Building with conscience.

EPD for StoTherm® ci Classic

StoTherm® ci Classic combines the features of Sto's most popular continuous insulation system, StoTherm® and the StoGuard® waterproof air barrier system for greater energy efficiency and protection against moisture intrusion.

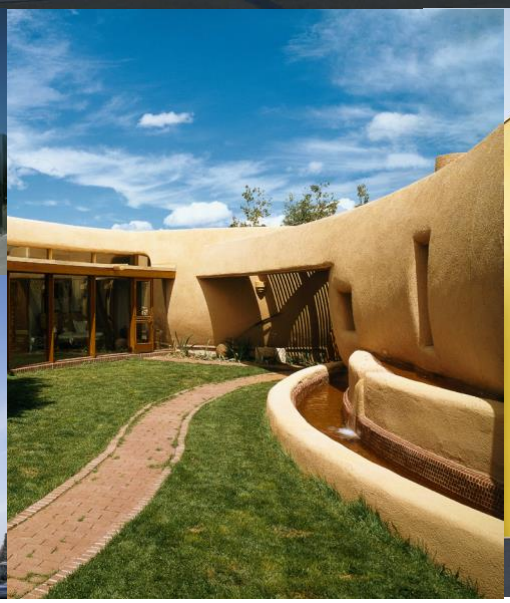
CONTENTS

epd Environmental Product Declaration

Building with conscience.

EPD for Sto Gold Coat®

Sto Gold Coat® is a code recognized, vapor permeable fluid-applied membrane designed for application under ci wall systems. Sto Gold Coat® is a sheathing treatment which is part of the StoGuard® air barrier and moisture barrier family of products.



epstengroup Environmental Product Declaration

epstengroup Solutions for a Sustainable World

PCR Identification	PCR for Architectural Coatings: NAICS 325510 on the basis of ISO 21930:2007, NSF International, 2017. Valid through June 23, 2022
Compliance to ISO 14040/44, ISO 14025 and ISO 21930	Yes
Product Category	Exterior Coating
Manufacturer's name	Sto Corp. 3800 Camp Creek Parkway SW, Building 1400, Suite 120 Atlanta, GA 30331 www.stocorp.com | (800) 221-2397
EPD program operator	Epsten Group 101 Marietta St. Suite 2600, Atlanta, GA 30303 www.epstengroup.com
Declaration Number	01-003
Date of Certification	December 18th, 2019
Period of Validity	5 years from date of certification
Functional Unit	One square meter of covered and protected substrate for 60 years
Market-base life used in assessment	10 Years
Design life used in assessment	N/A
Test method employed for determination of design life	N/A
Amount of colorant needed	See table 3
Overall Data Quality Assessment Score	Good
Site(s) in which the results of the LCA are representative	STO manufacturing sites in Atlanta, Georgia; Glendale, Arizona; and Rutland, Vermont
Information on where explanatory material can be obtained	See references at the end of this document.
LCA Software and Version Number	GaBi 9.2.0.58
LCI Database and Version Number	GaBi Database Version 8.7, Service Pack 39
This declaration was independently verified in accordance with ISO 14025: 2006 and the reference PCR: PCR for Architectural Coatings: NAICS 325510 ☐ Internal ☒ External	Kate McFeaters kmcfeaters@epstengroup.com Kathrin McFeaters
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting, LLC
This life cycle assessment was independently verified in accordance with ISO 14040/44 and the reference PCR by:	Kate McFeaters kmcfeaters@epstengroup.com Kathrin McFeaters

Comparability

In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the building level per ISO 21930 guidelines. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-to-case basis.

Company

We believe in '**Building with conscience**'.

That means ensuring that all building products are not only safe, effective and easy to install, but also environmentally responsible and sustainable. We know you're always looking for the smartest and newest technology to create energy efficient buildings with superior aesthetics.

That's exactly what our products help you achieve. Products like our wall systems, coatings and finishes are consistent favorites among design professionals, contractors and property owners alike. Whatever your needs or vision may be, we offer products for every type of building project; whether it's new construction, restoration or panelization, commercial or residential work.

An architect or specifier focuses on aesthetics and feasibility, a contractor needs products that are easy to work with, and a building owner requires high value and low costs on properties. Sto understands these unique needs, and delivers the smart, innovative materials and solutions that make this all possible. That's why Sto remains the innovative leader in integrated exterior wall systems.

When you combine that commitment to product support and innovation with value-added offerings like consultative design and color services through Sto Studio or training in proper application techniques through the Sto Institute, you get an integrated exterior wall system solution unmatched in the industry.

Manufacturing Sites Covered in this EPD

Atlanta Plant

Glendale Plant

Rutland Plant

Product Identification

Sto Gold Coat® is a fluid-applied vapor permeable air barrier offered in 5-gallon pails. There are no finish or color base options provided.

Table 1: Sto Gold Coat® Identification

Product Name	Product Number	Base Type	Finish Type
Sto Gold Coat®	81636	n/a	n/a

Product Description

Sto Gold Coat® is a fluid-applied vapor permeable air barrier and water-resistive barrier (WRB) with built-in anti-freeze properties. It is used over prepared vertical above grade concrete, concrete masonry, brick masonry, wood and glass mat gypsum sheathing behind StoTherm® ci and other wall claddings. Gold Coat® is treated in the study as a undercoater and it only utilizes the market-based lifetime (10 years for exterior undercoater).

Performance Features

Waterproof Material	Structural and Durable	Low Temperature Application	Spray Applied with Airless Spray Equipment
Vapor Permeable	UV Durable	Build-in Freeze Protection	Water-base and Low VOC

Material Composition

The material composition of Sto Gold Coat® is listed below:

Table 2: Material composition for Gold Coat®

Ingredient	Gold Coat®
Additives	1-2%
Colorant	3-4%
Polymer	25-26%
Silica	41-42%
Silicate	0%
Surfactant	0-1%
Water	25-26%

Components related to Life Cycle Assessment

The functional unit for the LCA study was covering and protecting 1 square meter (m2) of substrate for a period of 60 years—the assumed lifetime of a building. The reference flow required for the functional unit is calculated based on the product lifespan scenarios prescribed in the PCR. The market-based lifetime is 10 years. By default, Gold Coat® has a 5-year warranty. In case it is applied on Sto's wall systems, the warranty is extended to 10 years. The reference flow required for one functional unit is provided in Table 3.

Table 3: Market-based lifetime and reference flow

	Functional Unit [1 m^2]	Reference Flow [kg]	Tint needed [kg]
Lifespan		Market-based Lifetime [10 years]	
Gold Coat® over plywood)	1	3.08	N/A
Gold Coat® over CMU	1	8.87	N/A

Scope and Boundaries of the Life Cycle Assessment

The LCA was performed in accordance with ISO 14040 standards. The study is a cradle-to-grave LCA and includes the following life stages as prescribed in the PCR.

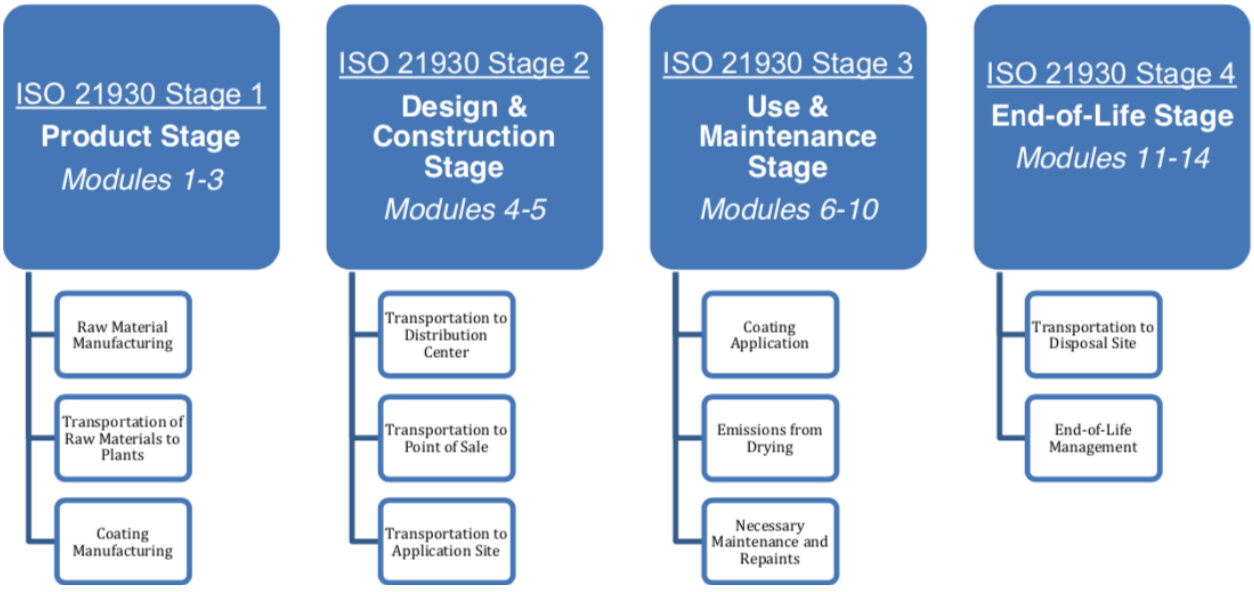


Figure 1: Life stages for the cradle-to-grave LCA

Cut-off Criteria

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

Data Quality

The overall data quality level was determined to be good. Primary data was collected from Sto's facilities in Atlanta, GA, Glendale, AZ and Rutland, VT for the 2018 reference year. When primary data did not exist, secondary data were obtained from the Gabi V8.7 Database Service Pack 39. Overall, both primary and secondary data are considered good quality in terms of geographic, temporal and technological coverage.

Estimates and Assumption

Assumptions were made to represent the cradle-to-grave environmental performance of Sto's products. These assumptions were made in accordance with the PCR and include the transportation distances, the disposal of packaging material and the product at its end of life and use phase assumptions.

Allocation

General principles of allocation were based on ISO 14040/44. Where possible, allocation was avoided. When allocation was necessary it was done on a physical mass basis.

Product Stage

Sto Gold Coat is produced at Sto's Atlanta, GA, Glendale, AZ and Rutland, VT facilities. This stage includes an aggregation of raw material extraction, supplier processing, delivery, manufacturing and packaging by Sto. Sto Gold Coat is supplied in 5-gallon pails.

Design and Construction Stage

The design and construction process stage starts with the packaged product leaving the production site and ends with being delivered to the application site.

During this stage, the finished product is moved from a shipping dock for distribution. The end gate is the application site after the purchaser acquires the finished product and transports it to the application site.

Use and Maintenance Stage

The use stage begins when the user prepares the product before applying it to a substrate and ends with any leftover coating and discarded packaging entering the end-of-life stage. Detailed application instructions are provided online. The application procedure includes mixing and applying. As recommended, an electric drill/mixer and a spray pump are assumed to be used for mixing and application. The equipment is not included in the study as these are multi-use tools and the impacts per declared unit is considered negligible, but electricity to power application tools has been included.

As prescribed in the PCR, 10% of the wet mass of Sto Gold Coat is assumed to be unused and properly disposed of.

End-of-Life Stage

Table 4: End-of-life Disposal Scenarios

Waste Flow	Recycling	Incineration	Landfilling
Paper Packaging	66.6%	6.01%	27.39%
Steel Packaging	33.3%	12.01%	54.69%
Plastic Packaging	9.1%	16.36%	74.54%
Unused Product	0%	0%	100%
Post-Consumer Product	0%	0%	100%

In this stage, the disposal of installation waste, packaging waste and product waste at its end of life is included. The disposal pathway of each waste stream is modeled based on the recommendation of PCR and US EPA's latest waste management fact sheet.

Life Cycle Assessment Results

As prescribed by the PCR, TRACI 2.1 impact characterization methodology and IPCC 5th assessment report are adopted to calculate the environment impacts. Table 5 provides the acronym key of the impact indicators declared in this EPD.

Table 5: LCIA impact category and LCI Indicator keys

Abbreviation	Parameter	Unit
	TRACI 2.1	
AP	Acidification potential of soil and water	kg SO_2 eq
EP	Eutrophication potential	kg N eq
GWP	Global warming potential including biogenic carbon emission	kg CO_2 eq
ODP	Depletion of stratospheric ozone layer	kg CFC 11 eq
POCP	Photochemical ozone creation potential	kg O_3 eq
	Resource Use Parameters	
RPR	Use of renewable primary energy	MJ, net calorific value (LHV)
RMR	Use of renewable Material Resources	kg
NRER	Depletion of Non-Renewable Energy Resources	MJ, net calorific value
NRMR	Depletion of Non-Renewable Material Resources	kg
FW	Consumption of Freshwater	m^3
	Waste Parameters	
HWD	Disposed-of-hazardous waste	kg
NHWD	Disposed-of non-hazardous waste	kg
	Biogenic Carbon Parameter	
BC	Biogenic Carbon	kg CO_2 eq
	Energy Differentiation Parameters	
HWP	Hydro/wind Power	MJ, net calorific value (LHV)
FE	Fossil Energy	MJ, net calorific value (LHV)
BE	Bio-energy	MJ, net calorific value (LHV)
NE	Nuclear Energy	MJ, net calorific value (LHV)
OE	Other Energy	MJ, net calorific value (LHV)

Sto Gold Coat® over Plywood

	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Market-based lifetime	AP [kg SO_2 eq]	2.88E-02	1.24E-03	2.39E-05	8.39E-04
	EP [kg N eq]	9.37E-04	1.01E-04	1.00E-06	1.48E-04
	GWP [kg CO_2 eq]	5.35E+00	2.42E-01	8.46E-03	1.79E-01
	ODP [kg CFC 11 eq]	-1.42E-13	2.30E-17	2.81E-17	4.44E-16
	POCP [kg O_3 eq]	2.04E-01	2.84E-02	3.14E-01	1.36E-02
	RPRE [MJ]	5.79E+00	1.06E-01	1.86E-02	1.29E-01
	NRPRE [MJ]	1.22E+02	3.43E+00	1.36E-01	1.96E+00
	FW [m3]	3.11E-02	4.09E-04	4.76E-05	2.61E-04
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	3.23E+00	0.00E+00	0.00E+00	0.00E+00
	HWD [kg]	1.12E-07	2.78E-08	5.98E-11	8.47E-09
	NHWD [kg]	2.21E-01	1.29E-04	4.28E-05	3.16E+00
	BC [kg CO_2 eq]	3.81E-01			
	HWP [MJ]	1.98E-01			
	FE [MJ]	3.00E+00			
	BE [MJ]	9.76E-02			
	NE [MJ]	7.85E-01			
	OE [MJ]	7.88E-02			

Sto Gold Coat® over CMU

	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Market-based lifetime	AP [kg SO_2 eq]	8.29E-02	3.58E-03	6.86E-05	2.41E-03
	EP [kg N eq]	2.69E-03	2.92E-04	2.89E-06	4.26E-04
	GWP [kg CO_2 eq]	1.54E+01	6.96E-01	2.43E-02	5.16E-01
	ODP [kg CFC 11 eq]	-4.07E-13	6.61E-17	8.07E-17	1.28E-15
	POCP [kg O_3 eq]	5.87E-01	8.17E-02	9.04E-01	3.91E-02
	RPRE [MJ]	1.67E+01	3.05E-01	5.36E-02	3.70E-01
	NRPRE [MJ]	3.50E+02	9.87E+00	3.92E-01	5.63E+00
	FW [m3]	8.93E-02	1.18E-03	1.37E-04	7.52E-04
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	9.31E+00	0.00E+00	0.00E+00	0.00E+00
	HWD [kg]	3.22E-07	8.00E-08	1.72E-10	2.44E-08
	NHWD [kg]	6.36E-01	3.72E-04	1.23E-04	9.09E+00
	BC [kg CO_2 eq]	1.10E+00			
	HWP [MJ]	5.70E-01			
	FE [MJ]	8.63E+00			
	BE [MJ]	2.81E-01			
	NE [MJ]	2.26E+00			
	OE [MJ]	2.27E-01			

Interpretation

Overall, the Product Stage which includes raw material extraction delivery and product manufacturing are the highest contributors to all impact indicators except POCP where the contribution from application phase is more prominent because of VOC emission.

Reference

- Life Cycle Assessment, LCA report for Sto Corp. WAP Sustainability, September 2019
- PCR for Architectural Coatings: NAICS 325510. NSF International, 2017
- ISO14044:2006 Environmental Management–Life cycle assessment–Requirements and Guidelines.
- ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
- ISO 21930:2007 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.
- Advancing Sustainable Materials Management: 2015 Fact Sheet. US EPA. Available at https://www.epa.gov/sites/production/files/2018-07/documents/2015_smm_msw_factsheet_07242018_fnl_508_002.pdf
- Product Bulletin – Sto Gold Coat. Sto Corp. Available at https://www.stocorp.com/wp-content/content/Products_TechService/Air%20Moisture%20Barriers/Product%20Bulletins/PB_81636_Sto_Gold%20Coat_EN.pdf

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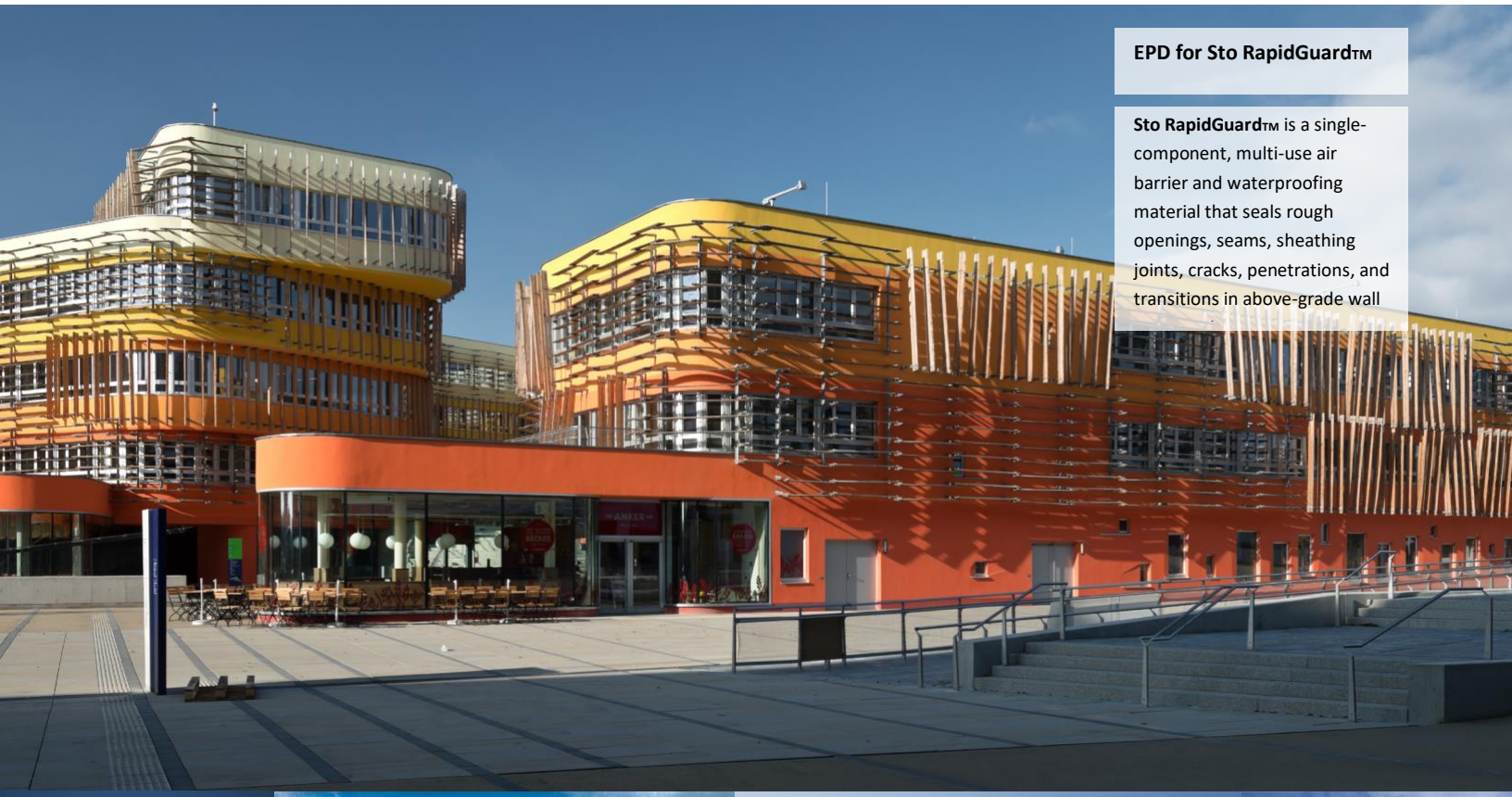
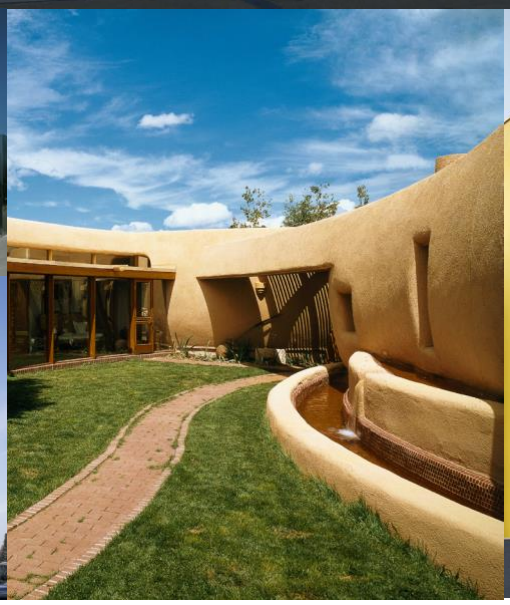


EPD for Sto RapidGuard™

Sto RapidGuard™ is a single-component, multi-use air barrier and waterproofing material that seals rough openings, seams, sheathing joints, cracks, penetrations, and transitions in above-grade wall



epstengroup Environmental Product Declaration

epstengroup Solutions for a Sustainable World

Manufacturer Name	Sto Corp. 3800 Camp Creek Parkway SW, Building 1400, Suite 120, Atlanta, GA 30331 www.stocorp.com | (800) 221-2397
EPD Program Operator	Epsten Group 101 Marietta St. Suite 2600, Atlanta, GA 30303 www.epstengroup.com
Compliance to ISO21930:2017	Yes
Product Name	Sto RapidGuard™
Product's Intended Application and Use	Air Barrier and Waterproofing Membrane
Declaration Number	01-006
Date of Certification	December 18th, 2019
Period of Validity	5 years from date of certification
Functional Unit	One square meter of covered substrate for 60 years
Reference Service Life used in assessment	10 Years
Overall Data Quality Assessment Score	Good
Manufacturing Location	Facility in Guelph, ON, Canada
LCA Software and Version Number	GaBi 9.2.0.58
LCI Database and Version Number	GaBi Database, Service Pack 39
ISO 21930: 2017 serves as the core PCR Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:2006 ☐ Internal ☒ External	Kate McFeaters kmcfeaters@epstengroup.com Kathrine McFeaters
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting, LLC
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Kate McFeaters kmcfeaters@epstengroup.com Kathrine McFeaters

Comparability

In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the building level per ISO 21930 guidelines. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-to-case basis.

Company

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That means ensuring that all building products are not only safe, effective and easy to install, but also environmentally responsible and sustainable. We know you're always looking for the smartest and newest technology to create energy efficient buildings with superior aesthetics.

That's exactly what our products help you achieve. Products like our wall systems, coatings and finishes are consistent favorites among design professionals, contractors and property owners alike. Whatever your needs or vision may be, we offer products for every type of building project; whether it's new construction, restoration or panelization, commercial or residential work.

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When you combine that commitment to product support and innovation with value-added offerings like consultative design and color services through Sto Studio or training in proper application techniques through the Sto Institute, you get an integrated exterior wall system solution unmatched in the industry.

