biomass	MJ-Eq	4.0E+02	3.9E+02	4.2E+02	4.1E+02
Renewable wind, solar, geothermal	MJ-Eq	2.7E+02	3.2E+02	3.9E+02	3.9E+02
Renewable, water	MJ-Eq	1.2E+03	1.3E+03	1.5E+03	1.5E+03
Total	**MJ-Eq**	**5.6E+04**	**6.0E+04**	**6.6E+04**	**6.6E+04**

Table 9: Cradle-to-grave primary energy use per metric tonne of finished KERALITE®

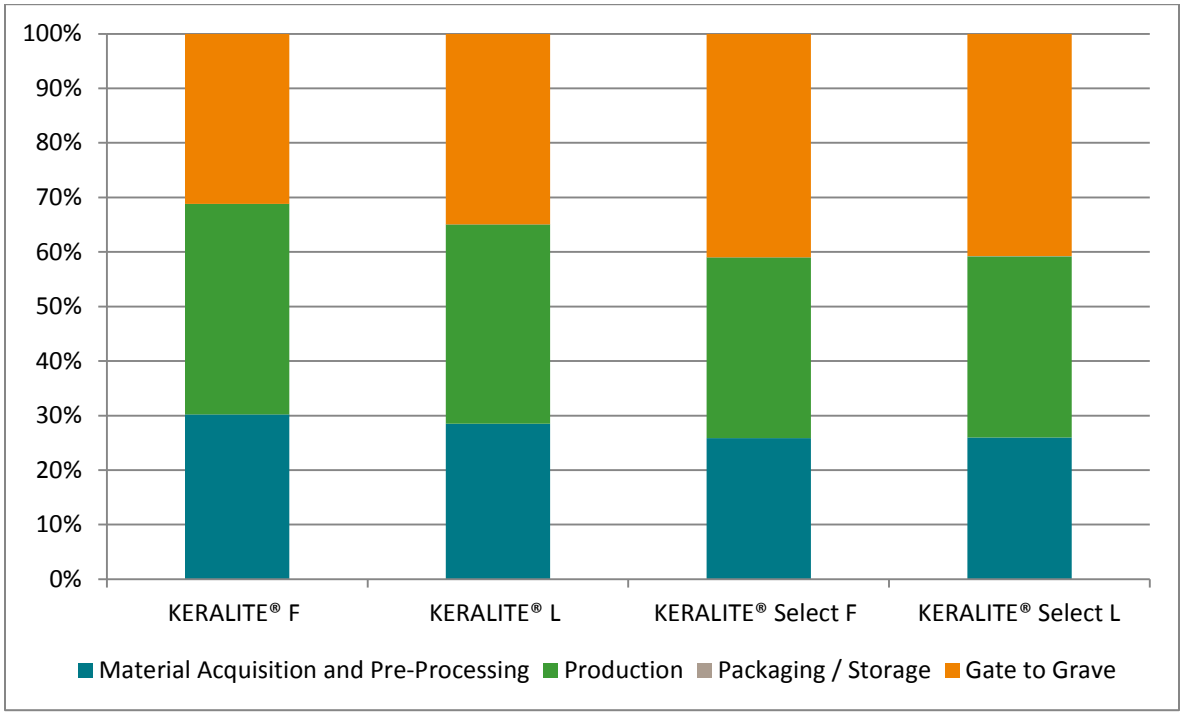


Figure 4: Cradle to Grave Cumulative Energy Demand of the KERALITE product line.

Waste Management

Waste	Unit	Raw Material Extraction and Processing	Flat Glass Production	Flat Glass Packaging/ Storage	Total Cradle-to-Gate
Incineration (includes with and without energy recovery)	kg	6.8E+00	-	4.5E-04	6.8E+00
Landfill (non-hazardous solid waste)	kg	1.9E+02	2.5E+01	9.9E-03	2.2E+02
Hazardous waste	kg	2.8E+00	4.30E-03	1.10E-04	2.8E+00
Landfill avoidance (recycling)	kg	2.0E+00	1.1E+01	7.4E-05	1.3E+01

Table 10: Total cradle-to-gate waste per metric tonne of unfinished flat glass

Waste	Unit	KERALITE® F Cradle-to-Grave	KERALITE® L Cradle-to-Grave	KERALITE® Select F Cradle-to-Grave	KERALITE® Select L Cradle-to-Grave
Incineration (includes with and without energy recovery)	kg	6.8E+00	6.8E+00	6.8E+00	6.8E+00
Landfill (non-hazardous solid waste)	kg	1.4E+03	1.4E+03	1.4E+03	1.4E+03
Hazardous waste	kg	2.8E+00	2.8E+00	2.8E+00	2.8E+00
Landfill avoidance (recycling)	kg	1.4E+01	1.4E+01	1.4E+01	1.4E+01

Table 11: Cradle-to-grave waste per metric tonne of finished KERALITE®

Life Cycle Impact Assessment

The environmental impacts listed below were assessed throughout the life cycle of KERALITE® as defined above.

