Declaration Owner

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Products

PentalQuartz® (VICOSTONE®) Quartz Surfaces

Functional Unit

The functional unit is one square meter of countertop provided and maintained for a period of 10 years in residential use.

EPD Number and Period of Validity

SCS-EPD-04770
EPD Valid December 14, 2017 through December 13, 2022

Product Category Rule

Product Category Rule for Environmental Product Declarations: *PCR for Residential Countertops*. NSF International. Valid through September 17, 2018.

Program Operator

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Disclaimers: *This EPD conforms to ISO 14025, 14040, and ISO 14044.*

Scope of Results Reported: *The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.*

Accuracy of Results: *Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.*

Comparability: *The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.*

PCR review, was conducted by	Evan Griffing, PhD, Environmental Clarity LLC, egriffing@environmentalclarity.com
Approved Date: December 14, 2017 – End Date: December 13, 2022	
Independent verification of the declaration and data, according to ISO 14025:2006	☐ internal ☑ external
Third party verifier	Tom Gloria, P.h.D., Industrial Ecology Consultants

ABOUT PentalQuartz (VICOSTONE)

PentalQuartz® (VICOSTONE®) is a pioneer in manufacturing quartz-based engineered stone in Asia. With a global distribution network, PentalQuartz® (VICOSTONE®) Quartz Surfaces are now available in all continents and recommended by interior designers and architects. With five production lines of compound stones utilizing technology transferred from Breton S.p.A (Italy), and using the most advanced techniques with latest technology, PentalQuartz® (VICOSTONE®) can provide millions of square meters per year and is one of the leading engineered stone manufacturers in the world.

PRODUCT DESCRIPTION

PentalQuartz® (VICOSTONE®) quartz based engineered stones are produced from up to 93% pure natural quartz aggregates that are adhered with polymer resin with color powder, and have a hardness and flexural strength that is much higher than natural and other engineered stones. With a special and luxurious beauty, PentalQuartz® (VICOSTONE®) compound stones are widely used in interior applications such as kitchen countertops, bathroom vanities, wall paneling, flooring, etc. In this LCA study, PentalQuartz® (VICOSTONE®) Quartz Surfaces are fabricated for use as a residential countertop. The manufacturer warrants the product for a period of 15 years from the date of purchase.

PRODUCT CHARACTERISTICS AND PERFORMANCE

Table 1. *Product characteristics for PentalQuartz® (VICOSTONE®) Quartz Surfaces.*

Characteristic	Nominal Value	Unit
Slab thickness	20.0 (0.787)	mm (inch)
Slab length	305 (120)	cm (inch)
Slab width	144 (56)	cm (inch)
Slab weight	50.0 (10.2)	kg/m^2 (lb/ft^2)
Underlayment included	N	Y/N
VOC Emissions Test Method	GREENGUARD Gold	-

Table 2. *Product performance test results for PentalQuartz® (VICOSTONE®)Quartz Surfaces.*

Properties	Results	Test Method
Water Absorption (% by weight)	ASTM C97/C97M-09:2009	≤ 0.05%
	EN 14617-1:2013	≤ 0.06%
Apparent Density	ASTM C97/C97M-09:2009	2.2 – 2.4 gr/cm^3
	EN 14617-1:2013	
Flexural Strength	ASTM C880/C880M-09:2009	> 40 MPa
	EN 14617-2:2008	
Dimension Stability	EN14617-12:2012	Class A
Electrical Stability	EN 14617-13:2013	Volume resistance (R_V) = $0.9x10^{14}\Omega$
		Volume resistance (p_V) = $4.88x10^{14}\Omega m$
Impact Resistance	ASTM D1709:2015	≥ 3.0 J
	EN 14617-9:2005	
Compressive Strength	ASTM C170/C170M-09:2009	≥ 155 MPa
	EN 14617-15:2005	
Mohs Scale of Hardness	EN101	6.0 – 7.0
Resistance to Deep Abrasion	ASTM C1243:2009	Volume of chord: $V \leq 195mm^3$
	EN 14617-4:2012	
Freeze-Thaw Resistance	ASTM C1026:2013	No defects after 15 freeze-thaw cycles
	EN 14617-5:2012	No defects after 25 freeze-thaw cycles
Slip Resistance at Honed 400	DIN 51130:2004	R9 – R10
Microbial Resistance	ASTM D 6329:2015	Ranking 3: Resistant to Mold Growth
Chemical Resistance to Acids	EN 14617-10:2012	Class C_4
Thermal Shock Resistance	EN 14617-6:2012	No visual defects after 20 cycles
Determination of Resistance to Immersion in Boiling Water	AS 2924.2-7:1998 (EQUI. TO ISO 4586.2-7:1997)	Effect on surface (rating): 5 (no visible change)
Determination of Resistance to Dry Heat	AS 2924.2-8:1998 (EQUI. TO ISO 4586.2-8:1997)	Effect on surface (rating): 5
Determination of Resistance to Staining (Procedure A)	AS 2924.2-15:1998 (EQUI. TO ISO 4586.2-15: 1997)	(no visible change)