Manufacturing Sites Covered in this EPD

Manufacturing location is Guelph, ON, Canada

Product Identification

RapidGuard™ is offered in two packaging options. Table 1 lists the products declared in this EPD.

Table 1: List of RapidGuard™ Products

Product Name	Product Number
Sto RapidGuard™ Cartridge	81571-740
Sto RapidGuard™ Sausage	81571-741

Product Description

Sto RapidGuard™ is a single-component, multi-use air barrier and waterproofing material that seals rough openings, seams, sheathing joints, cracks, penetrations, and transitions in above-grade wall construction.

Performance Features

Waterproof Material	No mesh/fabric/tapes needed at rough openings and sheathing joints	Cures in wet weather and on damp substrates
Vapor Permeable	Fast Cure	Gun Applied

Technical Details

Table 2： Technical Data

Performance*	Test Method	Test Criteria	Result
Water Penetration Resistance	AATCC-127 (waster column)	Resist 21.6" (55 cm) water for 5 hours	No water penetration
Tensile Strength	ASTM D412	n/a	250 psi (1724 kPa)
Elongation at Break	ASTM D412	n/a	400%
Durometer Hardness	ASTM D2240	Shore A	40-45 points
Adhesion (psi)	ASTM D4541	>50 psi (345 kPa) or substrate failure: OSB, Plywood, Concrete, CMU, Vinyl, Galvanized Steel, and Gypsum Sheathing	> 50 psi (345 kPa) > 20 psi (138 kPa) to gypsum sheathing (substrate failure)
Water Vapor Permeability (@DFT)	ASTM E96 (wet cup method)	n/a	6.18 perms @ 20 mils (353 ng/s•m^2•Pa) 5.37 perms @ 30 mils (307 ng/s•m^2•Pa)
Air Leakage Resistance	ASTM E2178	Less than 0.02 L/s/m^2	Pass
% Solids by Volume	n/a	n/a	98%
VOC Content	n/a	Compliant with EPA and South Coast AQMD requirements for Building Envelope Coatings	< 21 g/L
Building Code Compliance	Meets requirements of 2015 IBC, IRC, and IECC as an air barrier and joint treatment, ICC AC 212 and ASTM E 2570		

*Results are based on lab testing under controlled conditions. Results can vary between labs or from field tests.

Material Composition

The material composition of RapidGuard™ is listed below:

Table 3: Material composition of RapidGuard™

Ingredient	Mass %
Calcium Carbonate	45-55%
Plasticizers	25-30%
Silane Polymer	17-24%
Colorant	2-3%
Wax	1-2%
Silica	1-2%
Other Additives	<1%

Components related to Life Cycle Assessment

The functional unit for the LCA study was covering 1 square meter (m^2) of substrate for a period of 60 years—the assumed lifetime of a building. The reference flow required for the functional unit is calculated based on the product lifespan scenarios prescribed in ISO 21930:2017. The reference service life of the product is 10 years which is the warranty of Sto's wall system. The reference flow required for one functional unit is provided in Table 4.

Table 4: Reference flow and Functional Unit

Product	Functional Unit [1 m^2]	Reference Flow [kg]
RapidGuard™	1	7.68

Scope and Boundaries of the Life Cycle Assessment

The LCA was performed in accordance with ISO 14040 standards. The study is a cradle-to-grave LCA and includes the following life stages as prescribed in ISO 21930:2017.

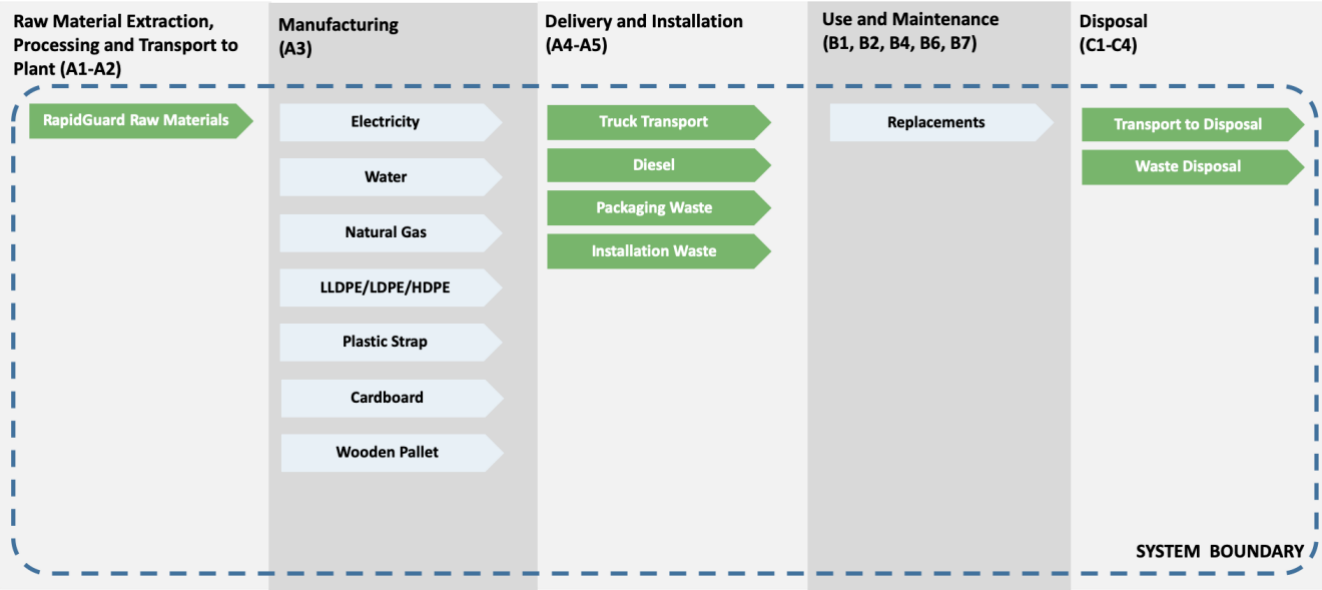


Figure 1: Life stages for the cradle-to-grave LCA

Cut-off Criteria

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

Data Quality

The overall data quality level was determined to be good. Primary data was collected from the manufacturing facility in Guelph, ON in Canada for the 2018 reference year. When primary data did not exist, secondary data were obtained from the Gabi V9.2.0.58 Database Service Pack 39. Overall, both primary and secondary data are considered good quality in terms of geographic, temporal and technological coverage.

Estimates and Assumption

Assumptions were made to represent the cradle-to-grave environmental performance of Sto's products. These assumptions include the transportation distances, the disposal of packaging material and the product at its end of life and use phase assumptions.

Allocation

General principles of allocation were based on ISO 14040/44. Where possible, allocation was avoided. When allocation was necessary it was done on a physical mass basis. To derive a per unit value for manufacturing inputs such as electricity, water, heating oil and natural gas, a series of allocation calculations were adopted. The facility level of utility data was allocated based on production values of different types of products in the same manufacturing facility. Then the data is further allocated among products of different packaging specifications based on the mass because it is believed the energy consumption and water consumption correlated better on a mass basis.

Production Stage (A1-A3)

RapidGuard™ is manufactured in Guelph, ON in Canada. This stage includes an aggregation of raw material extraction, supplier processing, delivery, manufacturing and packaging by the manufacturer. The raw materials used in the production manufacturing are sourced from the USA, Europe and China. After proper homogenization, the product is filled in 29-oz. (0.86-L) cartridges and 20-oz. (0.6-L) sausages ,and then further packaged in cartons and shipped on wooden pallets from Canada to facilities in the US for distribution.

Transport to Construction Site (A4)

RapidGuard™ is assumed to be shipped from the manufacturing facility in Canada to distribution facilities in the US via truck. From the distribution facilities, the product is shipped to construction sites. Table 5 gives the transportation details including the distances and the truck dataset used in the model. Transport distances are calculated based on the locations of the manufacturing facility, the distribution facilities, and customers' zip codes retrieved from the sales records.

Table 5: Transport Details

Parameter	Details	Unit
Type of transport	Truck	-
Fuel type	Diesel	-
Liters of fuel	39.0625	l/100km
Vehicle type	Heavy duty diesel truck/ 45,000 lb payload	-
Transport distance from the manufacturing facility to distribution facilities	1724.17	km
Transport distance from the distribution facilities to construction sites	782.21	km

Installation (A5)

RapidGuard™ is a one-component product without the need for mixing. The product can be applied with a caulking gun and spread with a dry joint knife, trowel or spatula while material is still wet. Detailed installation instructions can be found at Sto's website.

The installation process is manual. Thus, no energy or no material input other than the product is required. The LCA study considered a 10% of product loss in the installation process. Together with the product loss, the waste derived from the packaging material coming with the product are disposed of properly. In addition, the VOC emission from the curing of applied RapidGuard™ was also taken into account.

Table 6: Installation (A5)

Parameter	Value	Unit
Product loss per functional unit	7.68E-01	kg/ESL
Waste materials at the construction site before waste processing, generated by product installation	2.21E+00	kg/ESL
Plastic material recycled	1.77E-01	kg/ESL
Plastic material landfilled	1.47E+00	kg/ESL
Plastic material incinerated	3.02E-01	kg/ESL
Cardboard recycled	1.19E-01	kg/ESL
Cardboard landfilled	4.79E-02	kg/ESL
Cardboard incinerated	1.16E-02	kg/ESL
GWP based in biogenic carbon content of cardboard packaging	6.30E-01	kg CO2e/ESL
Wood material recycled	1.40E-02	kg/ESL
Wood material landfilled	5.85E-02	kg/ESL
Wood material incinerated	1.36E-02	kg/ESL
GWP based in biogenic carbon content of wood packaging	1.55E-01	kg CO2e/ESL
Direct emissions to ambient air	9.43E-02	kg/ESL

» Use Stage (B1-B5 & B6-B7)

Since the product is applied under a wall surface, there are no use phase inputs required to maintain the performance of the product other than the replacement needed through the estimated service life (ESL) of a whole building. The ESL in the study is assumed to be 60 years which is a standard established and used in many PCRs of similar product categories such as architectural coating. The RSL of the product is determined by the warranty of the product, which is ten years. Therefore, after initial installation on a building with a 60-year service life, there will be five replacements needed. Besides the emissions to the air disclosed in the above table, there are no other emissions to air, soil or water, including those of any regulated substances.

Table 7: Replacement (B4)

Parameter	Value	Unit
Reference Service Life (RSL)	10	Years
Estimated Service Life (ESL)	60	Years
Replacement cycle	5	(ESL/RSL)-1
Declared product properties	As per Product Identification section	-
Design application parameters	As per technical details in Table 2	-
An assumed quality of work, when installed in accordance with the manufacturer's instructions	Industry Standard	-

» End-of-Life Stage (C1-C4)

In this stage, the product at its end of life is transported to the waste disposal facility and processed. Included in this stage are the following:

- Deconstruction – There are no impacts during this stage as the product is manually removed.
- Transportation to disposal – Estimated fuel requirements made based on weight of product and average distance to landfill.
- Waste processing for landfilling — This process is included in the landfilling process.
- Waste disposal — Due to the fact that all the products in study are installed as part of a wall system including the external coating/finish, and are not able to be dismantled based on their material type, it is reasonable to assume that the products at their end-of-life stage are landfilled.

Table 8: End-of-Life Parameters

	RapidGuard™	Unit
Collected with mixed construction waste	6.82	kg/ESL
Landfilling	100	%
Product for final deposition	6.82	kg/ESL

Life Cycle Assessment Results

As prescribed by ISO 21930:2017, TRACI 2.1 impact characterization methodology and IPCC 5th assessment report are adopted to calculate the environment impacts. Table 9 provides the acronym key of the impact indicators declared in this EPD.

Table 9: LCIA impact category and LCI Indicator keys

Abbreviation	Parameter	Unit
	TRACI 2.1	
AP	Acidification potential of soil and water	kg SO_2 eq
EP	Eutrophication potential	kg N eq
GWP	Global warming potential including biogenic carbon emission	kg CO_2 eq
ODP	Depletion of stratospheric ozone layer	kg CFC 11 eq
POCP	Photochemical ozone creation potential	kg O_3 eq
ADP-Fossil Fuel	Abiotic depletion potential for fossil resources (An indicator derived from CML 2001-Jan 2016)	MJ, net calorific value
	Resource Use Parameters	
RPR_E	Renewable primary energy as energy carrier	MJ, net calorific value
RPR_M	Renewable primary energy resources as material utilization	MJ, net calorific value
$NRPR_E$	Non-renewable primary energy as energy carrier	MJ, net calorific value
$NRPR_M$	Non-renewable primary energy as material utilization	MJ, net calorific value
SM	Use of secondary material	kg
RSF	Use of renewable secondary fuels	MJ, net calorific value
NRSF	Use of non-renewable secondary fuels	MJ, net calorific value
RE	Recovered energy	MJ, net calorific value
FW	Use of fresh water	m^3
	Waste Parameters	
HWD	Disposed-of-hazardous waste	kg
NHWD	Disposed-of non-hazardous waste	kg
HLRW	High-level radioactive waste disposed	kg
ILLRW	Intermediate and low-level radioactive waste disposed	kg
	Carbon Removal and Emission Parameter	
BCRP	Biogenic Carbon Removal from Product	kg CO_2 eq
BCEP	Biogenic Carbon Emission from Product	kg CO_2 eq
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2 eq
BCEK	Biogenic Carbon Emission from Packaging	kg CO_2 eq
BCEW	Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	kg CO_2 eq
CCE	Calcination Carbon Emissions	kg CO_2 eq
CCR	Carbonation Carbon Removals	kg CO_2 eq
CWNR	Carbon Emissions from Combustion of Waste from Non- Renewable Sources used in Production Processes	kg CO_2 eq

» Sto RapidGuard™ – Results

TRACI Results and ADP-Fossil Fuel

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
AP [kg SO_2 eq]	2.50E-02	1.45E-03	3.19E-04	0.00E+00	0.00E+00	0.00E+00	1.35E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.60E-06	0.00E+00	2.29E-04	MND
EP [kg N eq]	7.68E-04	1.20E-04	9.48E-05	0.00E+00	0.00E+00	0.00E+00	4.97E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.96E-07	0.00E+00	1.17E-05	MND
GWP [kg CO_2 eq]	4.49E+00	3.02E-01	1.64E-01	0.00E+00	0.00E+00	0.00E+00	2.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.72E-03	0.00E+00	4.99E-02	MND
ODP [kg CFC 11 eq]	3.13E-13	-1.62E-15	-1.19E-15	0.00E+00	0.00E+00	0.00E+00	1.54E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.47E-17	0.00E+00	-2.62E-15	MND
POCP [kg O_3 eq]	1.94E-01	3.31E-02	2.61E-03	0.00E+00	0.00E+00	0.00E+00	1.17E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-04	0.00E+00	4.59E-03	MND
ADP-fossil fuel [MJ]	8.28E+01	4.26E+00	3.13E-01	0.00E+00	0.00E+00	0.00E+00	4.41E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.85E-02	0.00E+00	7.77E-01	MND

Resource Use

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
RPR_E [MJ]	1.80E+01	1.33E-01	2.14E-02	0.00E+00	0.00E+00	0.00E+00	9.11E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-03	0.00E+00	6.08E-02	MND
RPR_M [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
$NRPR_E$ [MJ]	8.96E+01	4.29E+00	3.22E-01	0.00E+00	0.00E+00	0.00E+00	4.75E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.87E-02	0.00E+00	7.97E-01	MND
$NRPR_M$ [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
FW [m_3]	3.84E-02	5.14E-04	2.70E-04	0.00E+00	0.00E+00	0.00E+00	1.96E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.64E-06	0.00E+00	9.46E-05	MND

Waste

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD [kg]	1.85E-07	3.47E-08	1.11E-09	0.00E+00	0.00E+00	0.00E+00	1.12E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.14E-10	0.00E+00	2.79E-09	MND
NHWD [kg]	4.63E-01	1.62E-04	3.48E-01	0.00E+00	0.00E+00	0.00E+00	9.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.46E-06	0.00E+00	1.14E+00	MND
HLRW [kg]	3.62E-06	1.15E-08	4.38E-09	0.00E+00	0.00E+00	0.00E+00	1.82E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-10	0.00E+00	9.70E-09	MND
ILLRW [kg]	2.70E-03	9.49E-06	3.52E-06	0.00E+00	0.00E+00	0.00E+00	1.36E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.56E-08	0.00E+00	7.72E-06	MND

Carbon Removal and Emission

Indicator	RapidGuard™
BCRP [kg CO2 eq]	7.80E-01
BCEP [kg CO2 eq]	7.85E-01
BCRK [kg CO2 eq]	1.36E-01
BCEK [kg CO2 eq]	6.26E-02
BCEW [kg CO2 eq]	0.00E+00
CCE [kg CO2 eq]	0.00E+00
CCR [kg CO2 eq]	0.00E+00
CWNR [kg CO2 eq]	0.00E+00

» Interpretation

In one reference service life of the product, the production stage, which includes raw material extraction, transportation from suppliers and manufacturing, is the highest contributor to all impact indicators. The impact from the remaining stages is negligible. From the perspective of a whole building lifespan, the vast majority of the impacts are derived from the number of replacements needed. This is directly related to the impacts associated with the manufacture of new products that are used to replace the original. Improving the relatively short lifespan of the product is essential to reducing the overall impact of the product.

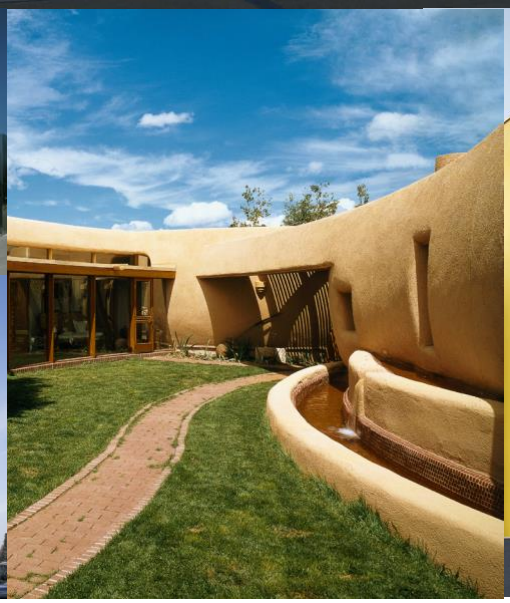
» Reference

- Life Cycle Assessment, LCA report for Sto Corp. WAP Sustainability, October 2019
- ISO14044:2006 Environmental Management–Life cycle assessment–Requirements and Guidelines.
- ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
- ISO 21930:2007 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.
- Sto Studio. Sto Corp, 2019. Available at https://www.stocorp.com/sto-studio-us/
- Installation Guide, Sto RapidGuard. Sto Corp. Available at https://www.stocorp.com/wp-content/content/Systems_TechService/Air%20and%20Moisture%20Barriers/Installation%20and%20Repair/IG_Sto%20RapidGuard%20Installation%20Guide(HiRes).pdf

Building with conscience.

EPD for StoGuard® Transition Membrane

StoGuard® Transition Membrane is a flexible air barrier membrane for use on vertical above grade wall construction over properly prepared concrete, concrete masonry (CMU), glass mat gypsum sheathing and Exterior or Exposure I wood-based sheathing.



epstengroup Environmental Product Declaration

epstengroup Solutions for a Sustainable World

Manufacturer Name	Sto Corp. 3800 Camp Creek Parkway SW, Building 1400, Suite 120, Atlanta, GA 30331 www.stocorp.com | (800) 221-2397
EPD Program Operator	Epsten Group 101 Marietta St. Suite 2600, Atlanta, GA 30303 www.epstengroup.com
Compliance to ISO21930:2017	Yes
Product Name	StoGuard® Transition Membrane
Product's Intended Application and Use	Flexible air barrier membrane
Declaration Number	01-007
Date of Certification	December 18th, 2019
Period of Validity	5 years from date of certification
Functional Unit	One square meter of covered substrate for 60 years
Reference Service Life used in assessment	10 Years
Overall Data Quality Assessment Score	Good
Manufacturing Location	Wörschach, Austria
LCA Software and Version Number	GaBi 9.2.0.58
LCI Database and Version Number	GaBi Database, Service Pack 39
ISO 21930: 2017 serves as the core PCR Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:2006 ☐ Internal ☒ External	Kate McFeaters kmcfeaters@epstengroup.com Kathonie McFeaters
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting, LLC
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Kate McFeaters kmcfeaters@epstengroup.com Kathonie McFeaters

Comparability

In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the building level per ISO 21930 guidelines. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-to-case basis.

Company

We believe in '**Building with conscience**'.

That means ensuring that all building products are not only safe, effective and easy to install, but also environmentally responsible and sustainable. We know you're always looking for the smartest and newest technology to create energy efficient buildings with superior aesthetics.

That's exactly what our products help you achieve. Products like our wall systems, coatings and finishes are consistent favorites among design professionals, contractors and property owners alike. Whatever your needs or vision may be, we offer products for every type of building project; whether it's new construction, restoration or panelization, commercial or residential work.

An architect or specifier focuses on aesthetics and feasibility, a contractor needs products that are easy to work with, and a building owner requires high value and low costs on properties. Sto understands these unique needs, and delivers the smart, innovative materials and solutions that make this all possible. That's why Sto remains the innovative leader in integrated exterior wall systems.

When you combine that commitment to product support and innovation with value-added offerings like consultative design and color services through Sto Studio or training in proper application techniques through the Sto Institute, you get an integrated exterior wall system solution unmatched in the industry.

Manufacturing Sites Covered in this EPD

Manufacturing location is Wörschach, Austria.

Product Identification

StoGuard® Transition Membrane is offered in five different width options. It is a flexible air barrier membrane for use on vertical above grade wall construction over properly prepared concrete, concrete masonry (CMU), glass mat gypsum sheathing and Exterior or Exposure I wood-based sheathing.Table 1 lists the products declared in this EPD.

Table 1: List of StoGuard® Transition Membrane Products

Product Name	Product #	Width
StoGuard® Transition Membrane	81272	120 mm (4.75")
	81342	152 mm (6")
	81343	228 mm (9")
	81344	304 mm (12")
	81349	457 mm (18")

Product Description

StoGuard® Transition Membrane is applicator-friendly and cost-saving:

- StoGuard® Transition Membrane can be easily applied without the use of special tools or applicator training.
- Thanks to the durability of StoGuard® Transition Membrane, it will not tear or lose effectiveness while in service.
- Because StoGuard® Transition Membrane is a fully adhered product, it will not peel or suffer loss of adhesion along edges.
- StoGuard® Transition Membrane will not stain surfaces due to adhesive leaching or streaking.
- StoGuard® Transition Membrane does not require the use of primers or terminations mastics for proper installation.
- Because StoGuard® Transition Membrane is a flexible material, it can be used in a wide range of applications for both static and dynamic joint conditions. One product solves multiple job site conditions.
- StoGuard® Transition Membrane is compatible with all StoGuard® vapor permeable or vapor impermeable membranes.

Performance Features

Waterproof	Flexible	Fully adhered membrane	No adhesive leaching	Compatible with other StoGuard® products
Fast and easy to install	Durable	UV-resistant	Versatile	Sustainability

Technical Details

Table 2: Technical Data

Performance	Test Method	Test Criteria	Result
Elongation*	ASTM D412	Measure	260%
Tensile Strength*	ASTM D412	Measure	60 psi (.41 MPa)
Tear and Adhesion Properties at 25% Elongation	ASTM C1523	No tearing or loss of adhesion after conditioning	Pass after dry, wet, frozen, and heat aged conditioning
Water Vapor Permeance	ASTM E96		1.48 perms (85 ng/Pa•s•m2)
Air Leakage**	ASTM E2178	≤ 0.02 L/m2•s @ 75 Pa (≤ 0.004 cfm/ft2 @ 1.57 psf)	Passed
Water Column	AATCC 127 (modified)	No leakage for 5 hours miimum	Passed
Adhesion	ASTM D4541	≥ 60 psi (414 kPa)	Passed on plywood, OSB, concrete, and CMU sbustrates. Exceeded strength of glass mat facing attachment when adhered to glass mat gypsum sheathing
Cyclic Elongation	Lab Method	500 cycles at 0% to 50% elongation and return	No loss of continuity of membrane or loss of bond at joint

*Elongation and Tensile strength measured in transverse direction (perpendicular to length of roll).