Impact Category	Units	Raw Material Extraction and Processing	Flat Glass Production	Flat Glass Packaging/ Storage	Total Cradle-to-Gate*
Global warming	kg CO_2 eq	1.0E+03	5.3E+02	1.4E-01	1.5E+03
Acidification	mol H+ eq	6.1E+00	1.7E+00	8.7E-04	7.8E+00
Eutrophication	kg PO_4 eq	4.5E+00	2.3E-01	3.1E-04	4.7E+00
Smog	kg O_3 eq	1.4E-04	8.0E-05	8.2E-09	2.2E-04
Ozone Depletion	kg CFC-11 eq	9.3E+01	5.1E+01	1.3E-02	1.4E+02
Metal Resource Depletion Potential**	kg Fe eq	8.9E+01	2.2E+01	1.6E-02	1.1E+02

*May not sum due to rounding

**Metal Resource Depletion Potential is calculated with ReCiPe Midpoint v1.07 Metal Depletion methodology

Table 12: Cradle-to-gate life cycle impact assessment results per metric tonne of unfinished flat glass

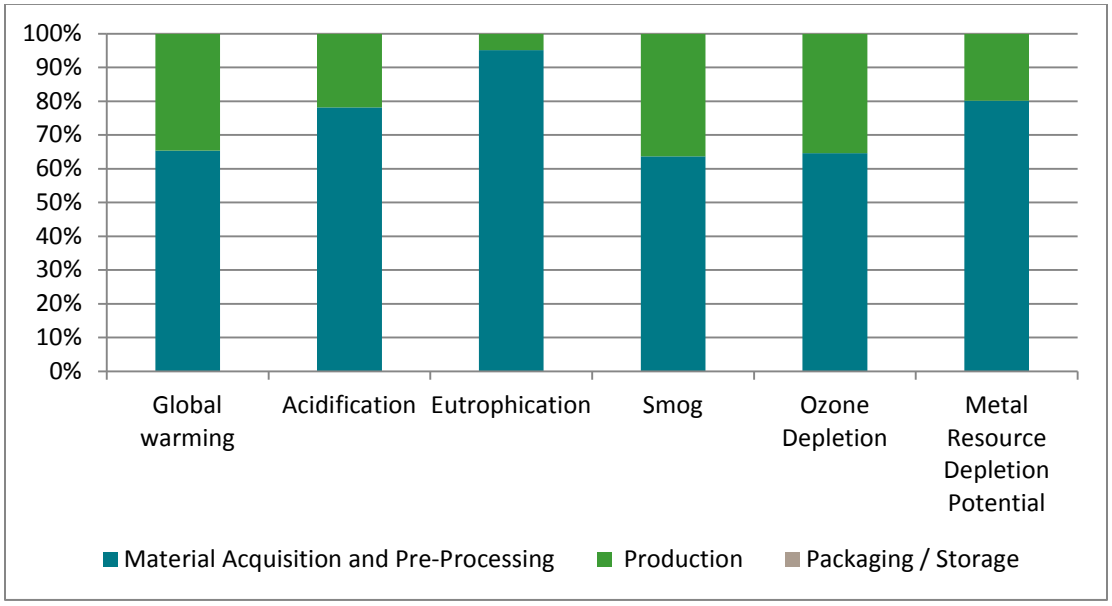


Figure 5: Cradle to Gate Environmental Impact Assessment of KERALITE flat glass.

Impact Category	Units	KERALITE® F Cradle-to-Grave	KERALITE® L Cradle-to-Grave	KERALITE® Select F Cradle-to-Grave	KERALITE® Select L Cradle-to-Grave
Global warming	kg CO_2 eq	2.5E+03	2.4E+03	2.5E+03	2.5E+03
Acidification	mol H+ eq	1.6E+01	1.6E+01	1.6E+01	1.6E+01
Eutrophication	kg PO_4 eq	6.7E+00	6.7E+00	6.8E+00	6.7E+00
Smog	kg O_3 eq	3.7E+02	3.7E+02	3.7E+02	3.7E+02
Ozone Depletion	kg CFC-11 eq	2.8E-04	2.8E-04	2.9E-04	2.8E-04
Metal Resource Depletion Potential**	kg Fe eq	1.5E+02	1.5E+02	1.6E+02	1.6E+02

**Metal Resource Depletion Potential is calculated with ReCiPe Midpoint v1.07 Metal Depletion methodology

Table 13: Cradle-to-grave life cycle impact assessment results per metric tonne of KERALITE®