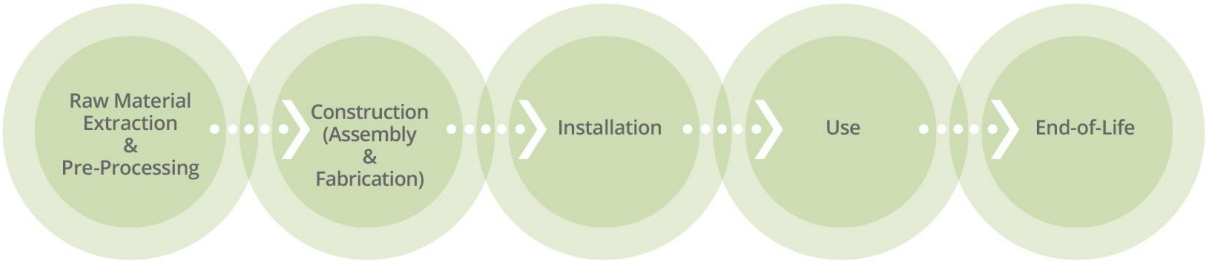
MATERIAL COMPOSITION

Table 3. *Material composition of PentalQuartz® (VICOSTONE®)Quartz Surfaces in kilograms per functional unit and in*

Material	Amount in Final Product (kg/m²)	Percent of Total (%)	Material Resources Type
Product			
Quartz	44	88%	Virgin non-renewable
Polyester resin	3.6	7.1%	Virgin non-renewable
Styrene	1.9	3.8%	Virgin non-renewable
Color pigments	0.35	0.69%	Virgin non-renewable
Additives	0.17	0.34%	Virgin non-renewable
Total	**50**	**100%**	-