** Based on extrapolation of similar E2178 test data.

Material Composition

The material composition of StoGuard® Transition Membrane is listed below:

Table 3: Material composition of StoGuard® Transition Membrane

Ingredient	Mass %
Polyester	20-25%
Thermoplastic Elastomer	75-80%
Colorant	0.04%

Components related to Life Cycle Assessment

The functional unit for the EPD was covering 1 square meter (m^2) of substrate for a period of 60 years—the assumed lifetime of a building. The reference flow required for the functional unit is calculated based on the product lifespan scenarios prescribed in ISO 21930:2017. The reference service life of the product is 10 years which is the warranty of Sto's wall system. Because the impacts of the product applied on different substrates differ by more than 10%. The results will be reported separately for application on plywood and CMU, which is respectively the lower and upper band of the amount of installation material. The reference flow required for one functional unit is provided in Table 4.

Table 4: Reference flow and Functional Unit

Substrate	FUnctional Unit [1 m^2]	Product	Reference Flow of product [kg]	Installation Material	Reference Flow of installation material [kg]
Plywood	1	StoGuard® Transition Membrane	2.4	Sto Gold Coat	5.6
CMU					12.06

Scope and Boundaries of the Life Cycle Assessment

The LCA was performed in accordance with ISO 14040 standards. The study is a cradle-to-grave LCA and includes the following life stages as prescribed in ISO 21930:2017.

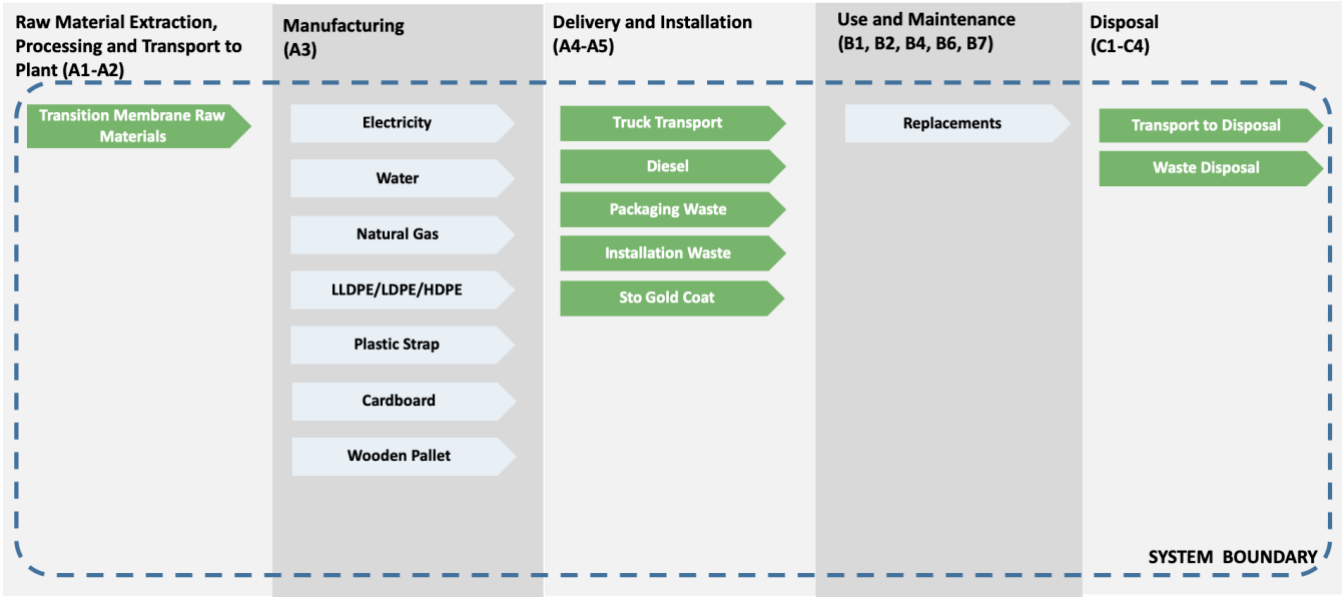


Figure 1: Life stages for the cradle-to-grave LCA

Cut-off Criteria

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

Data Quality

The overall data quality level was determined to be good. Primary data was collected from the manufacturing facility in Wörschach, Austria for the 2018 reference year. When primary data did not exist, secondary data were obtained from the Gabi V9.2.0.58 Database Service Pack 39. Overall, both primary and secondary data are considered acceptable quality in terms of geographic, temporal and technological coverage.

Estimates and Assumption

Assumptions were made to represent the cradle-to-grave environmental performance of Sto's products. These assumptions include up stream and downstream transportation distances, the disposal of packaging material, the method in which the product is disposed of at its end of life and relevant use phase assumptions.

Allocation

General principles of allocation were based on ISO 14040/44. Where possible, allocation was avoided. When allocation was necessary it was done on a physical mass basis. To derive a per unit value for manufacturing inputs such as electricity, water, and natural gas, a series of allocation calculations were adopted. The facility level of utility data was allocated based on production values of different types of products in the same manufacturing facility. Then the data is further allocated among products of different specifications based on the mass because it is believed the energy consumption and water consumption correlated better on a mass basis.

Production Stage (A1-A3)

StoGuard® Transition Membrane is manufactured in Wörschach, Austria. This stage includes an aggregation of raw material extraction, supplier processing, delivery, manufacturing and packaging by the manufacturer.

Transport to Construction Site (A4)

The product is assumed to be shipped from the manufacturing facility to distribution facilities in the US via truck and ocean freight transportation. From the distribution facilities, the product is shipped to construction sites by trucks. Table 5 gives the transportation details including the distances and the truck dataset used in the model. Transport distances are calculated based on the locations of the manufacturing facility, the distribution facilities, and customers' zip codes retrieved from the sales records.

Table 5: Transport Details

Parameter	Truck in US	Ocean Vessel	Truck in EU	Unit
Fuel type	Diesel	Heavy fuel oil	Diesel	-
Liters of fuel	39.0625	0.00023	33.1	l/100km
Vehicle type	Heavy duty diesel truck/ 50,000 lb payload	Container ship, 5,00 to 200, 000 dwt payload capacity, ocean going	Truck-trailer, Euro 0 - 6 mix, 34 - 40t gross weight / 27t payload capacity	-
Transport distance from the manufacturing facility to the departure port	n/a	n/a	441	km
Transport from EU to the USA	n/a	14127.62	n/a	km
Transport from arrival port to distribution facilities	446.59	n/a	n/a	km
Transport distance from the distribution facilities to construction sites	636.45	n/a	n/a	km

Installation (A5)

StoGuard® Transition Membrane is installed with any of the StoGuard® fluid-applied air barrier products: Sto Gold Coat, Sto Emerald Coat, Sto AirSeal or Sto VaporSeal. It also may be installed using Sto Extra Seal cementitious air barrier material. In this EPD, Sto Gold Coat is used as the complementary installation material due to the availability of its LCA data. Detailed application instructions are provided online.

The installation process is manual. Thus no energy or additional material other than the product and Sto Gold Coat is required. The use amount of Sto Gold Coat is calculated based on the coverages on two substrates: plywood and CMU, which give a lower and upper band of the coverage area. The LCA study considered a 10% of product loss as waste in the installation process. Together with the product loss, the waste was is also generated from the packaging material. In addition, VOC emissions from the curing of applied Sto Gold Coat was also taken into account.

Table 6: Installation (A5)

Parameter	Transition Membrane on Plywood	Transition Membrane on CMU	Unit
Product loss per functional unit	0.24		kg/ESL
Waste materials at the construction site before waste processing, generated by product installation	1.10E+00	2.07E+00	kg/ESL
Plastic material recycled	9.65E-02	1.82E-01	kg/ESL
Plastic material landfilled	7.99E-01	1.51E+00	kg/ESL
Plastic material incinerated	1.64E-01	3.10E-01	kg/ESL
Cardboard recycled	2.38E-03		kg/ESL
Cardboard landfilled	9.60E-04		kg/ESL
Cardboard incinerated	2.32E-04		kg/ESL
GWP based in biogenic carbon content of cardboard packaging	2.10E-4		kg CO_2e/ESL
Wood material recycled	2.64E-03		kg/ESL
Wood material landfilled	1.10E-02		kg/ESL
Wood material incinerated	2.56E-03		kg/ESL
GWP based in biogenic carbon content of wood packaging	2.92E-02		kg CO_2e/ESL
Steel material recycled	7.13E-03	1.54E-02	kg/ESL
Steel material landfilled	1.17E-02	2.53E-02	kg/ESL
Steel material incinerated	2.53E-03	5.44E-03	kg/ESL
Direct emissions to ambient air	2.04E-01	3.95E-01	kg/ESL

Use Stage (B1-B5 & B6-B7)

Since the product is applied under a wall surface, there are no use phase inputs required to maintain the performance of the product other than the replacement needed through the estimated service life (ESL) of a whole building. The ESL in the study is assumed to be 60 years which is a standard established and used in many PCRs of similar product categories such as architectural coating. The RSL of the product is determined by the warranty of the product, which is ten years. Therefore, after initial installation on a building with a 60-year service life, there will be five replacements needed. Besides the emissions to the air disclosed in the above table, there are no other emissions to air, soil or water, including those of any regulated substances.

Table 7: Replacement (B4)

Parameter	Value	Unit
Reference Service Life (RSL)	10	Years
Estimated Service Life (ESL)	60	Years
Replacement cycle	5	(ESL/RSL)-1
Declared product properties	As per Product Identification section	-
Design application parameters	As per technical details in Table 2	-
An assumed quality of work, when installed in accordance with the manufacturer's instructions	Industry Standard	-

End-of-Life Stage (C1-C4)

In this stage, the product at its end of life is transported to the waste disposal facility and processed. Included in this stage are the following:

- Deconstruction – There are no impacts during this stage as the product is manually removed.
- Transportation to disposal – Estimated fuel requirements made based on weight of product and average distance to landfill.
- Waste processing for landfilling — This process is included in the landfilling process.
- Waste disposal — Due to the fact that all the products in study are installed as part of a wall system including the external coating/finish, and are not able to be dismantled based on their material type, it is reasonable to assume that the products at their end-of-life stage are landfilled.

Table 8: End-of-Life Parameters

Parameter	Transition Membrane on Plywood	Transition Membrane on CMU	Unit
Collected with mixed construction waste	6.98	12.6	kg/ESL
Landfilling	100	100	%
Product for final deposition	6.98	12.6	kg/ESL

Life Cycle Assessment Results

As prescribed by ISO 21930:2017, TRACI 2.1 impact characterization methodology and IPCC 5th assessment report are adopted to calculate the environment impacts. Table 9 provides the acronym key of the impact indicators declared in this EPD.

Table 9: LCIA impact category and LCI Indicator keys

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	TRACI 2.1	
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EP	Eutrophication potential	kg N eq
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POCP	Photochemical ozone creation potential	kg O_3 eq
ADP-Fossil Fuel	Abiotic depletion potential for fossil resources (An indicator derived from CML 2001-Jan 2016)	MJ, net calorific value
	Resource Use Parameters	
RPR_E	Renewable primary energy as energy carrier	MJ, net calorific value
RPR_M	Renewable primary energy resources as material utilization	MJ, net calorific value
$NRPR_E$	Non-renewable primary energy as energy carrier	MJ, net calorific value
$NRPR_M$	Non-renewable primary energy as material utilization	MJ, net calorific value
SM	Use of secondary material	kg
RSF	Use of renewable secondary fuels	MJ, net calorific value
NRSF	Use of non-renewable secondary fuels	MJ, net calorific value
RE	Recovered energy	MJ, net calorific value
FW	Use of fresh water	m^3
	Waste Parameters	
HWD	Disposed-of-hazardous waste	kg
NHWD	Disposed-of non-hazardous waste	kg
HLRW	High-level radioactive waste disposed	kg
ILLRW	Intermediate and low-level radioactive waste disposed	kg
	Carbon Removal and Emission Parameter	
BCRP	Biogenic Carbon Removal from Product	kg CO_2 eq
BCEP	Biogenic Carbon Emission from Product	kg CO_2 eq
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2 eq
BCEK	Biogenic Carbon Emission from Packaging	kg CO_2 eq
BCEW	Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	kg CO_2 eq
CCE	Calcination Carbon Emissions	kg CO_2 eq
CCR	Carbonation Carbon Removals	kg CO_2 eq
CWNR	Carbon Emissions from Combustion of Waste from Non- Renewable Sources used in Production Processes	kg CO_2 eq

StoGuard® Transition Membrane on Plywood -- Results

TRACI Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
AP [kg SO_2 eq]	1.75E-03	1.69E-03	9.76E-03	0.00E+00	0.00E+00	0.00E+00	6.73E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.54E-06	0.00E+00	2.54E-04	MND
EP [kg N eq]	1.71E-04	6.90E-05	3.44E-04	0.00E+00	0.00E+00	0.00E+00	2.99E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.83E-07	0.00E+00	1.30E-05	MND
GWP [kg CO_2 eq]	1.17E+00	9.20E-02	1.96E+00	0.00E+00	0.00E+00	0.00E+00	1.64E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.02E-03	0.00E+00	5.53E-02	MND
ODP [kg CFC 11 eq]	-1.52E-13	-3.88E-16	1.74E-11	0.00E+00	0.00E+00	0.00E+00	8.62E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.63E-17	0.00E+00	-2.91E-15	MND
POCP [kg O_3 eq]	3.17E-02	3.38E-02	7.11E-02	0.00E+00	0.00E+00	0.00E+00	7.09E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.14E-04	0.00E+00	5.09E-03	MND
ADP-fossil fuel [MJ]	3.18E+01	1.20E+00	3.81E+01	0.00E+00	0.00E+00	0.00E+00	3.60E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.27E-02	0.00E+00	8.62E-01	MND

Resource Use

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
RPR_E [MJ]	3.00E+00	2.55E-02	1.74E+00	0.00E+00	0.00E+00	0.00E+00	2.41E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.33E-03	0.00E+00	6.74E-02	MND
RPR_M [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
$NRPR_E$ [MJ]	3.33E+01	1.21E+00	4.09E+01	0.00E+00	0.00E+00	0.00E+00	3.82E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.29E-02	0.00E+00	8.84E-01	MND
$NRPR_M$ [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
FW [m_3]	4.74E-03	7.57E-05	1.06E-02	0.00E+00	0.00E+00	0.00E+00	7.74E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.15E-06	0.00E+00	1.05E-04	MND

Waste

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD [kg]	2.54E-08	1.22E-08	3.95E-08	0.00E+00	0.00E+00	0.00E+00	4.03E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48E-10	0.00E+00	3.10E-09	MND
NHWD [kg]	1.18E-02	3.43E-05	2.61E-01	0.00E+00	0.00E+00	0.00E+00	7.68E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-06	0.00E+00	1.26E+00	MND
HLRW [kg]	7.91E-07	2.76E-09	1.30E-06	0.00E+00	0.00E+00	0.00E+00	1.05E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E-10	0.00E+00	1.08E-08	MND
ILLRW [kg]	5.92E-04	2.06E-06	1.08E-03	0.00E+00	0.00E+00	0.00E+00	8.43E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.50E-08	0.00E+00	8.56E-06	MND

StoGuard® Transition Membrane on CMU – Results

TRACI Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
AP [kg SO_2 eq]	1.75E-03	1.69E-03	1.89E-02	0.00E+00	0.00E+00	0.00E+00	1.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.59E-05	0.00E+00	4.24E-04	MND
EP [kg N eq]	1.71E-04	6.90E-05	6.56E-04	0.00E+00	0.00E+00	0.00E+00	4.60E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.47E-06	0.00E+00	2.16E-05	MND
GWP [kg CO_2 eq]	1.17E+00	9.20E-02	3.77E+00	0.00E+00	0.00E+00	0.00E+00	2.57E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.04E-03	0.00E+00	9.23E-02	MND
ODP [kg CFC 11 eq]	-1.52E-13	-3.88E-16	3.37E-11	0.00E+00	0.00E+00	0.00E+00	1.68E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.72E-17	0.00E+00	-4.85E-15	MND
POCP [kg O_3 eq]	3.17E-02	3.38E-02	1.37E-01	0.00E+00	0.00E+00	0.00E+00	1.06E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.57E-04	0.00E+00	8.49E-03	MND
ADP-fossil fuel [MJ]	3.18E+01	1.20E+00	7.38E+01	0.00E+00	0.00E+00	0.00E+00	5.42E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.12E-02	0.00E+00	1.44E+00	MND

Resource Use

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
RPR_E [MJ]	3.00E+00	2.55E-02	3.36E+00	0.00E+00	0.00E+00	0.00E+00	3.25E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.22E-03	0.00E+00	1.13E-01	MND
RPR_M [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
$NRPR_E$ [MJ]	3.33E+01	1.21E+00	7.91E+01	0.00E+00	0.00E+00	0.00E+00	5.76E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.16E-02	0.00E+00	1.48E+00	MND
$NRPR_M$ [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
FW [m_3]	4.74E-03	7.57E-05	2.04E-02	0.00E+00	0.00E+00	0.00E+00	1.27E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.59E-06	0.00E+00	1.75E-04	MND

Waste

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD [kg]	2.54E-08	1.22E-08	7.64E-08	0.00E+00	0.00E+00	0.00E+00	5.99E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.81E-10	0.00E+00	5.17E-09	MND
NHWD [kg]	1.18E-02	3.43E-05	4.65E-01	0.00E+00	0.00E+00	0.00E+00	1.29E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.70E-06	0.00E+00	2.11E+00	MND
HLRW [kg]	7.91E-07	2.76E-09	2.51E-06	0.00E+00	0.00E+00	0.00E+00	1.66E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-10	0.00E+00	1.80E-08	MND
ILLRW [kg]	5.92E-04	2.06E-06	2.10E-03	0.00E+00	0.00E+00	0.00E+00	1.35E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.59E-07	0.00E+00	1.43E-05	MND

Carbon removal and Emission

Indicator	Tranisition Membrane on plywood	Transition Membrane on CMU
BCRP [kg CO2 eq]	5.86E-02	6.10E-02
BCEP [kg CO2 eq]	5.95E-02	6.13E-02
BCRK [kg CO2 eq]	5.51E-03	5.96E-03
BCEK [kg CO2 eq]	2.05E-03	2.37E-03
BCEW [kg CO2 eq]	0.00E+00	0.00E+00
CCE [kg CO2 eq]	0.00E+00	0.00E+00
CCR [kg CO2 eq]	0.00E+00	0.00E+00
CWNR [kg CO2 eq]	0.00E+00	0.00E+00

Interpretation

In one reference service life of the product, the stage that contributes the most enviornmental impact is the installation stage. Unlike many products, the impact derived from the production of the declared product is exceeded by those from the installation of Sto Transition Membrane. This also explains the significant differences in impacts between substrate types. From the perspective of a whole building lifespan, the vast majority of the impacts are derived from the number of replacements needed. This is directly related to the impacts associated with the manufacture of new installation material and new products that are used to replace the original. Improving the relatively short lifespan of the products is essential to reducing the overall impact of the product.

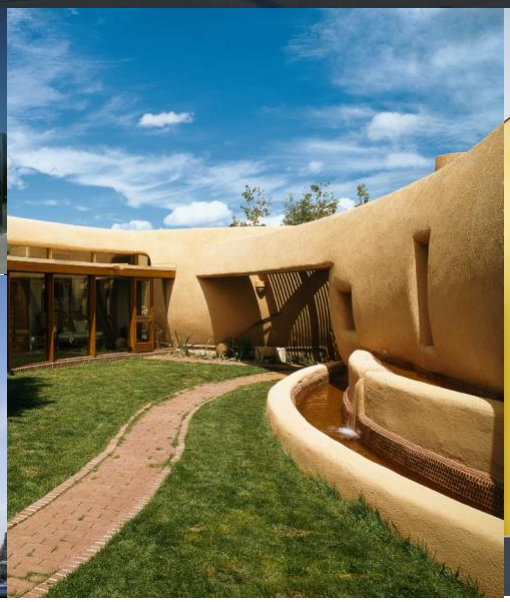
Reference

- Life Cycle Assessment, LCA report for Sto Corp. WAP Sustainability, October 2019
- ISO14044:2006Environmental Management–Life cycle assessment–Requirements and Guidelines.
- ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
- ISO 21930:2007 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.
- Sto Studio. Sto Corp, 2019. Available at https://www.stocorp.com/sto-studio-us/
- Product Bulletin – StoGuard Transition Membrane. Sto Corp. Available at https://www.stocorp.com/wp-content/content/Products_TechService/Air%20Moisture%20Barriers/Product%20Bulletins/PB_81272_StoGuard_Transition_Membrane_EN.pdf

Building with conscience.

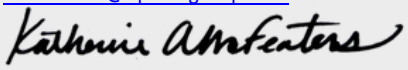
EPD for BTS® Plus

Sto BTS® Plus is a one-component, polymer-modified, cement based, dry powder material used as an adhesive and base coat in Sto Wall Claddings, including StoTherm ci Classic and StoTherm ci Lotusan Systems.



epstengroup Environmental Product Declaration

epstengroup Solutions for a Sustainable World

PCR Identification	PCR for Architectural Coatings: NAICS 325510 on the basis of ISO 21930:2007, NSF International, 2017. Valid through June 23, 2022
Compliance to ISO 14040/44, ISO 14025 and ISO 21930	Yes
Product Category	Exterior Coating
Manufacturer's name	Sto Corp. 3800 Camp Creek Parkway SW, Building 1400, Suite 120 Atlanta, GA 30331 www.stocorp.com | (800) 221-2397
EPD program operator	Epsten Group 101 Marietta St. Suite 2600, Atlanta, GA 30303 www.epstengroup.com
Declaration Number	01-004
Date of Certification	December 18th, 2019
Period of Validity	5 years from date of certification
Functional Unit	One square meter of covered and protected substrate for 60 years
Market-base life used in assessment	10 Years
Design life used in assessment	N/A
Test method employed for determination of design life	N/A
Amount of colorant needed	See table 3
Overall Data Quality Assessment Score	Good
Site(s) in which the results of the LCA are representative	STO manufacturing sites in Atlanta, Georgia; and Glendale, Arizona.
Information on where explanatory material can be obtained	See references at the end of this document.
LCA Software and Version Number	GaBi 9.2.0.58
LCI Database and Version Number	GaBi Database Version 8.7, Service Pack 39
This declaration was independently verified in accordance with ISO 14025: 2006 and the reference PCR: PCR for Architectural Coatings: NAICS 325510 ☐ Internal ☒ External	Kate McFeaters kmcfeaters@epstengroup.com 
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting, LLC
This life cycle assessment was independently verified in accordance with ISO 14040/44 and the reference PCR by:	Kate McFeaters kmcfeaters@epstengroup.com 

Comparability

In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the building level per ISO 21930 guidelines. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-to-case basis.

Company

We believe in '**Building with conscience**'.

That means ensuring that all building products are not only safe, effective and easy to install, but also environmentally responsible and sustainable. We know you're always looking for the smartest and newest technology to create energy efficient buildings with superior aesthetics.

That's exactly what our products help you achieve. Products like our wall systems, coatings and finishes are consistent favorites among design professionals, contractors and property owners alike. Whatever your needs or vision may be, we offer products for every type of building project; whether it's new construction, restoration or panelization, commercial or residential work.

An architect or specifier focuses on aesthetics and feasibility, a contractor needs products that are easy to work with, and a building owner requires high value and low costs on properties. Sto understands these unique needs, and delivers the smart, innovative materials and solutions that make this all possible. That's why Sto remains the innovative leader in integrated exterior wall systems.