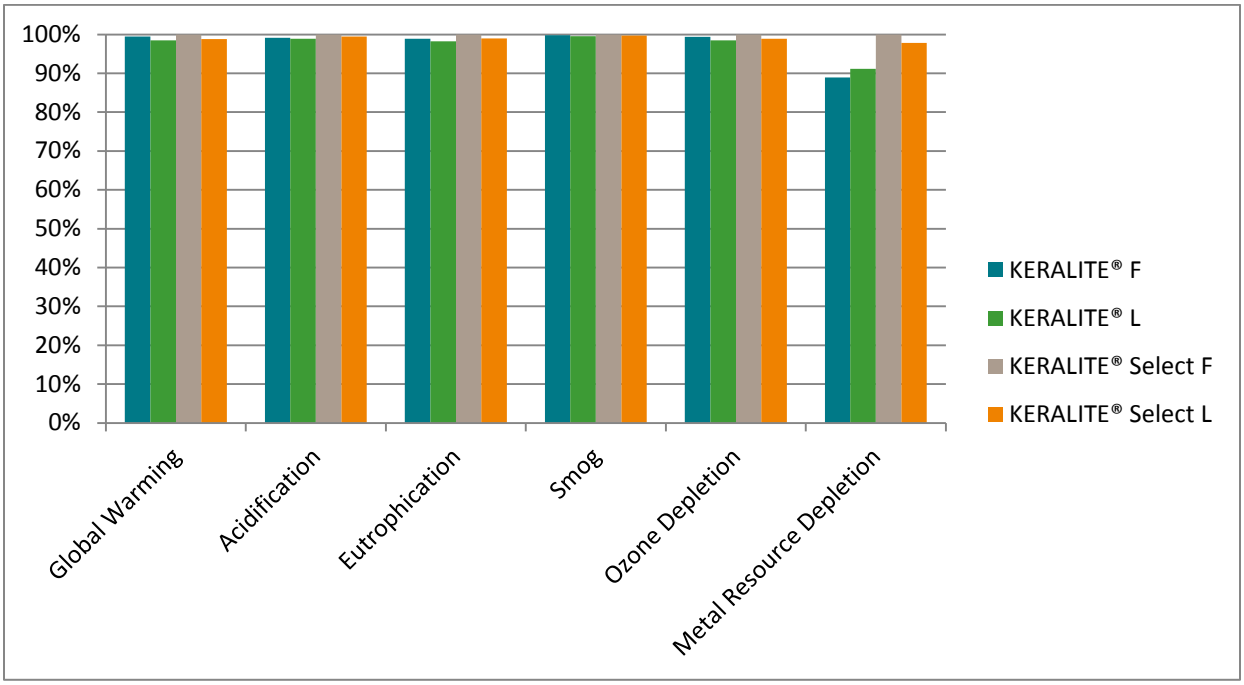


Figure 6: Cradle to Grave Environmental Impact Assessment of KERALITE product line.

Optional Environmental Information

Organizational Awards

Saint-Gobain has been awarded the ENERGYSTAR Partner of the Year Sustained Excellence Award for 2013 for the third straight year for the corporation's innovations in sustainable operations and manufacturing.

ENERGY STAR AWARD 2013
PARTNER OF THE YEAR
Sustained Excellence

References

- ASTM E1991-05 Standard Guide for Environmental Life Cycle Assessment (LCA) of Building Material/Products
- ASTM E2010-01 Standard Test Method for Positive Pressure Fire Tests of Window Assemblies
- ASTM E2074-00e1 Standard Test Method for Fire Tests of Door Assemblies
- ASTM E2114-08 Standard Technology for Sustainability Relative to the Performance of Buildings
- ASTM E2129-10 Standard Practice for Data Collection for Sustainability Assessment of Building Products
- ASTM E2432-11 Standard Guide for General Principles of Sustainability Relative to Buildings
- CAN/ULC-S104-10 Standard Method for Fire Tests of Door Assemblies
- CAN4-S106 Standard Method for Fire Tests of Window and Glass Block Assemblies
- CPSC 16CFR Part 1201 (Categories I & II) – Safety Standard for Architectural Glazing
- EN 15804:2012 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
- EPA, Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI)
- FTC Part 260, Green guides
- GANA PCR for Flat Glass UN CPC 3711. V1.
- (ILCD, 2010) Joint Research Commission, 2010, ILCD Handbook: General Guide for Life Cycle Assessment
- Intergovernmental Panel on Climate Change (IPCC)
- ISO 14025:2006 *Environmental labels and declarations – Type III environmental declarations – Principles and procedures*[6]
- ISO 14040:2006 *Environmental management - Life cycle assessment – Principles and framework*
- ISO 14044:2006 *Environmental management - Life cycle assessment – Requirements and guidelines*
- ISO 21930, Sustainability in building construction – Environmental declaration of building products
- NFPA 80, NFPA 252, NFPA 257
- Uniform Building Code (UBC) 7-2 Fire Test & UBC 7-4
- RIVM and Raboud University, CML, PRe Consultants, ReCiPe 1.07 methodology, www.lcia-recipe.net
- UL 9 & UL 10c – Fire Tests of Window Assemblies; Positive Pressure Fire Tests of Door Assemblies
- USEPA Waste Reduction Model (WARM)
- World Business Council for Sustainable Development's Global Water Tool
- World Resources Institute (WRI) Draft Product Life Cycle Accounting and Reporting Standard

LCA Development

This EPD and corresponding LCA were prepared by Sustainable Solutions Corporation of Royersford, Pennsylvania.

Contact Vetrotech

For more information, please visit http://www.vetrotech.com/usa/About-Vetrotech-USA/Contact-Vetrotech.aspx