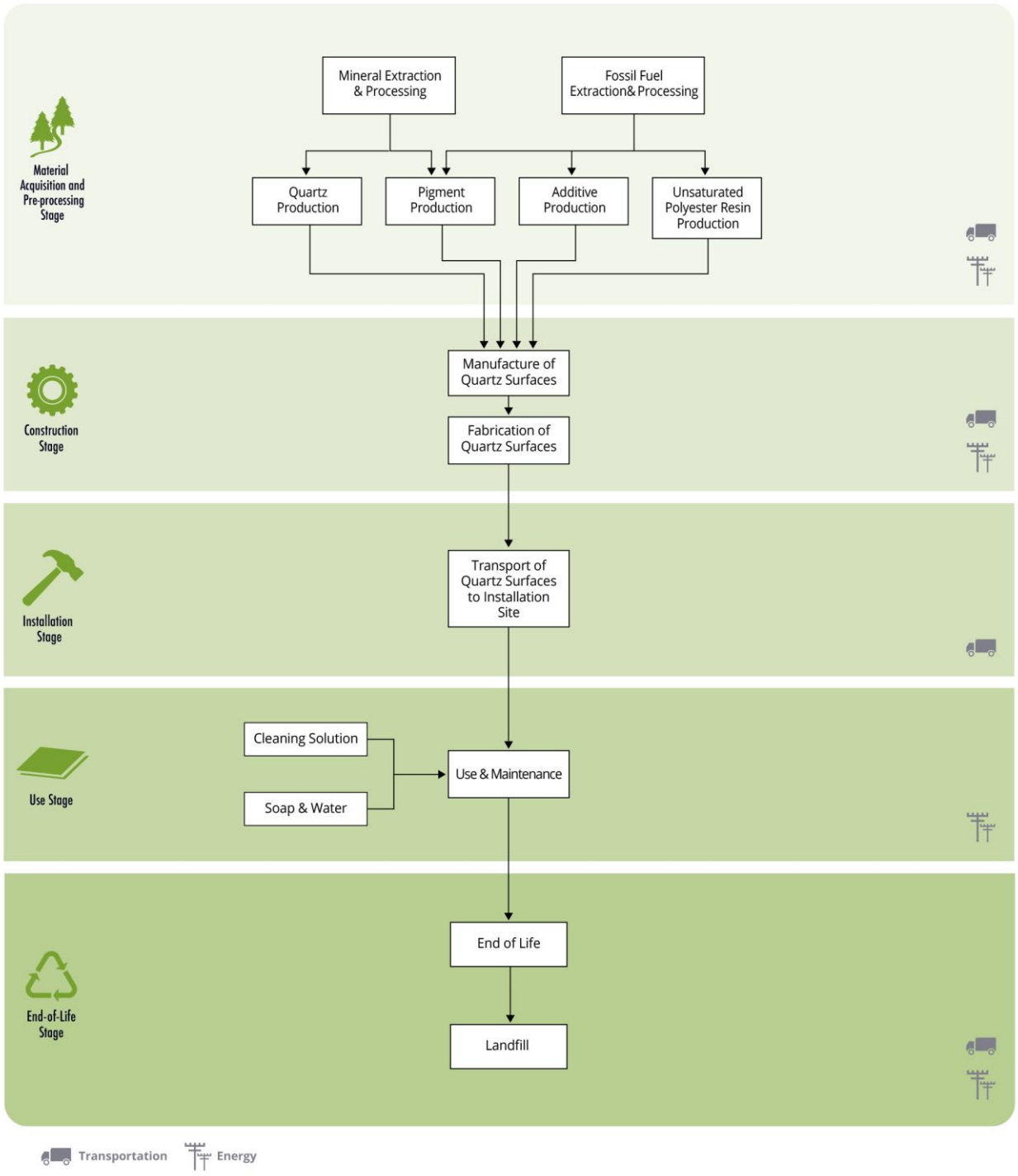
LIFE CYCLE ASSESSMENT STAGES

A cradle-to-grave life cycle assessment (LCA) was completed for this product in accordance with ISO 14040, ISO 14044, and the Product Category Rule for Environmental Product Declarations: *PCR for Residential Countertops*. The diagram below illustrates the life cycle stages included in this EPD.



PRODUCT LIFE CYCLE FLOW DIAGRAM

The diagrams below are a representation of the most significant contributions to the life cycle of PentalQuartz® (VICOSTONE®)Quartz Surfaces. This includes material acquisition and pre-processing, construction (assembly and fabrication), installation, use, and end-of-life.



LIFE CYCLE INVENTORY

The life cycle inventory (LCI) flows for the EPD are shown in Table 4 in accordance with the requirements of the PCR. Water usage from electricity generation is included.

Table 4. *Life cycle inventory flows for 1 m^2 PentalQuartz® (VICOSTONE®)Quartz Surfaces provided and maintained for a period of*