When you combine that commitment to product support and innovation with value-added offerings like consultative design and color services through Sto Studio or training in proper application techniques through the Sto Institute, you get an integrated exterior wall system solution unmatched in the industry.

Manufacturing Sites Covered in this EPD

Atlanta Plant

Glendale Plant

Product Identification

Sto BTS® Plus is offered in 47-lb bags and used as an undercoater. Thus, there are no finish or color base options provided.

Table 1: BTS® Plus Identification

Product Name	Product Number	Base Type	Finish Type
Sto BTS® Plus	80130	n/a	n/a

Product Description

Sto BTS® Plus is a one-component, polymer-modified, cement based, dry powder material used as an adhesive, skim coat and base coat in Sto Wall Claddings, including StoTherm ci Classic and StoTherm ci Lotusan Systems. According to the classification scheme developed by American Coating Association (ACA), BTS® Plus is treated in the study as an undercoater and as per PCR, it should only utilize the market-based lifetime (10 years for exterior undercoater).

Performance Features

One-component	High Polymer/ Cement Ratio	Vapor Permeable	Pre-blended
Polymer Modified	Creamy Smooth Consistency	High Build	Low Cement Ratio

Material Composition

The material compositions of BTS® Plus are listed below:

Table 2: Material composition for BTS® Plus

Ingredient	BTS® Plus
Additives	0-1%
Cement	40-45%
Colorant	0-1%
Polymer	2-3%
Silica	54-55%
Silicate	0-1%

Components related to Life Cycle Assessment

The functional unit for the LCA study was covering and protecting 1 square meter (m2) of substrate for a period of 60 years—the assumed lifetime of a building. The reference flow required for the functional unit is calculated based on the product lifespan scenarios prescribed in the PCR. The market-based lifetime is 10 years. By default, BTS® Plus has a 5-year warranty. In case it is applied on Sto's wall systems, the warranty is extended to 10 years. The reference flow required for one functional unit is provided in Table 3.

Table 3: Market-based lifetime and reference flow

	Functional Unit [1 m^2]	Reference Flow [kg]	Tint needed* [kg]
Lifespan		Market-based Lifetime [10 years]	
BTS® Plus – Adhesive over Rough Masonry	1	40.39	N/A
BTS® Plus – Average		14.12	N/A

Scope and Boundaries of the Life Cycle Assessment

The LCA was performed in accordance with ISO 14040 standards. The study is a cradle-to-grave LCA and includes the following life stages as prescribed in the PCR.

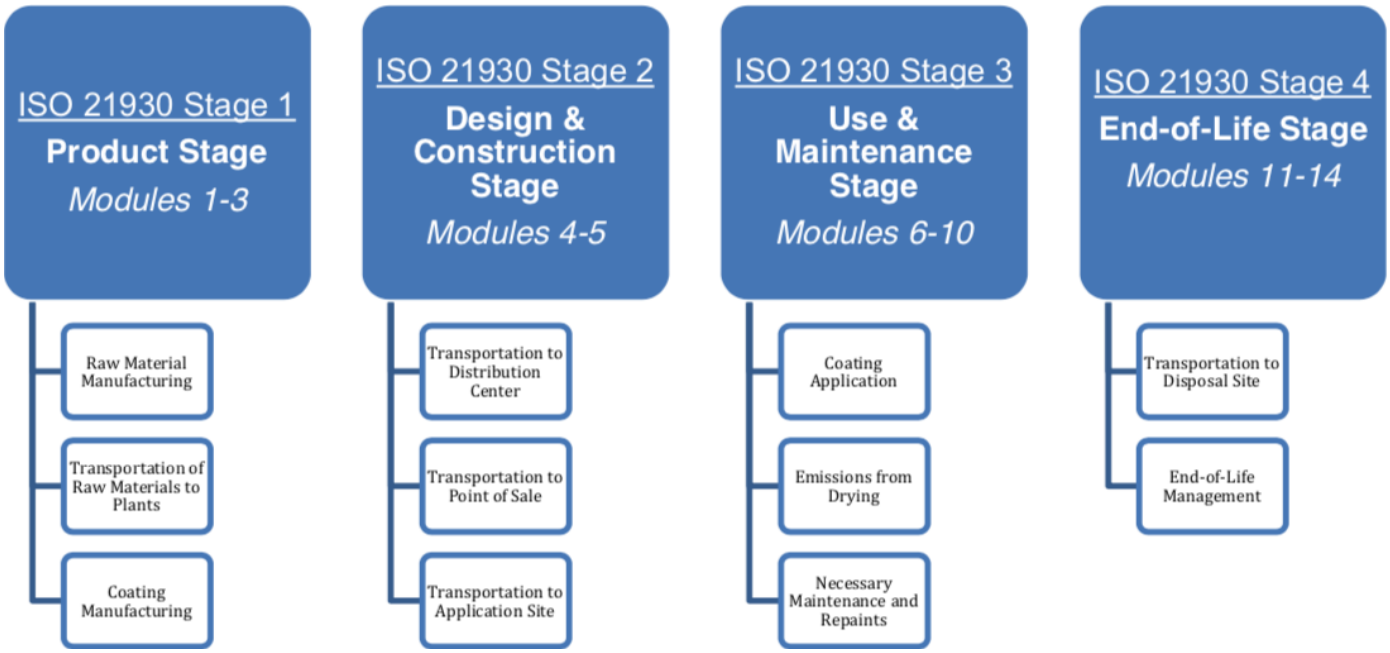


Figure 1: Life stages for the cradle-to-grave LCA

Cut-off Criteria

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

Data Quality

The overall data quality level was determined to be good. Primary data was collected from Sto's facilities in Atlanta, GA, and Glendale, AZ for the 2018 reference year. When primary data did not exist, secondary data were obtained from the Gabi V8.7 Database Service Pack 39. Overall, both primary and secondary data are considered good quality in terms of geographic, temporal and technological coverage.

Estimates and Assumption

Assumptions were made to represent the cradle-to-grave environmental performance of Sto's products. These assumptions were made in accordance with the PCR and include the transportation distances, the disposal of packaging material and the product at its end of life and use phase assumptions.

Allocation

General principles of allocation were based on ISO 14040/44. Where possible, allocation was avoided. When allocation was necessary it was done on a physical mass basis.

Product Stage

BTS® Plus is a dry-powder product. It is manufactured in both the Atlanta, GA and Glendale, AZ facilities. The facility in Atlanta also supplies BTS® concentrate to Glendale facility, based on which BTS® Plus is produced. BTS® Plus is packaged in a paper bag at 47 pounds (21.3 kgs) per bag. This stage includes an aggregation of raw material extraction, supplier processing, delivery, manufacturing and packaging by Sto.

Design and Construction Stage

The design and construction process stage starts with the packaged product leaving the production site and ends with being delivered to the application site.

During this stage, the finished product is moved from a shipping dock for distribution. The end gate is the application site after the purchaser acquires the finished product and transports it to the application site.

Use and Maintenance Stage

The use stage begins when the user prepares the product before applying it to a substrate and ends with any leftover coating and discarded packaging entering the end-of-life stage. Detailed application instructions are provided online. The application procedure includes mixing and applying. In the mixing process, BTS® Plus requires the addition of water at an average rate of 5.45 kg of water per 21.3-kg bag. As recommended, an electric drill/mixer and a spray pump are assumed to be used for mixing and application. The equipment is not included in the study as these are multi-use tools and the impacts per declared unit is considered negligible, but electricity to power application tools has been included.

As prescribed in the PCR, 10% of the wet mass of BTS® Plus is assumed to be unused and properly disposed of.

End-of-Life Stage

Table 4: End-of_life Disposal Scenarios

Waste Flow	Recycling	Incineration	Landfilling
Paper Packaging	66.6%	6.01%	27.39%
Unused Product	0%	0%	100%
Post-Consumer Product	0%	0%	100%

In this stage, the disposal of installation waste, packaging waste and product waste at its end of life is included. The disposal pathway of each waste stream is modeled based on the recommendation of PCR and US EPA's latest waste management fact sheet.

Life Cycle Assessment Results

As prescribed by the PCR, TRACI 2.1 impact characterization methodology and IPCC 5th assessment report are adopted to calculate the environment impacts. Table 5 provides the acronym key of the impact indicators declared in this EPD.

Table 5: LCIA impact category and LCI Indicator keys

Abbreviation	Parameter	Unit
	TRACI 2.1	
AP	Acidification potential of soil and water	kg SO_2 eq
EP	Eutrophication potential	kg N eq
GWP	Global warming potential including biogenic carbon emission	kg CO_2 eq
ODP	Depletion of stratospheric ozone layer	kg CFC 11 eq
POCP	Photochemical ozone creation potential	kg O_3 eq
	Resource Use Parameters	
RPR	Use of renewable primary energy	MJ, net calorific value (LHV)
RMR	Use of renewable Material Resources	kg
NRER	Depletion of Non-Renewable Energy Resources	MJ, net calorific value
NRMR	Depletion of Non-Renewable Material Resources	kg
FW	Consumption of Freshwater	m^3
	Waste Parameters	
HWD	Disposed-of-hazardous waste	kg
NHWD	Disposed-of non-hazardous waste	kg
	Biogenic Carbon Parameter	
BC	Biogenic Carbon	kg CO_2 eq
	Energy Differentiation Parameters	
HWP	Hydro/wind Power	MJ, net calorific value (LHV)
FE	Fossil Energy	MJ, net calorific value (LHV)
BE	Bio-energy	MJ, net calorific value (LHV)
NE	Nuclear Energy	MJ, net calorific value (LHV)
OE	Other Energy	MJ, net calorific value (LHV)

BTS® Plus – Adhesive over Rough Masonry

	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Market-based lifetime	AP [kg SO_2 eq]	8.90E-02	1.56E-02	6.73E-04	1.07E-02
	EP [kg N eq]	9.00E-03	1.27E-03	3.03E-05	1.52E-03
	GWP [kg CO_2 eq]	3.86E+01	3.04E+00	2.42E-01	1.94E+00
	ODP [kg CFC 11 eq]	3.82E-12	2.89E-16	8.03E-16	6.57E-15
	POCP [kg O_3 eq]	1.61E+00	3.57E-01	5.67E-03	1.79E-01
	RPRE [MJ]	4.35E+01	1.33E+00	5.23E-01	2.22E+00
	NRPRE [MJ]	4.64E+02	4.30E+01	3.85E+00	2.99E+01
	FW [m3]	1.09E-01	5.13E-03	1.18E-02	3.47E-03
	RMR [kg]	2.05E-01	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	4.04E+01	0.00E+00	0.00E+00	0.00E+00
	HWD [kg]	7.01E-07	3.49E-07	1.73E-09	1.11E-07
	NHWD [kg]	4.33E+00	1.62E-03	3.30E-03	4.09E+01
	BC [kg CO_2 eq]	4.21E+00			
	HWP [MJ]	2.67E+00			
	FE [MJ]	3.97E+01			
	BE [MJ]	1.29E+00			
	NE [MJ]	1.04E+01			
	OE [MJ]	1.04E+00			

BTS® Plus – Average Substrate

	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Market-based lifetime	AP [kg SO_2 eq]	3.11E-02	5.46E-03	2.35E-04	3.73E-03
	EP [kg N eq]	3.15E-03	4.45E-04	1.06E-05	5.30E-04
	GWP [kg CO_2 eq]	1.35E+01	1.06E+00	8.44E-02	6.78E-01
	ODP [kg CFC 11 eq]	1.34E-12	1.01E-16	2.81E-16	2.30E-15
	POCP [kg O_3 eq]	5.62E-01	1.25E-01	1.98E-03	6.26E-02
	RPRE [MJ]	1.52E+01	4.66E-01	1.83E-01	7.74E-01
	NRPRE [MJ]	1.62E+02	1.51E+01	1.35E+00	1.04E+01
	FW [m3]	3.82E-02	1.79E-03	4.12E-03	1.21E-03
	RMR [kg]	7.16E-02	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	1.41E+01	0.00E+00	0.00E+00	0.00E+00
	HWD [kg]	2.45E-07	1.22E-07	6.07E-10	3.88E-08
	NHWD [kg]	1.51E+00	5.68E-04	1.15E-03	1.43E+01
	BC [kg CO_2 eq]	1.47E+00			
	HWP [MJ]	9.34E-01			
	FE [MJ]	1.39E+01			
	BE [MJ]	4.51E-01			
	NE [MJ]	3.64E+00			
	OE [MJ]	3.65E-01			

Interpretation

Overall, the Product Stage is the major contributor to many impact categories including GWP. This is understandable as cement is a major ingredient of BTS® Plus and it is an energy-intensive material.

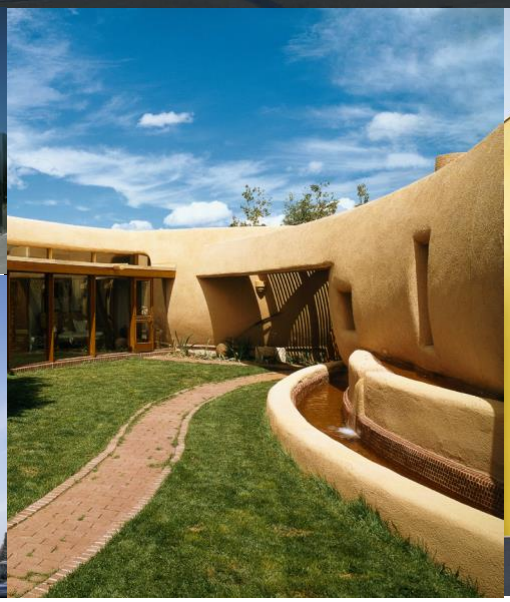
Reference

- Life Cycle Assessment, LCA report for Sto Corp. WAP Sustainability, September 2019
- PCR for Architectural Coatings: NAICS 325510. NSF International, 2017
- ISO14044:2006 Environmental Management–Life cycle assessment–Requirements and Guidelines.
- ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
- ISO 21930:2007 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.
- Advancing Sustainable Materials Management: 2015 Fact Sheet. US EPA. Available at https://www.epa.gov/sites/production/files/2018-07/documents/2015_smm_msw_factsheet_07242018_fnl_508_002.pdf
- Product Bulletin – Sto BTS® Plus. Sto Corp. Available at https://www.stocorp.com/wp-content/content/Products_TechService/Base%20Coats%20and%20Adhesives/Product%20Bulletins/PB_80727_Sto_BTS_Plus_EN.pdf

Building with conscience.

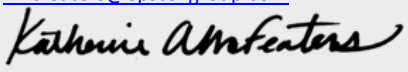
EPD for Sto TurboStick®

Sto TurboStick®
Sto TurboStick® is a ready-to-use, single component polyurethane foam adhesive for installing Sto insulation boards in StoTherm® exterior wall claddings.
Compared to cementitious adhesives, Sto TurboStick delivers unparalleled convenience and installation



epstengroup Environmental Product Declaration

epstengroup
Solutions for a Sustainable World

Manufacturer Name	Sto Corp. 3800 Camp Creek Parkway SW, Building 1400, Suite 120, Atlanta, GA 30331 www.stocorp.com | (800) 221-2397
EPD Program Operator	Epsten Group 101 Marietta St. Suite 2600, Atlanta, GA 30303 www.epstengroup.com
Compliance to ISO21930:2017	Yes
Product Name	Sto TurboStick®
Product's Intended Application and Use	Foam adhesive for securing insulation boards
Declaration Number	01-008
Date of Certification	December 18th, 2019
Period of Validity	5 years from date of certification
Functional Unit	One square meter of covered substrate for 60 years
Reference Service Life used in assessment	10 Years
Overall Data Quality Assessment Score	Good
Manufacturing Location	Wilmington, IL, USA
LCA Software and Version Number	GaBi 9.2.0.58
LCI Database and Version Number	GaBi Database, Service Pack 39
ISO 21930: 2017 serves as the core PCR Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:2006 ☐ Internal ☒ External	Kate McFeaters kmcfeaters@epstengroup.com 
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting, LLC
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Kate McFeaters kmcfeaters@epstengroup.com 

Comparability

In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the building level per ISO 21930 guidelines. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-to-case basis.

Company

We believe in '**Building with conscience**'.

That means ensuring that all building products are not only safe, effective and easy to install, but also environmentally responsible and sustainable. We know you're always looking for the smartest and newest technology to create energy efficient buildings with superior aesthetics.

That's exactly what our products help you achieve. Products like our wall systems, coatings and finishes are consistent favorites among design professionals, contractors and property owners alike. Whatever your needs or vision may be, we offer products for every type of building project; whether it's new construction, restoration or panelization, commercial or residential work.

An architect or specifier focuses on aesthetics and feasibility, a contractor needs products that are easy to work with, and a building owner requires high value and low costs on properties. Sto understands these unique needs, and delivers the smart, innovative materials and solutions that make this all possible. That's why Sto remains the innovative leader in integrated exterior wall systems.

When you combine that commitment to product support and innovation with value-added offerings like consultative design and color services through Sto Studio or training in proper application techniques through the Sto Institute, you get an integrated exterior wall system solution unmatched in the industry.

Manufacturing Sites Covered in this EPD

Manufacturing location is Wilmington, IL, USA.

Product Identification

Sto TurboStick® is offered in a 31-lb gross weight pressurized cylinder. Sto TurboStick® is a ready-to-use, single component polyurethane foam adhesive for securing Sto EPS Insulation Boards in StoTherm exterior wall claddings including StoTherm® ci XPS.

Table 1: List of TurboStick® Products

Product Name	Product Number
Sto TurboStick®	81181

Product Description

The leader in innovation, Sto offers an entirely new PU-foam adhesive system that outperforms traditional adhesives across the board. Sto TurboStick® requires no mixing, goes on easier, cures in just one hour, and can even be used for other applications, such as filling voids between insulation boards. It is also lightweight, so it requires no heavy lifting to get it up the scaffolding like cementitious adhesives.

- Ready-to-apply: Go straight to the wall as there is no mixing required compared to traditional cementitious adhesives;
- Cures in one hour: Rasp, cut joints and apply basecoat and mesh the same day instead of waiting until the following day;
- Small packaging: Easier to handle the material on scaffolding. Requires less space on the ground for staging compared to bag material; and
- Lightweight: The product weighs significantly less than a bag of basecoat. In addition, its compact size makes it easier to carry and handle, for example on scaffolding.

Performance Features

Convenient and Ready-to-Use	Pre-pressurized Container	Minimal preparation time
Compact and Lightweight High coverage rate	Fast	VOC Compliant

Technical Details

Table 2: Technical Data*

Performance	Test Method	Test Criteria	Result
Surface Burning	ASTM E-84-10 (UL 723, UBC 8-1, NFPA 255)	Flame Spread: ≤25 Smoke Developed: ≤450	Flame Spread: 10 Smoke Developed: 5
Tensile Strength	ASTM C-297	Greater than 15 psi	> 15 psi; cohesive failure of EPS insulation board
VOC (g/L)	This product contains no VOC's. Complies with US EPA (40 CFR 59) VOC emission standards for architectural coatings.		

*Results are based on lab testing under controlled conditions. Results can vary between labs or from field tests.

Material Composition

The material composition of TurboStick® is listed below:

Table 3: Material composition of TurboStick®

	TurboStick®
Polymethylenepolyphenl polyisocyanate, polypropyleneglycol copolymer	30-60%
1,1,1,2-Tetrafluoroethane	10-30%
Diphenylmethane Diisocyanate, isomers and homologues	10-30%
4,4'-Diphenylmethane diisocyanate	7-13%
N,N'-Dimorpholinodiethylether	1-5%

Components related to Life Cycle Assessment

The functional unit for the EPD was covering 1 square meter (m^2) of substrate for a period of 60 years—the assumed lifetime of a building. The reference flow required for the functional unit is calculated based on the product lifespan scenarios prescribed in ISO 21930:2017. The reference service life of the product is 10 years which is the warranty of Sto's wall system. The reference flow required for one functional unit is provided in Table 4.

Table 4: Reference flow and Functional Unit

Product	Functional Unit [1 m^2]	Reference Flow [kg]
TurboStick®	1	0.81

Scope and Boundaries of the Life Cycle Assessment

The LCA was performed in accordance with ISO 14040 standards. The study is a cradle-to-grave LCA and includes the following life stages as prescribed in ISO 21930:2017.

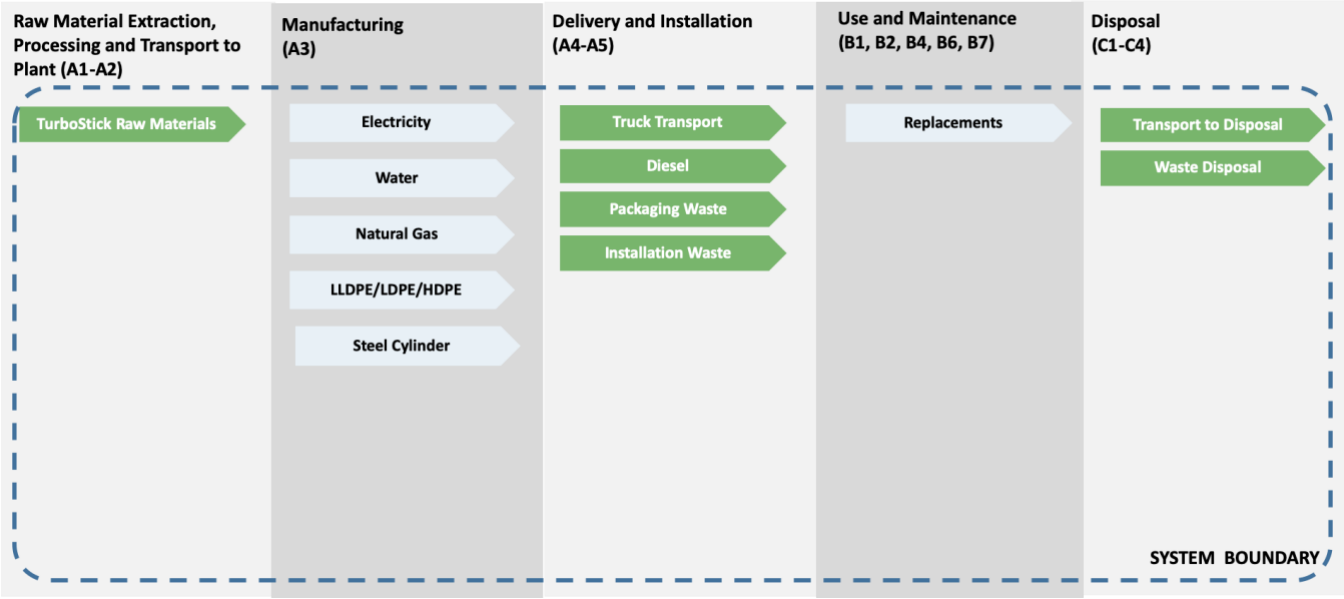


Figure 1: Life stages for the cradle-to-grave LCA

Cut-off Criteria

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

Data Quality

The overall data quality level was determined to be good. Primary data was collected from the manufacturing facility in Illinois, USA for the 2018 reference year. When primary data did not exist, secondary data were obtained from the Gabi V9.2.0.58 Database Service Pack 39. Overall, both primary and secondary data are considered acceptable quality in terms of geographic, temporal and technological coverage.

Estimates and Assumption

Assumptions were made to represent the cradle-to-grave environmental performance of Sto's products. These assumptions include up stream and downstream transportation distances, the disposal of packaging material, the method in which the product is disposed of at its end of life and relevant use phase assumptions.

Allocation

General principles of allocation were based on ISO 14040/44. Where possible, allocation was avoided. When allocation was necessary it was done on a physical mass basis. To derive a per unit value for manufacturing inputs such as electricity, water, and natural gas, a series of allocation calculations were adopted. The facility level of utility data was allocated based on production values of different types of products in the same manufacturing facility. Then the data is further allocated among products of different specifications based on the mass because it is believed the energy consumption and water consumption correlated better on a mass basis.

Production Stage (A1-A3)

TurboStick® is manufactured in Illinois, US. All the raw materials are supplied from the US. The product is a mixture of four types of substances: polyols, isocyanates, catalysts, and blowing agent, filled and shipped in a steel cylinder.

Transport to Construction Site (A4)

The product is assumed to be shipped from the manufacturing facility to distribution facilities in the US via truck. From the distribution facilities, the product is shipped to construction sites. Table 5 gives the transportation details including the distances and the truck dataset used in the model. Transport distances are calculated based on the locations of the manufacturing facility, the distribution facilities, and customers' zip codes retrieved from the sales records.

Table 5: Transport Details

Name	Details	Unit
Type of transport	Truck	-
Fuel type	Diesel	-
Liters of fuel	39.0625	l/100km
Vehicle type	Heavy duty diesel truck/ 45,000 lb payload	-
Transport distance from the manufacturing facility to distribution facilities	1437.95	km
Transport distance from the distribution facilities to construction sites	880.69	km

Installation (A5)

TurboStick® can be applied directly from the cylinder through a dispensing pistol without any additional steps. Hence, no specific installation materials are required. The reference flow is calculated on the basis of the coverage rates on TurboStick®'s product data sheets and a 10% installation waste was considered to account for the possibility of some unused amount left in the product containers. The disposal of the pressure cylinder is modeled to be landfilled as it is a standard practice to deal with pressure cylinder potentially containing unused adhesive polymer, while the installation waste disposal is modeled in accordance with EPA's Advancing Sustainable Materials Management: 2015 Fact Sheet. For TurboStick® which uses HFC-134a as the blowing agent, HFC-134a is modeled as the VOC emission flow. As the tools (dispensing pistol) used during the installation of the product are multi-use tools and can be reused after each installation, the per-functional unit impacts are considered negligible and therefore are not included. Detailed installation instructions are provided online. Packaging waste is generated and disposed of in this stage.

Table 6: Installation (A5)

Name	Value	Unit
Product loss per functional unit	8.09E-02	kg/ ESL
Waste materials at the construction site before waste processing, generated by product installation	0.362	kg/ ESL
Steel waste, packaging	0.281	kg/ ESL
VOC Emissions	0.154	Kg/ESL

Use Stage (B1-B5 & B6-B7)

Since the product is installed as part of the wall assembly, there are no use phase inputs required to maintain the product. The RSL of the product is 10 years, so five replacements are required to cover the estimated service life (ESL). The product requires no maintenance once installed. It is assumed that the product requires no repairs or refurbishments if it is properly applied. Besides the emissions to the air disclosed in the above table, there are no other emissions to air, soil or water, including those of any regulated substances.

Table 7: Replacement (B4)

Name	Value	Unit
Reference Service Life (RSL)	10	Years
Estimated Service Life (ESL)	60	Years
Replacement cycle	5	(ESL/RSL)-1
Declared product properties	As per Product Identification section	-
Design application parameters	As per technical details in Table 2	-
An assumed quality of work, when installed in accordance with the manufacturer's instructions	Industry Standard	-

End-of-Life Stage (C1-C4)

In this stage, the product is transported to the waste disposal facility and processed. Due to the fact that TurboStick® is applied as part of a wall system including the external coating/finish and are not able to be dismantled based on their material type, it is reasonable to assume that the products at their end-of-life stage are landfilled.

Table 8: End-of-Life Parameters

	TurboStick®	Unit
Collected with mixed construction waste	0.574	kg/ESL
Landfilling	100	%
Product for final deposition	0.574	kg/ESL

Life Cycle Assessment Results

As prescribed by ISO 21930:2017, TRACI 2.1 impact characterization methodology and IPCC 5th assessment report are adopted to calculate the environment impacts. Table 9 provides the acronym key of the impact indicators declared in this EPD.

Table 9: LCIA impact category and LCI Indicator keys

Abbreviation	Parameter	Unit
	TRACI 2.1	
AP	Acidification potential of soil and water	kg SO_2 eq
EP	Eutrophication potential	kg N eq
GWP	Global warming potential including biogenic carbon emission	kg CO_2 eq
ODP	Depletion of stratospheric ozone layer	kg CFC 11 eq
POCP	Photochemical ozone creation potential	kg O_3 eq
ADP-Fossil Fuel	Abiotic depletion potential for fossil resources (An indicator derived from CML 2001-Jan 2016)	MJ, net calorific value
	Resource Use Parameters	
RPR_E	Renewable primary energy as energy carrier	MJ, net calorific value
RPR_M	Renewable primary energy resources as material utilization	MJ, net calorific value
$NRPR_E$	Non-renewable primary energy as energy carrier	MJ, net calorific value
$NRPR_M$	Non-renewable primary energy as material utilization	MJ, net calorific value
SM	Use of secondary material	kg
RSF	Use of renewable secondary fuels	MJ, net calorific value
NRSF	Use of non-renewable secondary fuels	MJ, net calorific value
RE	Recovered energy	MJ, net calorific value
FW	Use of fresh water	m^3
	Waste Parameters	
HWD	Disposed-of-hazardous waste	kg
NHWD	Disposed-of non-hazardous waste	kg
HLRW	High-level radioactive waste disposed	kg
ILLRW	Intermediate and low-level radioactive waste disposed	kg
	Carbon Removal and Emission Parameter	
BCRP	Biogenic Carbon Removal from Product	kg CO_2 eq
BCEP	Biogenic Carbon Emission from Product	kg CO_2 eq
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2 eq
BCEK	Biogenic Carbon Emission from Packaging	kg CO_2 eq
BCEW	Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	kg CO_2 eq
CCE	Calcination Carbon Emissions	kg CO_2 eq
CCR	Carbonation Carbon Removals	kg CO_2 eq
CWNR	Carbon Emissions from Combustion of Waste from Non- Renewable Sources used in Production Processes	kg CO_2 eq

Sto TurboStick® -- Results

TRACI Results and ADP-Fossil

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
AP [kg SO_2 eq]	2.54E-03	1.60E-04	2.43E-05	0.00E+00	0.00E+00	0.00E+00	1.37E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.44E-07	0.00E+00	1.98E-05	MND
EP [kg N eq]	1.89E-04	1.32E-05	5.09E-06	0.00E+00	0.00E+00	0.00E+00	1.04E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.88E-08	0.00E+00	1.01E-06	MND
GWP [kg CO_2 eq]	1.23E+00	3.34E-02	3.30E+01	0.00E+00	0.00E+00	0.00E+00	1.71E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.35E-04	0.00E+00	4.31E-03	MND
ODP [kg CFC 11 eq]	1.30E-08	-1.80E-16	-1.58E-16	0.00E+00	0.00E+00	0.00E+00	6.48E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.27E-18	0.00E+00	-2.27E-16	MND
POCP [kg O_3 eq]	3.82E-02	3.66E-03	3.23E-04	0.00E+00	0.00E+00	0.00E+00	2.13E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.67E-05	0.00E+00	3.97E-04	MND
ADP-fossil fuel [MJ]	1.72E+01	4.71E-01	5.24E-02	0.00E+00	0.00E+00	0.00E+00	8.88E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.33E-03	0.00E+00	6.72E-02	MND

Resource Use

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
RPR_E [MJ]	5.53E-01	1.47E-02	3.60E-03	0.00E+00	0.00E+00	0.00E+00	2.88E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-04	0.00E+00	5.26E-03	MND
RPR_M [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
$NRPR_E$ [MJ]	1.80E+01	4.74E-01	5.36E-02	0.00E+00	0.00E+00	0.00E+00	9.28E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.35E-03	0.00E+00	6.89E-02	MND
$NRPR_M$ [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
FW [m_3]	4.94E-03	5.68E-05	1.54E-05	0.00E+00	0.00E+00	0.00E+00	2.51E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.01E-07	0.00E+00	8.18E-06	MND

Waste

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD [kg]	2.25E-07	3.84E-09	2.24E-10	0.00E+00	0.00E+00	0.00E+00	1.14E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.71E-11	0.00E+00	2.42E-10	MND
NHWD [kg]	5.21E-02	1.79E-05	6.09E-02	0.00E+00	0.00E+00	0.00E+00	1.06E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.26E-07	0.00E+00	9.86E-02	MND
HLRW [kg]	3.60E-07	1.27E-09	5.93E-10	0.00E+00	0.00E+00	0.00E+00	1.82E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.94E-12	0.00E+00	8.39E-10	MND
ILLRW [kg]	3.00E-04	1.05E-06	4.74E-07	0.00E+00	0.00E+00	0.00E+00	1.51E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.41E-09	0.00E+00	6.67E-07	MND

Carbon Removal and Emission

Indicator	TurboStick®
BCRP [kg CO2 eq]	1.16E-02
BCEP [kg CO2 eq]	1.70E-02
BCRK [kg CO2 eq]	1.38E-03
BCEK [kg CO2 eq]	1.41E-03
BCEW [kg CO2 eq]	0.00E+00
CCE [kg CO2 eq]	0.00E+00
CCR [kg CO2 eq]	0.00E+00
CWNR [kg CO2 eq]	0.00E+00

Interpretation

In one reference service life of the product, the production stage, which includes the raw material extraction, transportation from suppliers and manufacturing, is the highest contributor to all impact indicators with the exception of GWP. The GWP impacts from the installation stage are dominant because of the remarkably high GWP intensity of the blowing agent. From the perspective of a whole building lifespan, the vast majority of the impacts are derived from the number of replacements needed. This is directly related to the impacts associated with the manufacture of new products that are used to replace the original. Improving the relatively short lifespan of the products is essential to reducing the overall impact of the product.

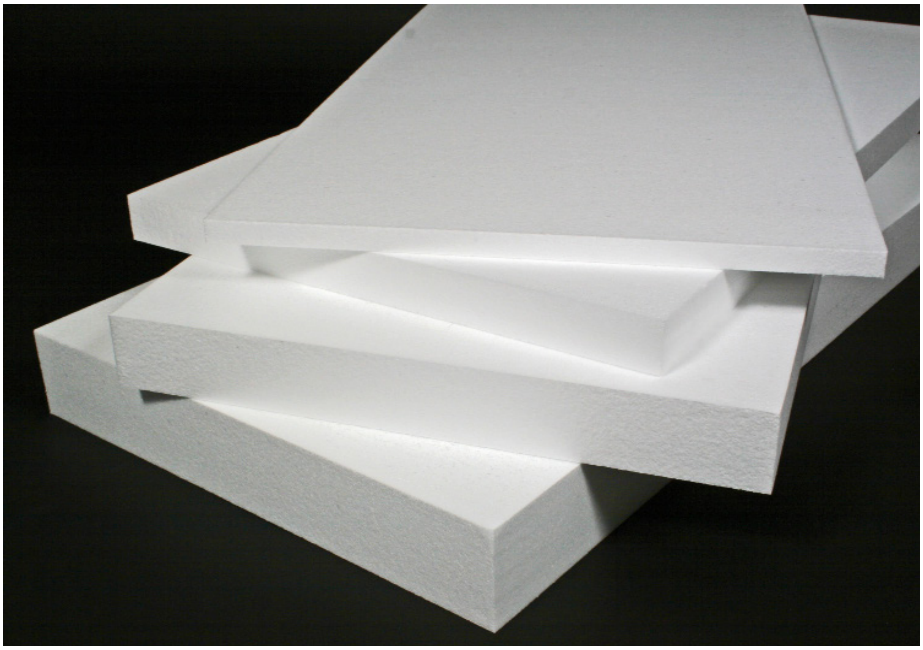
Reference

- Life Cycle Assessment, LCA report for Sto Corp. WAP Sustainability, October 2019
- ISO14044:2006 Environmental Management–Life cycle assessment–Requirements and Guidelines.
- ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
- ISO 21930:2007 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.
- Sto Studio. Sto Corp, 2019. Available at https://www.stocorp.com/sto-studio-us/
- Product Bulletin – Sto TurboStick. Sto Corp. Available at https://www.stocorp.com/wp-content/content/Products_TechService/Base%20Coats%20and%20Adhesives/Product%20Bulletins/PB_81181_Sto_Turbostick_EN.pdf

Environmental Product Declaration

Expanded Polystyrene Insulation

MOLDED, CLOSED-CELL FOAM PLASTIC INSULATION
LONG-TERM STABLE R-VALUE



Expanded polystyrene (EPS) is an innovative, high-performance building material engineered to deliver long-term, reliable energy efficiency. EPS insulation is an ideal choice for green building design, offering numerous environmental advantages, including reduced energy consumption, recycled content, localized distribution and improved indoor air quality.

This EPD complies with the Building Envelope Thermal Insulation Product Category Rule (PCR), version 1.4 by Underwriters Laboratory (UL).

EPS Industry Alliance

The EPS Industry Alliance (EPS-IA), which represents manufacturers and distributors of expanded polystyrene (EPS) products throughout North America, facilitates educational outreach on the technical, environmental and performance advancements of EPS.

The EPS industry is committed to sustainability through innovation. We demonstrate this dedication through lean manufacturing processes, a comprehensive recycling system and by harnessing new technologies to conserve raw materials and reduce waste. The EPS industry is continuously seeking to further market applications, reduce impacts and raise performance.

EPS-IA has invested significant time and resources in life-cycle analysis. This Environmental Product Declaration is part of our goal to provide life-cycle information on all EPS insulation applications.

www.epsindustry.org

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION ULE.COM/EPD

Environmental Product Declaration

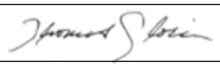
EPS Industry Alliance

EPS INSULATION

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	EPS Industry Alliance
DECLARATION NUMBER	4787238561.101.1
DECLARED PRODUCT	EPS Insulation
REFERENCE PCR	UL PCR: Building Envelope Thermal and Mechanical Insulation v1.4 2016
DATE OF ISSUE	8/10/2017
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 Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications

The PCR review was conducted by:	UL Environment
	Peer Review Panel
	epd@ul.com
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	
	Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	
	Thomas Gloria, Industrial Ecology Consultants

EPS Industry Alliance

EPS INSULATION

ACCORDING TO ISO 14025

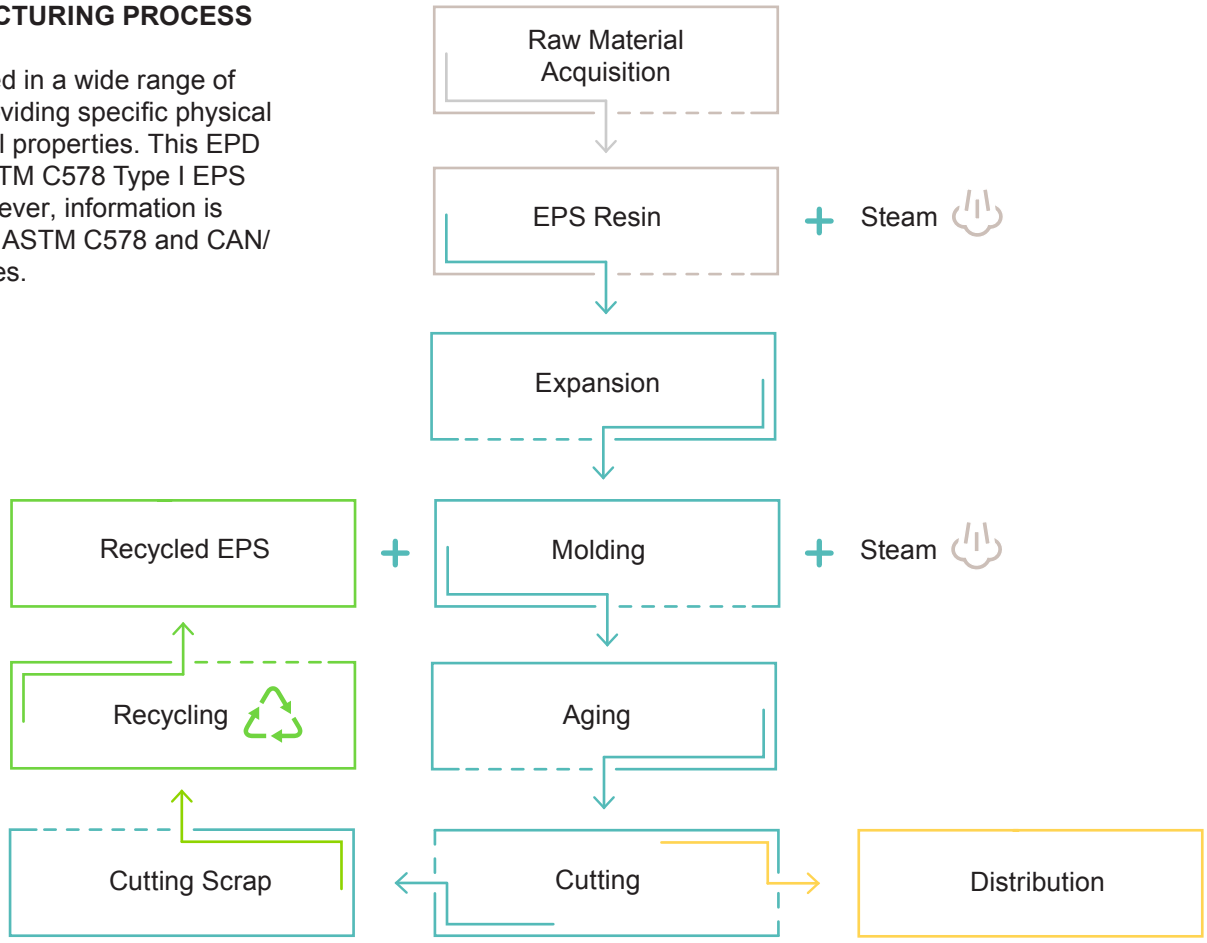
PRODUCT DESCRIPTION

Expanded polystyrene (EPS) insulation is a closed-cell foam plastic that is 98% air. EPS insulation is foam plastic and has never contained chlorofluorocarbon (CFCs), hydrofluorocarbons (HFCs) or hydrochlorofluorocarbon (HCFCs) blowing agents. EPS is easily recyclable and re-incorporated into the manufacturing process.

EPS is created in a two-stage process. First, EPS resin is loaded into an expander and exposed to steam, which causes it to expand. The expanded material is transferred into a block mold where, once again, steam is used to further expand and fuse the material into a solid, homogenous block. Recycled EPS is typically incorporated to produce a recycled content product. Following a short aging process, the EPS block is cut into sheets or various shapes to suit all insulation applications. Cutting scrap is recycled in-house and reused in the production cycle. The basic EPS product is white, although it can be colored.

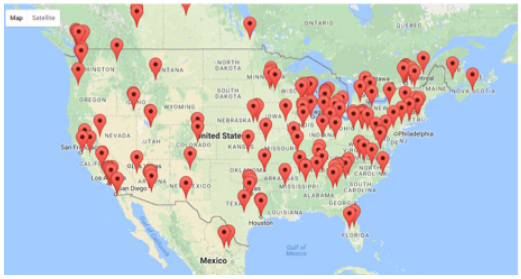
EPS MANUFACTURING PROCESS

EPS is produced in a wide range of types, each providing specific physical and mechanical properties. This EPD is based on ASTM C578 Type I EPS insulation. However, information is available for all ASTM C578 and CAN/ULC S701 Types.



MANUFACTURING LOCATIONS

Individual EPS manufacturers can be found across the U.S., Canada, and Mexio. With hundreds of North American locations, EPS can help meet other green building goals via localized manufacturing, which reduces the impacts of transportation.



You can find an EPS manufacturer on the EPS-IA website.

APPLICATIONS

Foundations

EPS insulation provides dependable, long-term performance for interior and exterior foundation applications. Its closed-cell structure results in minimal water absorption and moderate vapor permanence. Density, strength and thickness can be specified to meet compressive loading forces as well as thermal resistance requirements.

- Sub-Slab Insulation
- Exterior Perimeter Foundation Walls
- Interior Foundation Walls

Walls/Ceilings/Floors

Versatility, lasting value, and performance make EPS insulation ideal for a variety of wall, ceiling, and floor applications that substantially increase the thermal efficiency of the building structure.

- Walls & Ceilings
- Exterior Insulation Finish Systems (EIFS)
- Exterior Sheathing/Underlayment

Roofing

Roofing systems using EPS can meet the needs of the most demanding building requirements. EPS insulation is compatible with all commercial roofing systems, including but not limited to, built-up roofing and modified bitumen systems and single-ply membrane systems that are either ballasted, mechanically fastened or fully adhered.

- Flat, Tapered, Composite, & Flute Fill
- Built-Up & Modified Bitumen Membrane Systems
- Single-Ply Membrane Systems

TESTING & STANDARDS

EPS products have been the subject of extensive research and evaluation for more than 50 years.

ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

CAN/ULC-S701 Standard for Thermal Insulation, Polystyrene, Boards & Pipe Covering.

ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

CAN/ULC-S102.2 Standard Method of Test for Surface Burning Characteristics of Building Materials & Assemblies.

ASTM C1512 Standard Test Method for Characterizing the Effect of Exposure to Environmental Cycling on Thermal Performance of Insulation Products.

ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.

NFPA 285 Standard Fire Test Method for Evaluating Fire Propagation Characteristics of Exterior Non-Load Bearing Wall Assemblies Containing Combustible Components.

PERFORMANCE PROPERTIES

STABLE THERMAL RESISTANCE

The FTC R-value Rule recognizes the thermal performance of some insulation materials changes as they age (i.e., off-gassing) or settle, which affects the insulation's Long-Term Thermal Resistance (LTTR). However, the five-year and 50-year thermal resistance (RSI/R-values) for EPS insulation are the same as the initial RSI/R-values since the closed cell structure of EPS contains atmospheric air. The minimum RSI/R-value of EPS insulation provided for each product type may be used as a design value without any adjustment for age. Whether used as a stand-alone component or part of a highly engineered building system, EPS' insulating provides a permanent, lifetime R-value that delivers maximum energy efficiency.

The amount of insulation required will vary depending on the building design, climate, and energy costs, making it important to choose the most cost-effective R-value per inch (RSI per 25mm). The R-value of EPS insulation ranges from 3.1 to 4.3 per inch and the RSI ranges from 0.55 to 0.76 per 25mm.

Material Property	Units	ASTM C578 Types EPS Insulation Thermal Performance						
		XI	I	VIII	II	IX	XIV	XV
Thermal Resistance (R-value/RSI) @ 75°F/24°C	R-value per inch, minimum, ft²•hr•°F/BTU	3.1	3.6	3.8	4.0	4.2	4.2	4.3
	RSI per 25.4 mm, minimum, m²•°C/W	0.55	0.63	0.67	0.70	0.74	0.74	0.76

Material Property	Units	CAN/ULC-S701 Types EPS Insulation Thermal Performance		
		1	2	3
Thermal Resistance (RSI/R-value) @ 24°C/75°F	RSI per 25 mm, minimum, m²•°C/W	0.65	0.70	0.74
	R-value per inch, minimum, ft²•hr•°F/BTU	3.75	4.04	4.27

COMPRESSIVE RESISTANCE

Due to its high resiliency and compressive resistance, EPS is an excellent choice for the repetitive loading of roof insulation (walkability), sub-pavement flooring, road building, and as a general load-bearing insulation. With its flexible production process, the mechanical properties of EPS can be adjusted to suit every specified application.

Material Property	Units	ASTM C578 Types EPS Insulation Compressive Resistance						
		XI	I	VIII	II	IX	XIV	XV
Compressive Resistance	@ 10% Deformation minimum, psi	5	10	13	15	25	40	60
	@ 10% Deformation minimum, kPa	35	69	90	104	173	276	414

Material Property	Units	CAN/ULC-S701 Types EPS Insulation Compressive Resistance		
		1	2	3
Compressive Resistance	@ 10% Deformation minimum, kPa	70	110	140
	@ 10% Deformation minimum, psi	10	16	20

MOISTURE PROTECTION

EPS is hydrophobic and has a low equilibrium moisture content meaning it does not readily absorb moisture from the atmosphere – its closed-cell structure reduces the absorption and/or migration of moisture. EPS insulation is proven to retain its specified thermal and mechanical properties due to in-situ freeze-thaw cycling. When exposed to the extreme conditions of the ASTM C1512 test, EPS insulation exhibited drying potential under severe exposure conditions, which is critical for maintaining thermal resistance (RSI/R-value) under severe long-term exposure conditions.