Parameter	Total	Material Acquisition & Pre-processing	Construction	Installation	Use	End-of-Life
Emissions to Air (kg)						
SO_X	0.35	0.17	0.16	$1.3x10^{-2}$	$7.8x10^{-3}$	$3.6x10^{-3}$
NO_X	0.43	0.15	0.21	$3.9x10^{-2}$	$1.0x10^{-2}$	$1.6x10^{-2}$
CO_2	95	42	33	8.59	8.7	2.3
Methane	0.26	0.20	$3.8x10^{-2}$	$8.1x10^{-3}$	$9.1x10^{-3}$	$2.0x10^{-3}$
N_2O	$4.5x10^{-2}$	$4.1x10^{-2}$	$9.0x10^{-4}$	$1.8x10^{-4}$	$2.6x10^{-3}$	$1.0x10^{-4}$
CO	0.36	0.22	0.07	$1.8x10^{-2}$	0.050	$7.0x10^{-3}$
Water Usage and Emission to Water (kg)						
Water Consumption	4,600	2,700	850	99	940	25
Phosphates	$5.7x10^{-2}$	$3.4x10^{-2}$	$1.8x10^{-2}$	$2.1x10^{-3}$	$2.9x10^{-3}$	$2.9x10^{-4}$
Nitrates	0.17	$1.1x10^{-2}$	$5.6x10^{-3}$	$6.6x10^{-4}$	0.16	0.0
Dioxin	0.0	0.0	0.0	0.0	0.0	0.0
Arsenic	$1.2x10^{-4}$	$7.5x10^{-5}$	$3.1x10^{-5}$	$7.2x10^{-6}$	$7.6x10^{-6}$	$7.6x10^{-7}$
Lead	$1.4x10^{-4}$	$1.1x10^{-4}$	$2.1x10^{-5}$	$7.3x10^{-6}$	$8.2x10^{-6}$	$6.7x10^{-7}$
Mercury	$4.4x10^{-6}$	$2.6x10^{-6}$	$1.4x10^{-6}$	$1.6x10^{-7}$	$3.0x10^{-7}$	$2.3x10^{-8}$
Cadmium	$5.0x10^{-5}$	$3.2x10^{-5}$	$1.1x10^{-5}$	$3.2x10^{-6}$	$3.9x10^{-6}$	$3.2x10^{-7}$
Chromium	$3.8x10^{-4}$	$2.5x10^{-4}$	$9.0x10^{-5}$	$2.4x10^{-5}$	$2.2x10^{-5}$	$2.8x10^{-6}$
Energy Type and Usages (MJ)						
Primary energy demand	1,800	960	570	150	100	42
Fossil fuels	1,600	880	530	140	28	41
Nuclear	67	46	17	2.3	2.2	0.32
Renewable	120	27	22	1.7	72	0.37
Waste Management (kg)						
Incineration with energy recovery	INA	INA	INA	INA	INA	INA
Incineration without energy recovery	INA	INA	INA	INA	INA	INA
Landfill (Non-hazardous waste)	146	7.6	73	6.4	0.76	58
Hazardous waste	$1.0x10^{-3}$	$5.3x10^{-4}$	$3.6x10^{-4}$	$8.1x10^{-5}$	$5.1x10^{-5}$	$1.6x10^{-5}$
Landfill avoidance (recycling)	0.0	Negligible	0.0	Negligible	Negligible	Negligible

*Solar, wind, hydro, biomass

INA= Indicator not assessed

LIFE CYCLE IMPACT ASSESSMENT

The life cycle impact assessment (LCIA) for the EPD is conducted in accordance with requirements of the PCR. Impact category indicators are estimated using the TRACI 2.1 and CML characterization methods. The LCIA results are calculated using SimaPro 8.3 software.

Table 5. *LCIA results for 1 m^2 PentalQuartz® (VICOSTONE®) Quartz Surfaces provided and maintained for a period of 10 years.*

Impact Category	Units	Total	Material Acquisition & Pre-processing	Construction	Installation	Use	End-of-Life
Global warming potential	kg CO_2 eq	120	60	35	8.9	10	2.4
		100%	52%	30%	7.7%	8.4%	2.1%
Acidification potential	kg SO_2 eq	0.68	0.29	0.31	$4.1x10^{-2}$	$2.7x10^{-2}$	$1.5x10^{-2}$
		100%	42%	45%	6.0%	4.0%	2.2%
Photochemical ozone creation potential	kg O_3 eq	11	3.9	5.3	1.0	0.31	0.40
		100%	36%	49%	8.9%	2.8%	3.7%
Eutrophication potential	kg N eq	0.26	0.13	$6.2x10^{-2}$	$9.9x10^{-3}$	$5.3x10^{-2}$	$2.3x10^{-3}$
		100%	51%	24%	3.8%	21%	0.88%
Ozone depletion potential	kg CFC-11 eq	$1.7x10^{-5}$	$6.4x10^{-6}$	$7.4x10^{-6}$	$2.2x10^{-6}$	$3.7x10^{-7}$	$6.5x10^{-7}$
		100%	38%	44%	13%	2.2%	3.8%
Abiotic depletion potential (elements)*	kg Sb eq	$2.1x10^{-4}$	$1.1x10^{-4}$	$5.5x10^{-5}$	$2.6x10^{-5}$	$1.6x10^{-5}$	$1.7x10^{-6}$
		100%	53%	26%	13%	7.4%	0.82%
Abiotic depletion potential (fossil fuels)	MJ	1,600	880	530	140	27	41
		100%	54%	33%	8.8%	1.7%	2.5%