INSTALLATION

Specifying the appropriate product for a building application and installing it properly have a critical impact on the long-term performance of a building assembly. There are various building codes and industry standards – both at national and regional levels – that establish best practices for product specification and installation. To provide high-performance, long-lasting buildings, it is imperative for building and design professionals to be well informed about all applicable building codes and product standards, as well as manufacturer recommendations Strict adherence to proper installation requirements ensures all insulation products serve as effective design solutions that complement one another and ensure greater comfort, safety and lower maintenance while leaving a smaller footprint on the environment.

END-OF-LIFE MANAGEMENT & RECYCLING

Recycling has always been an integral part of operations at EPS processing plants. Cutting scrap is recycled and incorporated into the production cycle to make new EPS insulation. Recycled EPS can also be processed into new products such as plastic lumber.

INDOOR AIR QUALITY

EPS insulation products have a low volatile nature and are interior friendly. EPS has never incorporated CFCs, HFCs and HCFCs in its production process. Intertek Testing has verified EPS insulation VOC emissions through the standard methods of California Specification 01350: *Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers*.

Many EPS manufacturers are certified for indoor air quality as low emitting products by UL GREENGUARD. You can view individual company UL GREENGUARD listings on SPOT.

LIFE-CYCLE ASSESSMENT RESULTS & ANALYSIS

PRODUCT SYSTEM BOUNDARIES

The Life -Cycle Assessment for EPS insulation quantifies energy and resource use, solid waste and environmental impacts for the following phases in the life cycle:

- Raw material acquisition (e.g., feedstocks for plastic resin), and intermediate steps to convert the feedstocks into EPS resin.
- Transportation of virgin EPS resin and recycled EPS to EPS insulation manufacturers.
- Manufacturing of EPS insulation.
- Packaging for incoming materials to the insulation manufacturer, as well as packaging for the shipment of EPS insulation.
- Transporting EPS insulation to customers or a distribution center.
- Installation and maintenance of the insulation are included in the study. Installing the insulation is performed manually and maintaining the product does not require additional energy or resources.
- End-of-life management of insulation and secondary packaging (including disposal, incineration, or recycling).

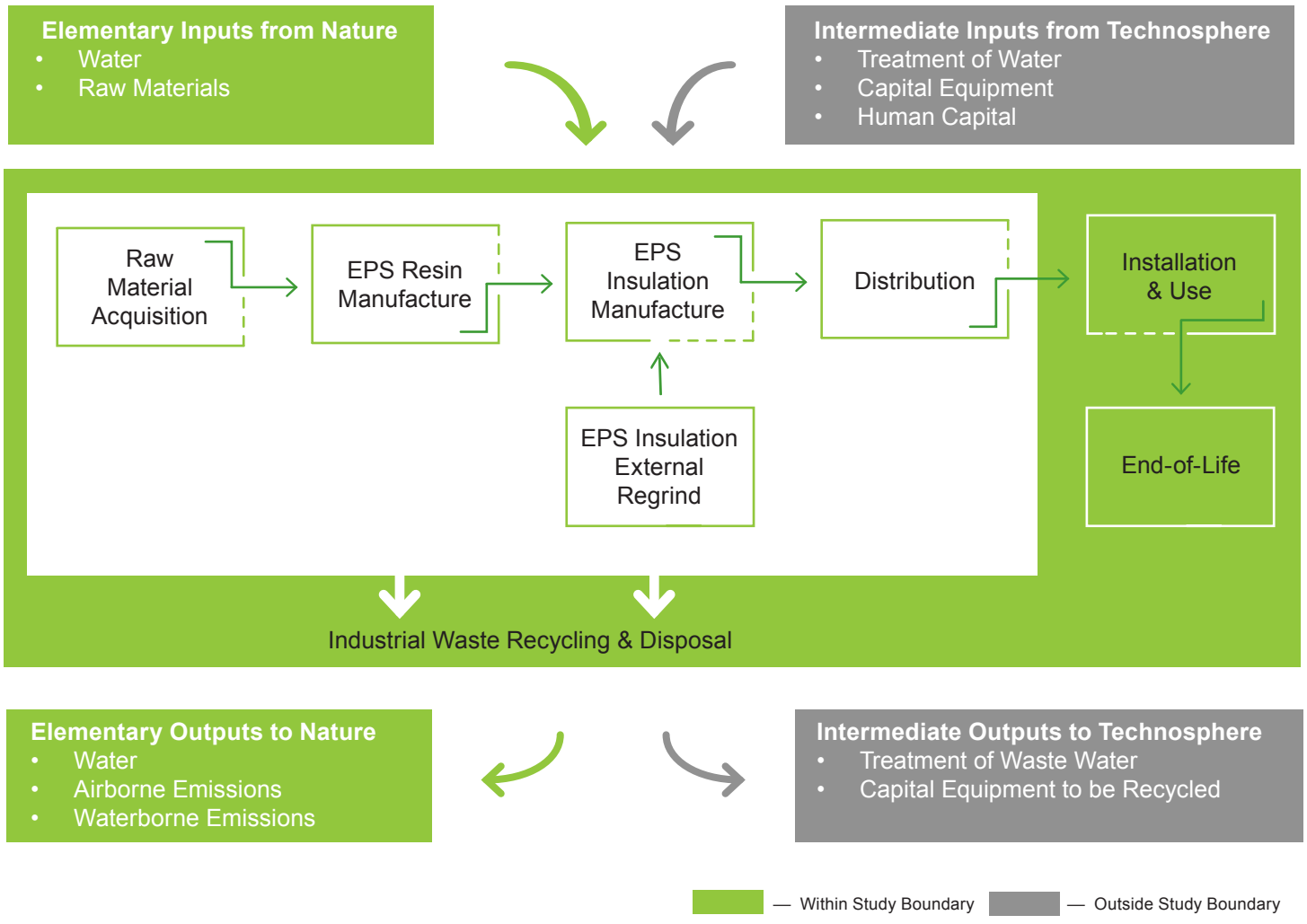
EPS Industry Alliance

EPS INSULATION

ACCORDING TO ISO 14025

The principal purpose of the LCA is to provide updated environmental impacts associated with EPS insulation from cradle to grave. The illustration below details EPS insulation production and subsequent life cycle stages.

EPS INSULATION SYSTEM BOUNDARIES



USE OF MATERIAL & ENERGY RESOURCES

Table 1 shows the primary energy demands per functional unit. Energy resource consumption is broken down by type and by resources. Figures 1 and 2 illustrate the results graphically.

	Basis: 1 m² with a thermal resistance RSI = 1 m²K/W and service life of 60 years
	Total Primary Energy
	MJ
NON-RENEWABLE RESOURCES	
Fossil Oil	26.50
Coal	3.80
Natural Gas	37.60
Uranium	1.72
RENEWABLE RESOURCES	
Hydropower	0.18
Landfill Gas	1.15
Wind	0.06
Biomass	0.33
Geothermal	0.01
Solar	0.01
TOTAL	**71.4**

Table 1: Primary Energy Demand for EPS Insulation

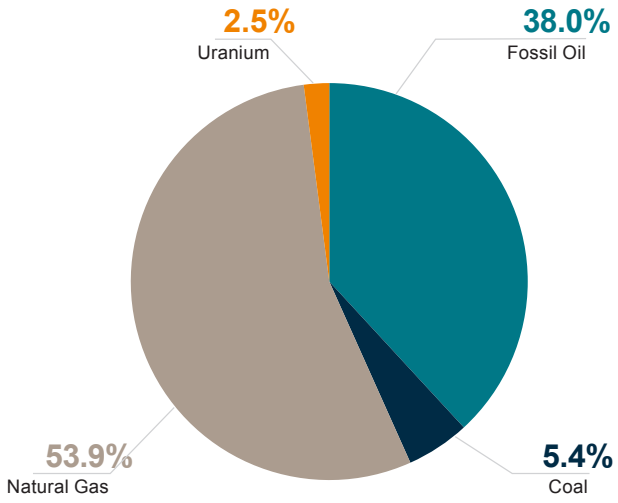


Figure 1: Non-Renewable Primary Energy Resources

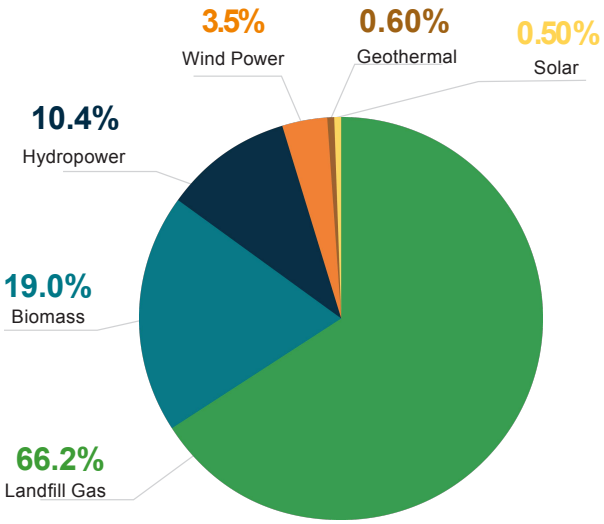


Figure 2: Renewable Primary Energy Resources

FUNCTIONAL UNIT

The functional unit used for this study is 1 m² (10.765 ft²) of insulation material with a thickness that gives an average thermal resistance RSI = 1 m²•K/W (R-value 5.68 ft²•hr•°F/BTU) and with a building service life of 60 years. The thickness of the ASTM C578 Type I EPS insulation required for the functional unit is 4.01 centimeters (1.58 in).

Note: The EPD data is derived from the LCA of EPS Insulation and Cradle-to-Gate LCA of EPS Resin reports by ERG/Franklin Associates. Percentages have been rounded and may not total to 100%.

GEOGRAPHIC ANALYSIS

The geographic scope of the analysis is insulation manufactured, used, and disposed of in North America. End-of-life management of insulation was modeled based on all insulation being taken to a construction and demolition (C&D) landfill. This included transport and landfill machinery. The insulation was modeled as inert within the landfill.

INVENTORY & IMPACT ASSESSMENT

The LCA study addresses global, regional, and local environmental impact categories. For most of the impact categories examined, the TRACI 2.1 methodology, developed by the United States Environmental Protection Agency (EPA) specific to U.S./Canadian conditions and updated in 2012, is employed.

For the category of acidification, units of TRACI 2.04 were used in accordance with the Product Category Rule. For the category of Global Warming Potential (GWP), contributing elementary flows are characterized using factors reported by the Intergovernmental Panel on Climate Change (IPCC) in 2013 with a 100 year time horizon.

DATA QUALITY ASSESSMENT

Primary data was collected from three EPS resin manufacturers in North America – one in Canada, one in the U.S., and one in Mexico. Data was provided by one plant for each manufacturer. A straight average of these three resin data sets was used for the average EPS resin data set.

Primary data was collected from a total of 29 insulation manufacturing plants (23 in the U.S. and six in Canada). The following companies provided data for this assessment: ACH Foam Technologies, Inc., Atlas EPS, Insulation Technology, Inc., Insulfoam, NOVA Chemicals Inc., Plasti-Fab Ltd., VersaTech, Inc., Styropek. All insulation data sets were weighted using production amounts provided by each plant.

The data quality goals were to use data that are (1) geographically representative for each insulation system based on the locations where material sourcing and resin manufacturing operations, insulation manufacturing, distribution, and end-of-life management take place, and (2) representative of current industry practices in these regions. EPS-IA provided current, geographically representative data for both the EPS resin and the EPS insulation system. Those data sets used in the models that were not collected for this analysis were drawn largely from reliable published databases (U.S. LCI Database) or from the ERG/Franklin Associates confidential database of primary North American unit process data. The data sets used were the most current and most geographically and technologically relevant data sets available during the data collection phase of the project.

METHODOLOGY

The LCA has been conducted following internationally accepted standards for LCA methodology as outlined in the ISO 14040 and 14044 standards, which provide guidance and requirements for conducting life cycle assessments. However, for some specific aspects of life cycle assessment, the ISO standards have some flexibility and allow for methodological choices to be made. These include the method used to allocate energy requirements and environmental releases among more than one useful product produced by a process, the methodology used to allocate environmental burdens for recycled content, and the methodology used for end of life management. The following sections describe the approach to each issue used in this study.

ENERGY DEMAND

Figure 3 shows total energy demand for the life cycle of the insulation system. The production of raw materials makes the largest contribution (81.8 percent) of the total energy demand for the EPS insulation. Insulation manufacturing also makes a significant contribution at 12 percent of the total. The manufacturing process for EPS insulation includes expansion of the resin, regrinding and converting scrap for reuse in the process, and, at some plants, combustion of captured blowing agent emissions. Transportation steps make up almost five percent of the total energy. A little more than two percent of that energy comes from distributing the insulation to the distribution centers and users. Packaging the resin and insulation requires very little energy. The insulation is installed manually, so no energy is required to complete that process. The use of the insulation also requires no energy. One percent of the total energy is required to dispose of the insulation, which includes transport to the C&D (construction and demolition) landfill, as well as for landfill equipment.

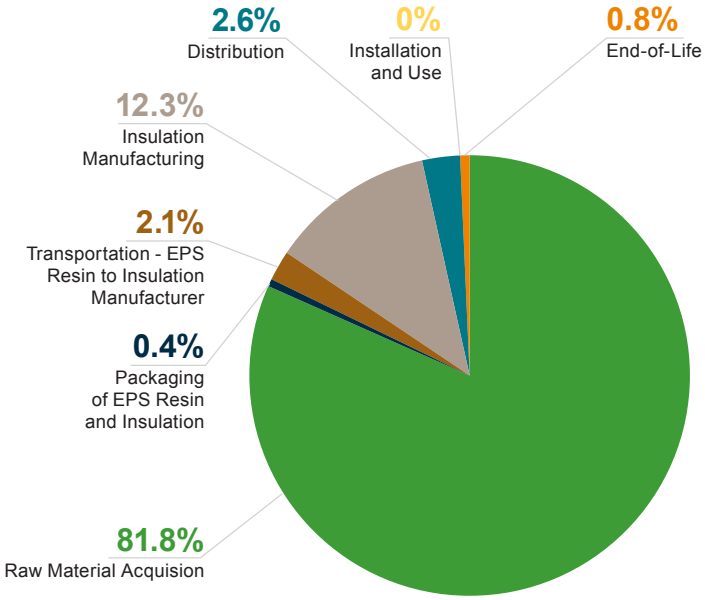


Figure 3: Total energy Demand for EPS Insulation

Table 2 displays the percent of total energy required as feedstock as well as the energy required for process and fuel-related energy. A little less than half (46 percent) of the total energy is used to create the plastic material used in the EPS insulation. If only the process and fuel-related energy is examined, two-thirds of the energy still comes from material acquisition and almost a quarter is used by the insulation production.

	Basis: 1 m^2 with a thermal resistance RSI=1 m^2K/W and service life of 60 years		
	Cumulative Energy	Non-Renewable Energy	Renewable Energy
	MJ	MJ	MJ
Raw Material Acquisition	58.4	57.1	1.32
Packaging of EPS Resin and Insulation	0.27	0.22	0.05
Transportation-Resin to Insulation	1.50	1.50	0.0023
Insulation Manufacturing	8.81	8.49	0.32
Distribution	1.85	1.85	0.0029
Installation and Use	0	0	0
End-of-Life	0.55	0.55	8.6E-04
TOTAL	**71.4**	**69.7**	**1.70**
	Percentage		
	Cumulative Energy	Non-Renewable Energy	Renewable Energy
	%	%	%
Raw Material Acquisition	81.8%	80.0%	1.9%
Packaging of EPS Resin and Insulation	0.4%	0.3%	0.1%
Transportation-Resin to Insulation	2.1%	2.1%	0.0%
Insulation Manufacturing	12.3%	11.9%	0.4%
Distribution	2.6%	2.6%	0.0%
Installation and Use	0.0%	0.0%	0.0%
End-of-Life	0.8%	0.8%	0.0%
TOTAL	**100%**	**98%**	**2%**

Table 2: Cumulative, Non-Renewable, and Renewable Energy Demand for EPS Insulation

GLOBAL WARMING POTENTIAL

Table 3 and Figure 4 show life cycle GWP results for the insulation systems. The raw material production of the insulation system accounts for the largest share of GWP (70 percent), followed by insulation manufacturing at 20 percent. The GWP emissions from the raw material stage are mainly associated with fossil fuel resources used as fuel and as feedstocks for the plastic resin and blowing agent. GWP from insulation manufacturing includes emissions from combustion of fuels used in the insulation manufacturing process, emissions from operation of a thermal oxidizer used to destroy blowing agent emissions at the manufacturing plant (including carbon dioxide from combustion of both the fuel and pentane burned in the thermal oxidizer), as well as emissions associated with production of the electricity used in the insulation manufacturing processes. More than 8 percent comes from combustion of the fuels used to transport the resin, as well as the transportation during distribution. End-of-life management of disposed EPS insulation contributes a little more than 1% of the total GWP for the insulation system; this is largely carbon dioxide emissions from the combustion of the fuels used to transport and distribute the insulation during landfilling.

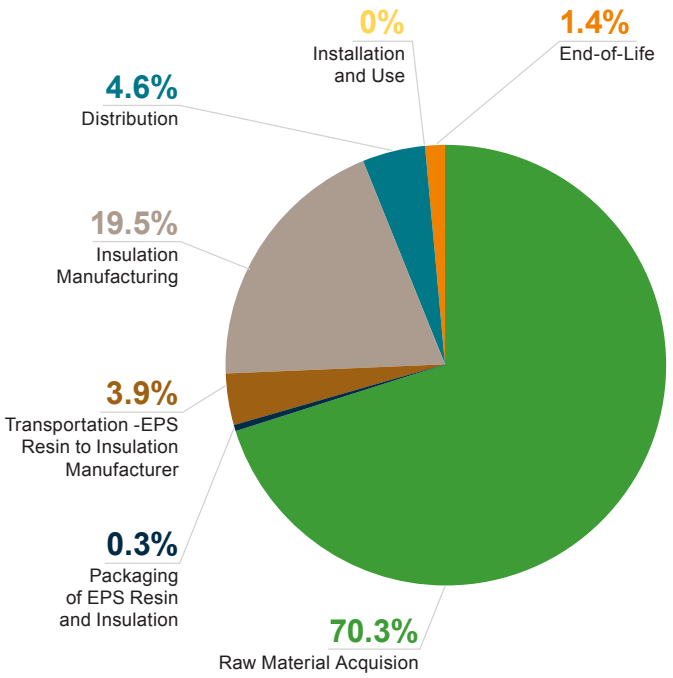


Figure 4: Global Warming Potential Results for EPS Insulation

Basis: 1 m^2 with a thermal resistance RSI = 1 m^2K/W and service life of 60 years		
	Global Warming Potential	Percentage of Total
	kg CO_2 eq	%
Raw Material Acquisition	1.96	70%
Packaging of EPS Resin and Insulation	0.0074	0.3%
Transportation-Resin to Insulation	0.11	3.9%
Insulation Manufacturing	0.55	20%
Distribution	0.13	4.6%
Installation and Use	0	0.0%
End-of-Life	0.038	1.4%
TOTAL	**2.79**	**100%**

Table 3: Global Warming Potential Results for EPS Insulation

WATER CONSUMPTION

Consumptive use of water in this study includes freshwater that is withdrawn from a water source or watershed and not returned to that source. Consumptive water use includes water consumed in chemical reactions, water that is incorporated into a product or waste stream, water that becomes evaporative loss, and water that is discharged to a different watershed or water body than the one from which it was withdrawn. Water consumption results shown for each life cycle stage include process water consumption as well as water consumption associated with production of the electricity and fuels used in that stage. Electricity-related water consumption includes evaporative losses associated with thermal generation of electricity from fossil and nuclear fuels, as well as evaporative losses due to establishment of dams for hydropower.

Water consumption results are shown in Figure 5. Process water consumption for EPS insulation manufacturing is associated with generation of electricity used in the processes, as well as extraction of oil and gas for material and fuel uses. These account for almost half of the consumed water. The insulation manufacturing itself accounts for 29 percent of the water consumed, due to steam production and cooling water makeup.

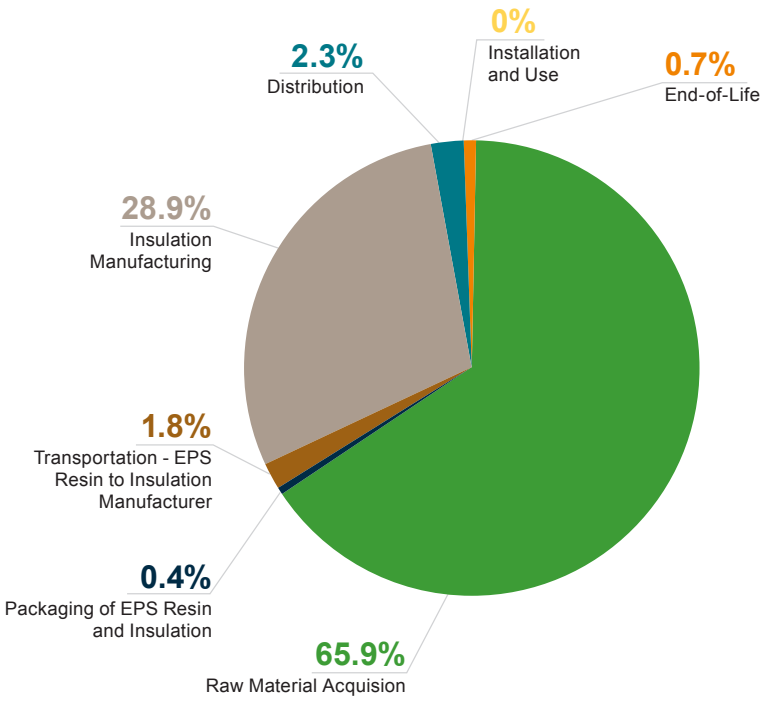
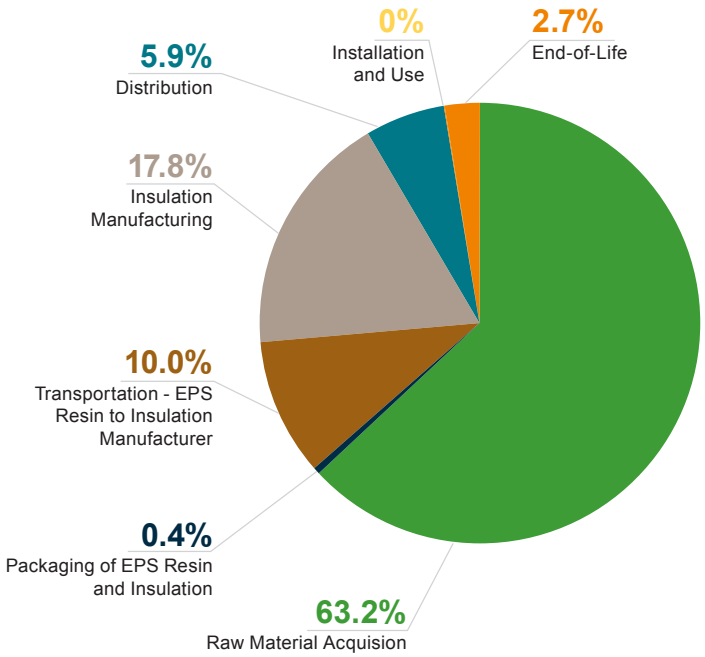


Figure 5: Consumptive Water Use for EPS Insulation

ACIDIFICATION

For the EPS insulation system, raw material production accounts for almost two-thirds of the total acidification potential, followed by insulation manufacturing (17.8 percent) and the transportation of resin and distribution, which together account for over 15 percent. The combustion of natural gas, coal and oil is the largest contributor to the acidification potential.

Figure 6: Acidification Potential Results for EPS Insulation



SOLID WASTE

Solid waste results include the following types of wastes:

- Process wastes that are generated by the various processes from raw material acquisition through production of insulation (e.g., sludges and residues from chemical reactions and material processing steps)
- Fuel-related wastes from the production and combustion of fuels used for process energy and transportation energy (e.g., refinery wastes, coal combustion ash)
- Postconsumer wastes that include the landfilling of the insulation and packaging included, plus ash from the 18% of the packaging that are managed by WTE combustion.

Results for solid waste by weight are shown in Table 4. The largest share of solid waste for all insulation systems is post-consumer solid waste (insulation disposed at the end of its useful life). The next largest contributor is raw material production, which accounts for 10% of the waste for the EPS insulation. Raw material solid wastes are largely associated with production and combustion of fuels (particularly coal used to generate electricity used in raw material production processes) and the production of crude oil and natural gas used as feedstocks for the EPS resin and blowing agent. The insulation manufacture creates approximately 5 percent of the total solid wastes, which include some off-spec resin sent to landfill, as well as solid wastes from emissions control devices. The small amounts of packaging used does not make a large contribution (1 percent) to solid waste results.

The total solid waste is also separated by hazardous and non-hazardous wastes, as well as by the fate of the solid waste. Hazardous waste accounts for only 0.03 percent of the total solid waste for the EPS insulation, while non-hazardous makes up the remaining. More than 99 percent of the solid waste is landfilled, with only 0.02 percent being incineration and less than 0.01 percent used for waste-to-energy.

	Basis: 1 m² with a thermal resistance RSI = 1 m²K/W and service life of 60 years								
		Hazardous Wastes				Non-Hazardous Wastes			
	Total Solid Waste	Waste-to-Energy	Incineration	Landfill	Hazardous Waste Total	Waste-to-Energy	Incineration	Landfill	Non-Hazardous Waste Total
	kg	kg	kg	kg	kg	kg	kg	kg	kg
Raw Material Acquisition	0.081	1.0E-05	1.5E-04	2.3E-05	1.9E-04	1.1E-06	0.0021	0.079	0.081
Packaging of EPS Resin and Insulation	0.011	5.2E-08	3.9E-06	1.2E-07	4.1E-06	1.2E-07	5.3E-05	0.011	0.011
Transportation-Resin to Insulation	0.0015	0	0	0	0	0	0	0.0015	0.0015
Insulation Manufacturing	0.037	0	0	0	0	0	0	0.037	0.037
Distribution	0.0019	0	0	0	0	0	0	0.0019	0.0019
Installation and Use	0	0	0	0	0	0	0	0	0
End-of-Life	0.61	0	0	0	0	0	0	0.61	0.61
TOTAL	**0.75**	**1.0E-05**	**1.6E-04**	**2.3E-05**	**1.9E-04**	**1.3E-06**	**0.0021**	**0.74**	**0.75**
	Percentage of Total								
		Hazardous Wastes				**Non-Hazardous Wastes**			
	Total Solid Waste	Waste-to-Energy	Incineration	Landfill	Hazardous Waste Total	Waste-to-Energy	Incineration	Landfill	Non-Hazardous Waste Total
	%	%	%	%	%	%	%	%	%
Raw Material Acquisition	10.9%	0%	0.02%	0%	0.03%	0%	0.28%	10.6%	10.8%
Packaging of EPS Resin and Insulation	1.4%	0%	0%	0%	0%	0%	0.01%	1.43%	1.45%
Transportation-Resin to Insulation	0.2%	0%	0%	0%	0%	0%	0%	0.20%	0.20%
Insulation Manufacturing	4.9%	0%	0%	0%	0%	0%	0%	4.92%	4.92%
Distribution	0.3%	0%	0%	0%	0%	0%	0%	0.25%	0.25%
Installation and Use	0%	0%	0%	0%	0%	0%	0%	0%	0%
End-of-Life	82.3%	0%	0%	0%	0%	0%	0%	82.3%	82.3%
TOTAL	**100%**	**0.00%**	**0.02%**	**0.00%**	**0.03%**	**0.00%**	**0.29%**	**99.7%**	**99.97%**

Table 4: Solid Waste by Weight for EPS Insulation

RESULTS SUMMARY

A summary table including result totals in each category for EPS insulation is displayed in Table 5. Normalized results for EPS insulation for all results categories are presented in Figure 7. For each results category, the values are displayed on a percentage basis, with each phase of the LCA shown based on its percent of the total amount (100%) for that category.

ASTM C578 TYPE I EPS INSULATION

IMPACT CATEGORY/ENVIRONMENTAL INDICATOR	UNITS	TOTAL
Total Energy	MJ	71.4
Non-Renewable Energy	MJ	69.7
Renewable Energy	MJ	1.74
Total Solid Waste	kg	0.75
Water Consumption	L	9.94
Global Warming	kg CO_2 eq	2.79
Eutrophication	kg N eq	3.6E-04
Smog Formation	kg O_3 eq	0.20
Ozone Depletion	kg CFC-11 eq	1.6E-08
Acidification	mol H+ eq	0.46

Table 5: Results Summary

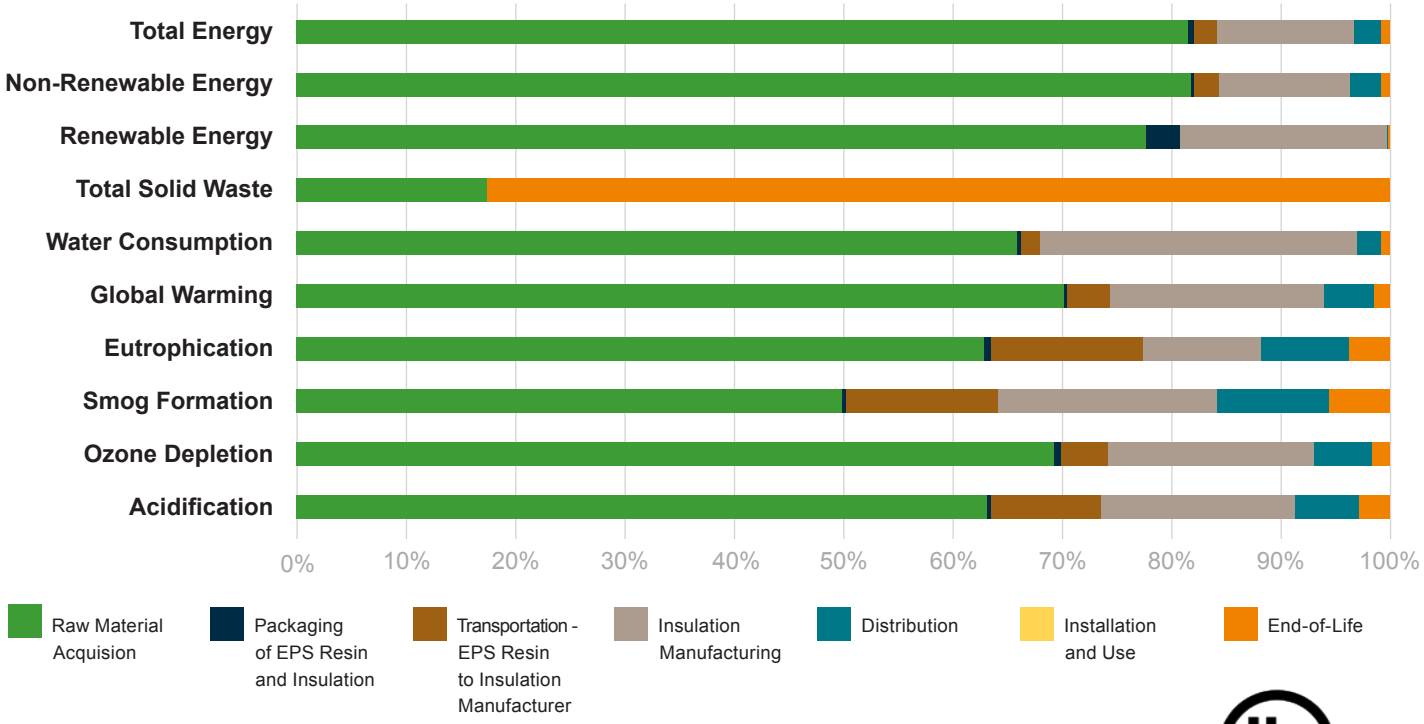


Figure 7: Normalized Results for EPS Insulation

RESULTS SUMMARY

The LCA is based on a functional unit of 1 m² (10.765 ft²) of ASTM C578 Type I EPS insulation with a thickness that gives an average thermal resistance RSI = 1 m²K/W (R-value 5.68 ft²•hr•°F/BTU) and with a building service life of 60 years. For this functional unit, the ASTM C578 Type I EPS insulation thickness would be 4.01 centimeters (1.57 inches).

Table 6 provides the EPS LCA results for ASTM C578 and CAN/ULC S701 EPS Types based on a functional unit of 1 m² (10.765 ft²) of insulation that gives a thermal resistance of RSI=1 m²K/W (R-value 5.68 ft²•hr•°F/BTU) and with a building service life of 60 years.

LCA RESULTS FOR ASTM C578 & CAN/ULC-S701 EPS TYPES

IMPACT CATEGORY/ ENVIRONMENTAL INDICATOR	UNITS	ASTM C578							CAN/ULC S701		
		Type XI	Type I	Type VIII	Type II	Type IX	Type XIV	Type XV	1	2	3
Total Energy	MJ	64.3	71.4	86.4	96.4	122	163	199	68.5	95.7	121
Non-Renewable Energy	MJ	62.7	69.7	84.3	94.1	119	160	194	66.9	93.4	118
Renewable Energy	MJ	1.53	1.74	2.06	2.30	2.90	3.89	4.74	1.63	2.28	2.87
Total Solid Waste	kg	0.66	0.75	0.91	1.01	1.28	1.72	2.09	0.72	1.01	1.27
Water Consumption	L	8.95	9.94	12.0	13.4	17.0	22.8	27.7	9.54	13.3	16.8
Global Warming	kg CO_2 eq	2.51	2.79	3.38	3.77	4.77	6.39	7.78	2.68	3.74	4.72
Eutrophication	kg N eq	3.2E-04	3.6E-04	4.4E-04	4.9E-04	6.2E-04	8.2E-04	10E-04	3.5E-04	4.8E-04	6.1E-04
Smog Formation	kg O_3 eq	0.18	0.20	0.24	0.27	0.34	0.46	0.56	0.19	0.27	0.34
Ozone Depletion	kg CFC-11 eq	1.4E-08	1.6E-08	1.9E-08	2.2E-08	2.7E-08	3.7E-08	4.4E-08	1.5E-08	2.1E-08	2.7E-08
Acidification	mol H+ eq	0.41	0.46	0.56	0.62	0.79	1.05	1.28	0.44	0.62	0.78

Table 6: EPS LCA Results for ASTM C578 & CAN/ULC-S701 EPS Types

REFERENCES

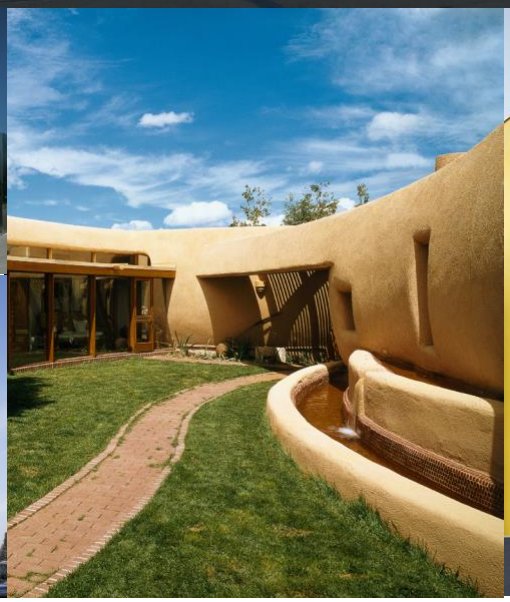
- *Product Category Rules for Preparing an Environmental Product Declaration (EPD) for Product Group: Building Envelope Thermal Insulation, Version 1.4, 23 September 2011*
- *Life Cycle Assessment of Expanded Polystyrene Insulation, Franklin Associates/ERG, 2017*
- *Cradle-to-Gate Life Cycle Analysis of Expanded Polystyrene Resin, Franklin Associates/ERG, 2017*
- *ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation*
- *CAN/ULC S701 Standard for Thermal Insulation, Polystyrene, Boards & Pipe Coverings*

Building with conscience.

EPD for Stolit®
in varied textures

Product Textures: 1.0, 1.0 Dark, 1.5, 1.5 Dark, Freeform, Freeform Dark, R1.5, R1.5 Dark

Stolit ® is a ready-mixed premium acrylic based exterior or interior textured wall finish enhanced with advanced polymer technology, designed for use as a finish coat over prepared vertical concrete, masonry or plaster substrates and in StoTherm® ci wall



epstengroup Environmental Product Declaration

epstengroup
Solutions for a Sustainable World

PCR Identification	PCR for Architectural Coatings: NAICS 325510 on the basis of ISO 21930:2007, NSF International, 2017. Valid through June 23, 2022
Compliance to ISO1 4040/44, ISO 14025 and ISO 21930	Yes
Product Category	Exterior Coating
Manufacturer's name	Sto Corp. 3800 Camp Creek Parkway SW, Building 1400, Suite 120 Atlanta, GA 30331 www.stocorp.com | (800) 221-2397
EPD program operator	Epsten Group 101 Marietta St. Suite 2600, Atlanta, GA 30303 www.epstengroup.com
Declaration Number	01-001
Date of Certification	December 18th, 2019
Period of Validity	5 years from date of certification
Functional Unit	One square meter of covered and protected substrate for 60 years
Market-base life used in assessment	10 Years
Design life used in assessment	5 Years
Test method employed for determination of design life	Product default warranty
Amount of colorant needed	See Table 3
Overall Data Quality Assessment Score	Good
Site(s) in which the results of the LCA are representative	STO manufacturing sites in Atlanta, Georgia; Glendale, Arizona; and Rutland, Vermont
Information on where explanatory material can be obtained	See references at the end of this document.
LCA Software and Version Number	GaBi 9.2.0.58
LCI Database and Version Number	GaBi Database Version 8.7, Service Pack 39
This declaration was independently verified in accordance with ISO 14025: 2006 and the reference PCR: PCR for Architectural Coatings: NAICS 325510 ☐ Internal ☒ External	Kate McFeaters kmcfeaters@epstengroup.com Kathrine McFeaters
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting, LLC
This life cycle assessment was independently verified in accordance with ISO 14040/44 and the reference PCR by:	Kate McFeaters kmcfeaters@epstengroup.com Kathrine McFeaters

Comparability

In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the building level per ISO 21930 guidelines. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-to-case basis.

Company

We believe in '**Building with conscience**'.

That means ensuring that all building products are not only safe, effective and easy to install, but also environmentally responsible and sustainable. We know you're always looking for the smartest and newest technology to create energy efficient buildings with superior aesthetics.

That's exactly what our products help you achieve. Products like our wall systems, coatings and finishes are consistent favorites among design professionals, contractors and property owners alike. Whatever your needs or vision may be, we offer products for every type of building project; whether it's new construction, restoration or panelization, commercial or residential work.

An architect or specifier focuses on aesthetics and feasibility, a contractor needs products that are easy to work with, and a building owner requires high value and low costs on properties. Sto understands these unique needs, and delivers the smart, innovative materials and solutions that make this all possible. That's why Sto remains the innovative leader in integrated exterior wall systems.

When you combine that commitment to product support and innovation with value-added offerings like consultative design and color services through Sto Studio or training in proper application techniques through the Sto Institute, you get an integrated exterior wall system solution unmatched in the industry.

Manufacturing Sites Covered in this EPD

Atlanta Plant

Glendale Plant

Rutland Plant

Product Identification

Stolit® finishes are offered in various coarseness and color bases that allow more freedom in building exterior designing and finishing. Table 1 lists the products declared in this EPD.

Table 1: List of Stolit® Products

Product Name	Product Number	Base Type	Finish Type
Stolit® 1.0	80130	Tintable White	Fine
Stolit® 1.0 Dark Colors	82130	Deep	Fine
Stolit® 1.5	80131	Tintable White	Medium
Stolit® 1.5 Dark Colors	82131	Deep	Medium
Stolit® Freeform	80156	Tintable White	Freeform
Stolit® Freeform Dark Colors	82156	Deep	Freeform
Stolit® R1.5	80141	Tintable White	Swirl
Stolit® R1.5 Dark Colors	82141	Deep	Swirl

Product Description

Stolit® is a series of ready-mixed, acrylic-based exterior or interior textured wall finishes. Stolit® is used as a decorative and protective wall coating over prepared vertical above grade concrete, masonry and plaster substrates, and in StoTherm® ci Systems. In this study, Stolit® 1.0, 1.5, R1.5 and Freeform are included. Two tint bases are offered: standard and dark colors which respectively can be transcribed to tintable white base and deep base in the PCR.

Performance Features

Mildew Resistance	Ready Mixed	Moisture Resistance	Low VOC & Odor
Vapor Permeable	Integral Color	Water-based	

Material Composition

The material compositions of Stolit® are listed below:

Table 2: Material composition for Stolit®

Product	Additives	Colorant	Limestone	Acrylic resin	Silica	Silicate	Surfactant	Water
Stolit® R1.5 Dark Colors	0.77%	0.60%	47.76%	5.03%	26.66%	2.69%	0.08%	15.75%
Stolit® R1.5	0.77%	0.60%	47.69%	5.03%	26.60%	2.69%	0.08%	15.88%
Stolit® 1.0 Dark Colors	0.77%	0.60%	49.20%	5.04%	25.26%	2.69%	0.07%	15.71%
Stolit® 1.0	0.77%	0.60%	49.16%	5.03%	25.20%	2.69%	0.07%	15.80%
Stolit® 1.5 Dark Colors	0.59%	0.61%	64.85%	6.95%	7.91%	2.46%	0.18%	15.65%
Stolit® 1.5	0.59%	0.80%	64.55%	6.95%	8.01%	2.46%	0.18%	15.66%
Stolit® Freeform Dark Colors	0.77%	0.58%	67.26%	4.84%	8.18%	2.59%	0.07%	15.08%
Stolit® Freeform	0.74%	0.58%	67.23%	4.84%	8.18%	2.58%	0.07%	15.13%

Components related to Life Cycle Assessment

The functional unit for the LCA study was covering and protecting 1 square meter (m^2) of substrate for a period of 60 years—the assumed lifetime of a building. The reference flow required for the functional unit is calculated based on the product lifespan scenarios prescribed in the PCR. The market-based lifetime is 10 years, and the design lifetime is determined either based on quality determined by ASTM tests or on the product warrant. By default, Stolit® finishes have a 5-year warranty. In case a finish is applied on Sto's wall systems, the warranty is extended to 10 years. In this EPD, default warranty is adopted as the design lifetime. The reference flow required for one functional unit is provided in Table 3.

Table 3: Market-based lifetime and reference flow

	Functional Unit	Reference Flow [kg]	Tint needed* [kg]	Reference Flow [kg]	Tint needed* [kg]
Lifespan		Design Lifetime [5 years]		Market-based Lifetime [10 years]	
Stolit® R1.5 Dark Colors	1	30.59	2.69	15.29	1.35
Stolit® R1.5	1	30.59	0.79	15.29	0.40
Stolit® 1.0 Dark Colors	1	29.58	2.60	14.80	1.30
Stolit® 1.0	1	29.58	0.77	14.80	0.38
Stolit® 1.5 Dark Colors	1	34.05	3.00	17.03	1.50
Stolit® 1.5	1	34.05	0.88	17.03	0.44
Stolit® Freeform Dark Colors	1	53.08	4.66	26.53	2.33
Stolit® Freeform	1	53.08	1.37	26.53	0.69

Scope and Boundaries of the Life Cycle Assessment

The LCA was performed in accordance with ISO 14040 standards. The study is a cradle-to-grave LCA and includes the following life stages as prescribed in the PCR.

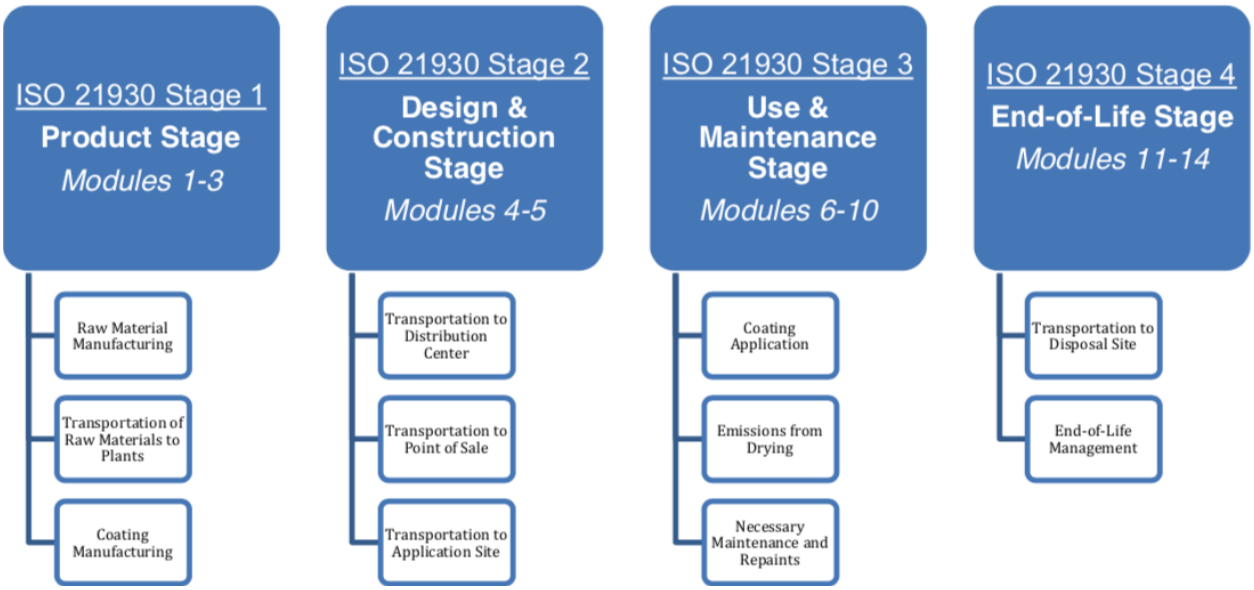


Figure 1: Life stages for the cradle-to-grave LCA

Cut-off Criteria

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

Data Quality

The overall data quality level was determined to be good. Primary data was collected from Sto's facilities in Atlanta, GA, Glendale, AZ and Rutland, VT for the 2018 reference year. When primary data did not exist, secondary data were obtained from the Gabi V8.7 Database Service Pack 39. Overall, both primary and secondary data are considered good quality in terms of geographic, temporal and technological coverage.

Estimates and Assumption

Assumptions were made to represent the cradle-to-grave environmental performance of Sto's products. These assumptions were made in accordance with the PCR and include the transportation distances, the disposal of packaging material and the product at its end of life and use phase assumptions.

Allocation

General principles of allocation were based on ISO 14040/44. Where possible, allocation was avoided. When allocation was necessary it was done on a physical mass basis.

Product Stage

Stolit® is produced at Sto's Atlanta, GA, Glendale, AZ and Rutland, VT facilities. This stage includes an aggregation of raw material extraction, supplier processing, delivery, manufacturing and packaging by Sto. Stolit® is supplied in 5-gallon pails.

Design and Construction Stage

The design and construction process stage starts with the packaged product leaving the production site and ends with being delivered to the application site.

During this stage, the finished product is moved from a shipping dock for distribution. The end gate is the application site after the purchaser acquires the finished product and transports it to the application site.

Use and Maintenance Stage

The use stage begins when the user prepares the product before applying it to a substrate and ends with any leftover coating and discarded packaging entering the end-of-life stage. Detailed application instructions are provided online. The application procedure includes mixing and applying. As recommended, an electric drill/mixer and a spray pump are assumed to be used for mixing and application. The equipment is not included in the study as these are multi-use tools and the impacts per declared unit is considered negligible, but electricity to power application tools has been included.