* This indicator is based on assumptions regarding current reserves estimates. Users should use caution when interpreting results because there is insufficient information on which indicator is best for assessing the depletion of abiotic resources.

SUPPORTING TECHNICAL INFORMATION

Unit processes are developed with SimaPro 8.3 software. The primary sources of secondary LCI data are from Ecoinvent.

Table 6. *LCI datasets and associated databases used to model the PentalQuartz® (VICOSTONE®)Quartz Surfaces product*

Flow	Dataset	Data Source	Publication Date
Product Materials			
Quartz	Silica sand {RoW}| production | Alloc Rec, U	Ecoinvent	2016
Polyester resin	Polyester resin, unsaturated {RoW}| production | Alloc Rec, U	Ecoinvent	2016
Styrene	Styrene {RoW}| production | Alloc Rec, U	Ecoinvent	2016
Pigment	Titanium dioxide {RER}| production, chloride process | Alloc Rec, U	Ecoinvent	2016
Additives	Chemical, organic {GLO}| production | Alloc Rec, U	Ecoinvent	2016
Electricity/Heat/Resources for Manufacturing			
Electricity	Electricity, medium voltage {RoW}| market for | Alloc Rec, U	Ecoinvent	2016
Natural Gas	Heat, district or industrial, natural gas {GLO}| market group for | Alloc Rec, U	Ecoinvent	2016
Diesel	Diesel, burned in building machine {GLO}| processing | Alloc Rec, U	Ecoinvent	2016
Fabrication			
Adhesive	Methyl methacrylate {GLO}| market for | Alloc Rec, U; Chemical, organic {GLO}| market for | Alloc Rec, U	Ecoinvent	2016
Electricity	Electricity, medium voltage {US}| market group for | Alloc Rec, U	Ecoinvent	2016
Use			
Stone Cleaner	Chemical, organic {GLO}| market for | Alloc Rec, U; Ethanol, without water, in 99.7% solution state, from ethylene {GLO}| market for | Alloc Rec, U; Sodium hydroxide, without water, in 50% solution state {GLO}| market for | Alloc Rec, U; Water, deionised, from tap water, at user {RoW}| market for water, deionised, from tap water, at user | Alloc Rec, U	Ecoinvent	2016
Soap	Soap {GLO}| market for | Alloc Rec, U	Ecoinvent	2016
Water	Tap water {RoW}| market for | Alloc Rec, U	Ecoinvent	2016
Transportation			
Road	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Rec, U	Ecoinvent	2016
Ship	Transport, freight, sea, transoceanic ship {GLO}| market for | Alloc Rec, U	Ecoinvent	2016
Waste	Municipal waste collection service by 21 metric ton lorry {RoW}| market for municipal waste collection service by 21 metric ton lorry | Alloc Rec, U	Ecoinvent	2016

Data Quality

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	Manufacturer data (primary data) are based on 2016 annual production, respectively. Representative datasets (secondary data) used for upstream and background processes are generally less than 10 years old. All of the data used represented an average of at least one year's worth of data collection.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study	The data used in the analysis provide the best possible representation available with current data. Representative data used in the assessment are representative of US, Global, or "Rest-of-World" (average for all countries in the world with uncertainty adjusted). Datasets chosen are considered sufficiently similar to actual processes.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one year and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	Except where noted, the LCA model included all known mass and energy flows. In some instances, surrogate data used to represent upstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 10% of the total environmental impact for each indicator are excluded. In total, these missing data represent less than 5% of the mass or energy flows.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	Data used in the assessment represent typical or average processes as currently reported from multiple data sources, and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction. Some proxy datasets are used to represent materials due to the lack of data available.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is considered to be high. Data sources of similar quality and age are used; with a bias towards Ecoinvent data where available. Different portions of the product life cycle are equally considered.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources	For the manufacturing of Quartz Surfaces, primary data were provided by Vicostone. Similarly, the upstream transport of materials used for manufacturing is based on supplier locations and amounts supplied, provided by Vicostone, while modes and distances for this leg of transportation were estimated using the online calculator provided by SeaRates. The fabrication process is derived from a fabrication manual provided by Vicostone and commercial sources for equipment used to derive key parameters for calculations. For the distribution of product from manufacturing facility to distribution center, a weighted average was calculated based on distribution center locations and the percent of annual shipments each received, provided by Vicostone, while modes and distances for this leg of transportation were estimated using the online calculator provided by SeaRates. The transport of Quartz Surfaces from distribution center to fabrication facility and from fabrication facility to installation are based on RITA's transport survey.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to the product materials is low. Data for upstream operations relied upon use of existing representative datasets. These datasets contained relatively recent data (<10 years), but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact methods required by the PCR include impact potentials, which lack characterization of providing and receiving environments or tipping points.

Allocation

Resource use at the Vicostone facility in Hoalac Hi-tech Park, Thachthat, Hanoi, Vietnam was allocated to the product based on the product weight as a fraction of the total facility production. Impacts from transportation were allocated based on the mass of material and distance transported.

System boundaries

The system boundaries of the life cycle assessment for the countertop was cradle-to-grave.

Elements excluded from the system boundary include the following:

- Construction activities, capital equipment, and infrastructure;
- Maintenance and operation of equipment;
- Personnel travel and resource use;
- Forklifts, storage frames, clamps, templating materials, and other reusable tools for fabrication;
- A-frames and strapping for shipping from manufacturing facility to distribution center;
- Ancillary and labeling materials used in manufacturing; and
- Repair of the countertops.

The deletion of these processes and inputs is permitted since it is not expected to significantly change the overall conclusions of the study and complies with the cut-off criteria requirements specified by the PCR.

A description of the system boundaries for this EPD are as follows:

- Material acquisition and pre-processing stage – The material acquisition, pre-processing, and intermediate processing stage starts when the material is extracted from nature, processed and refined, and ends when the material reaches the gate of the manufacturing facility (construction stage). Transportation within and between all processing is included. Waste and scrap created during this stage are included.
- Construction stage – The construction stage starts with the product material components entering the manufacturing facility and ends with the final countertop leaving the fabrication shop. Processes include manufacturing of quartz surface slab and fabrication into countertop in preparation for installation. Transportation of Quartz Surfaces slab between facilities is included (e.g., from the Vicostone manufacturing facility to distribution center, and from distribution center to fabrication shop). Waste and scrap generation are included. Countertops are generally delivered by truck using reusable cart equipment and padding to protect the faces (i.e., blankets, carpet); therefore, packaging of the final product is not included.
- Installation stage – The installation stage includes the delivery of the countertop to the point of installation, and energy and ancillary materials used during installation. Waste generated during countertop installation is included. Sinks, plumbing fixtures, and cook tops are excluded.
- Use stage – The use stage includes the cleaning of the countertop during its lifetime, as well as extraction, manufacturing and transport of all sundry material for cleaning. In accordance with the PCR, maintenance and repair of the countertop is generally insignificant and is excluded from this stage. The reference service life for the countertop in this EPD is 10 years.
- End of life stage – The end-of-life stage begins when the used product is ready for disposal and ends when the product is landfilled. Transportation for disposal is included.

Cut-off criteria

According to the PCR, cumulative omitted mass or energy flows shall not exceed 5% and mass or energy flows that contribute more than 10% to an impact category shall be included. In the present study, except as noted, all known materials and processes were included in the life cycle inventory.

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