As prescribed in the PCR, 10% of the wet mass of Stolit® is assumed to be unused and properly disposed of.

End-of-Life Stage

Table 4: End-of-life Disposal Scenarios

Waste Flow	Recycling	Incineration	Landfilling
Paper Packaging	66.6%	6.01%	27.39%
Steel Packaging	33.3%	12.01%	54.69%
Plastic Packaging	9.1%	16.36%	74.54%
Unused Product	0%	0%	100%
Post-Consumer Product	0%	0%	100%

In this stage, the disposal of installation waste, packaging waste and product waste at its end of life is included. The disposal pathway of each waste stream is modeled based on the recommendation of PCR and US EPA's latest waste management fact sheet.

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Life Cycle Assessment Results

As prescribed by the PCR, TRACI 2.1 impact characterization methodology and IPCC 5th assessment report are adopted to calculate the environment impacts. Table 5 provides the acronym key of the impact indicators declared in this EPD.

Table 5: LCIA impact category and LCI Indicator keys

Abbreviation	Parameter	Unit
	TRACI 2.1	
AP	Acidification potential of soil and water	kg SO_2 eq
EP	Eutrophication potential	kg N eq
GWP	Global warming potential including biogenic carbon emission	kg CO_2 eq
ODP	Depletion of stratospheric ozone layer	kg CFC 11 eq
POCP	Photochemical ozone creation potential	kg O_3 eq
	Resource Use Parameters	
RPR	Use of renewable primary energy	MJ, net calorific value (LHV)
RMR	Use of renewable Material Resources	kg
NRER	Depletion of Non-Renewable Energy Resources	MJ, net calorific value
NRMR	Depletion of Non-Renewable Material Resources	kg
FW	Consumption of Freshwater	m^3
	Waste Parameters	
HWD	Disposed-of-hazardous waste	kg
NHWD	Disposed-of non-hazardous waste	kg
	Biogenic Carbon Parameter	
BC	Biogenic Carbon	kg CO_2 eq
	Energy Differentiation Parameters	
HWP	Hydro/wind Power	MJ, net calorific value (LHV)
FE	Fossil Energy	MJ, net calorific value (LHV)
BE	Bio-energy	MJ, net calorific value (LHV)
NE	Nuclear Energy	MJ, net calorific value (LHV)
OE	Other Energy	MJ, net calorific value (LHV)

Stolit® R1.5 Dark Colors

	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Market-based lifetime	AP [kg SO_2 eq]	4.73E-02	6.12E-03	6.31E-03	4.41E-03
	EP [kg N eq]	2.75E-03	4.98E-04	2.30E-04	7.14E-04
	GWP [kg CO_2 eq]	1.36E+01	1.19E+00	2.99E+00	9.16E-01
	ODP [kg CFC 11 eq]	1.71E-09	1.13E-16	1.89E-14	2.49E-15
	POCP [kg O_3 eq]	5.46E-01	1.40E-01	8.05E-01	7.33E-02
	RPRE [MJ]	1.64E+01	5.22E-01	3.20E+00	7.57E-01
	NRPRE [MJ]	2.99E+02	1.69E+01	7.97E+01	1.11E+01
	FW [m3]	7.08E-02	2.01E-03	1.79E-02	1.42E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	1.59E+01	0.00E+00	1.35E+00	0.00E+00
	HWD [kg]	4.77E-06	1.37E-07	1.13E-08	4.58E-08
	NHWD [kg]	8.46E-01	6.36E-04	9.48E-03	1.70E+01
	BC [kg CO_2 eq]		1.53E+00		
	HWP [MJ]		9.79E-01		
	FE [MJ]		1.48E+01		
	BE [MJ]		4.84E-01		
	NE [MJ]		3.89E+00		
	OE [MJ]		3.90E-01		
	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Design lifetime	AP [kg SO_2 eq]	9.46E-02	1.22E-02	1.26E-02	8.82E-03
	EP [kg N eq]	5.50E-03	9.96E-04	4.60E-04	1.43E-03
	GWP [kg CO_2 eq]	2.72E+01	2.38E+00	5.98E+00	1.83E+00
	ODP [kg CFC 11 eq]	3.42E-09	2.26E-16	3.78E-14	4.98E-15
	POCP [kg O_3 eq]	1.09E+00	2.80E-01	1.61E+00	1.47E-01
	RPRE [MJ]	3.28E+01	1.04E+00	6.40E+00	1.51E+00
	NRPRE [MJ]	5.98E+02	3.38E+01	1.59E+02	2.22E+01
	FW [m3]	1.42E-01	4.02E-03	3.58E-02	2.84E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	3.18E+01	0.00E+00	2.70E+00	0.00E+00
	HWD [kg]	9.54E-06	2.74E-07	2.26E-08	9.16E-08
	NHWD [kg]	1.69E+00	1.27E-03	1.90E-02	3.40E+01
	BC [kg CO_2 eq]		3.07E+00		
	HWP [MJ]		1.96E+00		
	FE [MJ]		2.97E+01		
	BE [MJ]		9.68E-01		
	NE [MJ]		7.78E+00		
	OE [MJ]		7.81E-01		

	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Market-based lifetime	AP [kg SO_2 eq]	6.36E-02	6.11E-03	1.93E-03	4.23E-03
	EP [kg N eq]	2.83E-03	4.98E-04	7.06E-05	7.05E-04
	GWP [kg CO_2 eq]	1.39E+01	1.19E+00	9.06E-01	8.76E-01
	ODP [kg CFC 11 eq]	1.71E-09	1.13E-16	5.66E-15	2.35E-15
	POCP [kg O_3 eq]	5.62E-01	1.40E-01	7.78E-01	6.97E-02
	RPRE [MJ]	1.67E+01	5.22E-01	9.95E-01	7.11E-01
	NRPRE [MJ]	3.03E+02	1.69E+01	2.38E+01	1.04E+01
	FW [m3]	7.24E-02	2.01E-03	5.40E-03	1.34E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	1.59E+01	0.00E+00	4.00E-01	0.00E+00
	HWD [kg]	4.77E-06	1.37E-07	3.48E-09	4.35E-08
	NHWD [kg]	8.54E-01	6.36E-04	2.91E-03	1.62E+01
	BC [kg CO_2 eq]		1.40E+00		
	HWP [MJ]		9.78E-01		
	FE [MJ]		1.48E+01		
	BE [MJ]		4.84E-01		
	NE [MJ]		3.89E+00		
	OE [MJ]		3.90E-01		
	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Design lifetime	AP [kg SO_2 eq]	1.27E-01	1.22E-02	3.86E-03	8.46E-03
	EP [kg N eq]	5.66E-03	9.96E-04	1.41E-04	1.41E-03
	GWP [kg CO_2 eq]	2.78E+01	2.38E+00	1.81E+00	1.75E+00
	ODP [kg CFC 11 eq]	3.42E-09	2.26E-16	1.13E-14	4.70E-15
	POCP [kg O_3 eq]	1.12E+00	2.80E-01	1.56E+00	1.39E-01
	RPRE [MJ]	3.34E+01	1.04E+00	1.99E+00	1.42E+00
	NRPRE [MJ]	6.06E+02	3.38E+01	4.76E+01	2.08E+01
	FW [m3]	1.45E-01	4.02E-03	1.08E-02	2.68E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	3.18E+01	0.00E+00	8.00E-01	0.00E+00
	HWD [kg]	9.54E-06	2.74E-07	6.96E-09	8.70E-08
	NHWD [kg]	1.71E+00	1.27E-03	5.82E-03	3.24E+01
	BC [kg CO_2 eq]		2.80E+00		
	HWP [MJ]		1.96E+00		
	FE [MJ]		2.97E+01		
	BE [MJ]		9.68E-01		
	NE [MJ]		7.77E+00		
	OE [MJ]		7.80E-01		

Stolit® 1.0 Dark Colors

	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Market-based lifetime	AP [kg SO_2 eq]	4.91E-02	5.91E-03	6.11E-03	4.27E-03
	EP [kg N eq]	2.80E-03	4.82E-04	2.23E-04	6.91E-04
	GWP [kg CO_2 eq]	1.42E+01	1.15E+00	2.90E+00	8.86E-01
	ODP [kg CFC 11 eq]	2.06E-09	1.09E-16	1.83E-14	2.41E-15
	POCP [kg O_3 eq]	5.64E-01	1.35E-01	7.79E-01	7.09E-02
	RPRE [MJ]	1.77E+01	5.05E-01	3.10E+00	7.33E-01
	NRPRE [MJ]	3.09E+02	1.63E+01	7.69E+01	1.07E+01
	FW [m3]	7.34E-02	1.94E-03	1.73E-02	1.37E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	1.54E+01	0.00E+00	1.30E+00	0.00E+00
	HWD [kg]	5.67E-06	1.32E-07	1.09E-08	4.43E-08
	NHWD [kg]	9.34E-01	6.12E-04	9.13E-03	1.65E+01
	BC [kg CO_2 eq]		1.57E+00		
	HWP [MJ]		9.48E-01		
	FE [MJ]		1.44E+01		
	BE [MJ]		4.69E-01		
	NE [MJ]		3.76E+00		
	OE [MJ]		3.78E-01		
	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Design lifetime	AP [kg SO_2 eq]	9.82E-02	1.18E-02	1.22E-02	8.54E-03
	EP [kg N eq]	5.60E-03	9.64E-04	4.46E-04	1.38E-03
	GWP [kg CO_2 eq]	2.84E+01	2.30E+00	5.80E+00	1.77E+00
	ODP [kg CFC 11 eq]	4.12E-09	2.18E-16	3.66E-14	4.82E-15
	POCP [kg O_3 eq]	1.13E+00	2.70E-01	1.56E+00	1.42E-01
	RPRE [MJ]	3.54E+01	1.01E+00	6.20E+00	1.47E+00
	NRPRE [MJ]	6.18E+02	3.26E+01	1.54E+02	2.14E+01
	FW [m3]	1.47E-01	3.88E-03	3.46E-02	2.74E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	3.08E+01	0.00E+00	2.60E+00	0.00E+00
	HWD [kg]	1.13E-05	2.64E-07	2.18E-08	8.86E-08
	NHWD [kg]	1.87E+00	1.22E-03	1.83E-02	3.30E+01
	BC [kg CO_2 eq]		3.13E+00		
	HWP [MJ]		1.90E+00		
	FE [MJ]		2.87E+01		
	BE [MJ]		9.37E-01		
	NE [MJ]		7.53E+00		
	OE [MJ]		7.56E-01		

	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Market-based lifetime	AP [kg SO_2 eq]	6.54E-02	5.91E-03	1.86E-03	4.09E-03
	EP [kg N eq]	2.89E-03	4.82E-04	6.83E-05	6.82E-04
	GWP [kg CO_2 eq]	1.46E+01	1.15E+00	8.76E-01	8.48E-01
	ODP [kg CFC 11 eq]	2.06E-09	1.09E-16	5.47E-15	2.27E-15
	POCP [kg O_3 eq]	5.81E-01	1.35E-01	7.52E-01	6.74E-02
	RPRE [MJ]	1.81E+01	5.05E-01	9.63E-01	6.88E-01
	NRPRE [MJ]	3.13E+02	1.63E+01	2.31E+01	1.01E+01
	FW [m3]	7.53E-02	1.94E-03	5.22E-03	1.30E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	1.54E+01	0.00E+00	3.80E-01	0.00E+00
	HWD [kg]	5.65E-06	1.32E-07	3.37E-09	4.20E-08
	NHWD [kg]	9.41E-01	6.15E-04	2.81E-03	1.56E+01
	BC [kg CO_2 eq]		1.44E+00		
	HWP [MJ]		9.47E-01		
	FE [MJ]		1.44E+01		
	BE [MJ]		4.68E-01		
	NE [MJ]		3.76E+00		
	OE [MJ]		3.78E-01		
	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Design lifetime	AP [kg SO_2 eq]	1.31E-01	1.18E-02	3.72E-03	8.18E-03
	EP [kg N eq]	5.78E-03	9.64E-04	1.37E-04	1.36E-03
	GWP [kg CO_2 eq]	2.92E+01	2.30E+00	1.75E+00	1.70E+00
	ODP [kg CFC 11 eq]	4.12E-09	2.18E-16	1.09E-14	4.54E-15
	POCP [kg O_3 eq]	1.16E+00	2.70E-01	1.50E+00	1.35E-01
	RPRE [MJ]	3.62E+01	1.01E+00	1.93E+00	1.38E+00
	NRPRE [MJ]	6.26E+02	3.26E+01	4.62E+01	2.02E+01
	FW [m3]	1.51E-01	3.88E-03	1.04E-02	2.60E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	3.08E+01	0.00E+00	7.60E-01	0.00E+00
	HWD [kg]	1.13E-05	2.64E-07	6.74E-09	8.40E-08
	NHWD [kg]	1.88E+00	1.23E-03	5.62E-03	3.12E+01
	BC [kg CO_2 eq]		2.88E+00		
	HWP [MJ]		1.89E+00		
	FE [MJ]		2.87E+01		
	BE [MJ]		9.37E-01		
	NE [MJ]		7.52E+00		
	OE [MJ]		7.55E-01		

Stolit® 1.5 Dark Colors

	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Market-based lifetime	AP [kg SO_2 eq]	5.54E-02	6.81E-03	7.02E-03	4.91E-03
	EP [kg N eq]	3.14E-03	5.55E-04	2.56E-04	7.95E-04
	GWP [kg CO_2 eq]	1.61E+01	1.32E+00	3.33E+00	1.02E+00
	ODP [kg CFC 11 eq]	1.90E-09	1.26E-16	2.11E-14	2.77E-15
	POCP [kg O_3 eq]	6.28E-01	1.55E-01	8.97E-01	8.16E-02
	RPRE [MJ]	2.01E+01	5.81E-01	3.56E+00	8.44E-01
	NRPRE [MJ]	3.51E+02	1.88E+01	8.86E+01	1.23E+01
	FW [m3]	8.38E-02	2.24E-03	1.99E-02	1.58E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	1.77E+01	0.00E+00	1.50E+00	0.00E+00
	HWD [kg]	5.30E-06	1.52E-07	1.25E-08	5.10E-08
	NHWD [kg]	1.06E+00	7.07E-04	1.05E-02	1.90E+01
	BC [kg CO_2 eq]		1.78E+00		
	HWP [MJ]		1.09E+00		
	FE [MJ]		1.65E+01		
	BE [MJ]		5.39E-01		
	NE [MJ]		4.33E+00		
	OE [MJ]		4.35E-01		
	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Design lifetime	AP [kg SO_2 eq]	1.11E-01	1.36E-02	1.40E-02	9.82E-03
	EP [kg N eq]	6.28E-03	1.11E-03	5.12E-04	1.59E-03
	GWP [kg CO_2 eq]	3.22E+01	2.64E+00	6.66E+00	2.04E+00
	ODP [kg CFC 11 eq]	3.80E-09	2.52E-16	4.22E-14	5.54E-15
	POCP [kg O_3 eq]	1.26E+00	3.10E-01	1.79E+00	1.63E-01
	RPRE [MJ]	4.02E+01	1.16E+00	7.12E+00	1.69E+00
	NRPRE [MJ]	7.02E+02	3.76E+01	1.77E+02	2.46E+01
	FW [m3]	1.68E-01	4.48E-03	3.98E-02	3.16E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	3.54E+01	0.00E+00	3.00E+00	0.00E+00
	HWD [kg]	1.06E-05	3.04E-07	2.50E-08	1.02E-07
	NHWD [kg]	2.12E+00	1.41E-03	2.10E-02	3.80E+01
	BC [kg CO_2 eq]		3.56E+00		
	HWP [MJ]		2.18E+00		
	FE [MJ]		3.31E+01		
	BE [MJ]		1.08E+00		
	NE [MJ]		8.66E+00		
	OE [MJ]		8.70E-01		

	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Market-based lifetime	AP [kg SO_2 eq]	7.53E-02	6.81E-03	2.14E-03	4.71E-03
	EP [kg N eq]	3.32E-03	5.55E-04	7.86E-05	7.84E-04
	GWP [kg CO_2 eq]	1.67E+01	1.32E+00	1.01E+00	9.75E-01
	ODP [kg CFC 11 eq]	1.90E-09	1.26E-16	6.30E-15	2.61E-15
	POCP [kg O_3 eq]	6.69E-01	1.55E-01	8.66E-01	7.76E-02
	RPRE [MJ]	2.05E+01	5.81E-01	1.11E+00	7.92E-01
	NRPRE [MJ]	3.59E+02	1.88E+01	2.65E+01	1.16E+01
	FW [m3]	8.63E-02	2.24E-03	6.01E-03	1.50E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	1.77E+01	0.00E+00	4.40E-01	0.00E+00
	HWD [kg]	5.33E-06	1.52E-07	3.88E-09	4.84E-08
	NHWD [kg]	1.07E+00	7.07E-04	3.23E-03	1.80E+01
	BC [kg CO_2 eq]		1.64E+00		
	HWP [MJ]		1.09E+00		
	FE [MJ]		1.65E+01		
	BE [MJ]		5.39E-01		
	NE [MJ]		4.33E+00		
	OE [MJ]		4.35E-01		
	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Design lifetime	AP [kg SO_2 eq]	1.51E-01	1.36E-02	4.28E-03	9.42E-03
	EP [kg N eq]	6.64E-03	1.11E-03	1.57E-04	1.57E-03
	GWP [kg CO_2 eq]	3.34E+01	2.64E+00	2.02E+00	1.95E+00
	ODP [kg CFC 11 eq]	3.80E-09	2.52E-16	1.26E-14	5.22E-15
	POCP [kg O_3 eq]	1.34E+00	3.10E-01	1.73E+00	1.55E-01
	RPRE [MJ]	4.10E+01	1.16E+00	2.22E+00	1.58E+00
	NRPRE [MJ]	7.18E+02	3.76E+01	5.30E+01	2.32E+01
	FW [m3]	1.73E-01	4.48E-03	1.20E-02	3.00E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	3.54E+01	0.00E+00	8.80E-01	0.00E+00
	HWD [kg]	1.07E-05	3.04E-07	7.76E-09	9.68E-08
	NHWD [kg]	2.14E+00	1.41E-03	6.46E-03	3.60E+01
	BC [kg CO_2 eq]		3.29E+00		
	HWP [MJ]		2.18E+00		
	FE [MJ]		3.31E+01		
	BE [MJ]		1.08E+00		
	NE [MJ]		8.66E+00		
	OE [MJ]		8.69E-01		

Stolit® Freeform Dark Colors

	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Market-based lifetime	AP [kg SO_2 eq]	8.88E-02	1.06E-02	1.10E-02	7.66E-03
	EP [kg N eq]	4.96E-03	8.64E-04	3.99E-04	1.24E-03
	GWP [kg CO_2 eq]	2.51E+01	2.06E+00	5.20E+00	1.59E+00
	ODP [kg CFC 11 eq]	-8.37E-13	1.96E-16	3.28E-14	4.32E-15
	POCP [kg O_3 eq]	1.01E+00	2.42E-01	1.40E+00	1.27E-01
	RPRE [MJ]	2.98E+01	9.05E-01	5.56E+00	1.32E+00
	NRPRE [MJ]	5.54E+02	2.93E+01	1.38E+02	1.92E+01
	FW [m3]	1.29E-01	3.49E-03	3.10E-02	2.46E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	2.76E+01	0.00E+00	2.33E+00	0.00E+00
	HWD [kg]	7.85E-07	2.37E-07	1.95E-08	7.95E-08
	NHWD [kg]	1.47E+00	1.10E-03	1.64E-02	2.96E+01
	BC [kg CO_2 eq]		2.71E+00		
	HWP [MJ]		1.70E+00		
	FE [MJ]		2.58E+01		
	BE [MJ]		8.40E-01		
	NE [MJ]		6.75E+00		
	OE [MJ]		6.77E-01		
	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Design lifetime	AP [kg SO_2 eq]	1.78E-01	2.12E-02	2.20E-02	1.53E-02
	EP [kg N eq]	9.92E-03	1.73E-03	7.98E-04	2.48E-03
	GWP [kg CO_2 eq]	5.02E+01	4.12E+00	1.04E+01	3.18E+00
	ODP [kg CFC 11 eq]	-1.67E-12	3.92E-16	6.56E-14	8.64E-15
	POCP [kg O_3 eq]	2.02E+00	4.84E-01	2.80E+00	2.54E-01
	RPRE [MJ]	5.96E+01	1.81E+00	1.11E+01	2.64E+00
	NRPRE [MJ]	1.11E+03	5.86E+01	2.76E+02	3.84E+01
	FW [m3]	2.58E-01	6.98E-03	6.20E-02	4.92E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	5.51E+01	0.00E+00	4.66E+00	0.00E+00
	HWD [kg]	1.57E-06	4.74E-07	3.90E-08	1.59E-07
	NHWD [kg]	2.94E+00	2.20E-03	3.28E-02	5.92E+01
	BC [kg CO_2 eq]		5.42E+00		
	HWP [MJ]		3.40E+00		
	FE [MJ]		5.15E+01		
	BE [MJ]		1.68E+00		
	NE [MJ]		1.35E+01		
	OE [MJ]		1.35E+00		

	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Market-based lifetime	AP [kg SO_2 eq]	1.20E-01	1.06E-02	3.34E-03	7.35E-03
	EP [kg N eq]	5.13E-03	8.64E-04	1.23E-04	1.22E-03
	GWP [kg CO_2 eq]	2.58E+01	2.06E+00	1.57E+00	1.52E+00
	ODP [kg CFC 11 eq]	-8.35E-13	1.96E-16	9.82E-15	4.08E-15
	POCP [kg O_3 eq]	1.05E+00	2.42E-01	1.35E+00	1.21E-01
	RPRE [MJ]	3.05E+01	9.05E-01	1.73E+00	1.23E+00
	NRPRE [MJ]	5.63E+02	2.93E+01	4.14E+01	1.81E+01
	FW [m3]	1.33E-01	3.49E-03	9.37E-03	2.33E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	2.76E+01	0.00E+00	6.90E-01	0.00E+00
	HWD [kg]	7.89E-07	2.37E-07	6.04E-09	7.54E-08
	NHWD [kg]	1.49E+00	1.10E-03	5.04E-03	2.81E+01
	BC [kg CO_2 eq]		2.49E+00		
	HWP [MJ]		1.70E+00		
	FE [MJ]		2.58E+01		
	BE [MJ]		8.40E-01		
	NE [MJ]		6.74E+00		
	OE [MJ]		6.77E-01		
	Indicator	1. Product Stage	2. Design & Construction Stage	3. Use & Maintenance Stage	4. End-of-Life Stage
Design lifetime	AP [kg SO_2 eq]	2.40E-01	2.12E-02	6.68E-03	1.47E-02
	EP [kg N eq]	1.03E-02	1.73E-03	2.46E-04	2.44E-03
	GWP [kg CO_2 eq]	5.16E+01	4.12E+00	3.14E+00	3.04E+00
	ODP [kg CFC 11 eq]	-1.67E-12	3.92E-16	1.96E-14	8.16E-15
	POCP [kg O_3 eq]	2.10E+00	4.84E-01	2.70E+00	2.42E-01
	RPRE [MJ]	6.10E+01	1.81E+00	3.46E+00	2.46E+00
	NRPRE [MJ]	1.13E+03	5.86E+01	8.28E+01	3.62E+01
	FW [m3]	2.66E-01	6.98E-03	1.87E-02	4.66E-03
	RMR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NRMR [kg]	5.51E+01	0.00E+00	1.38E+00	0.00E+00
	HWD [kg]	1.58E-06	4.74E-07	1.21E-08	1.51E-07
	NHWD [kg]	2.98E+00	2.20E-03	1.01E-02	5.62E+01
	BC [kg CO_2 eq]		4.98E+00		
	HWP [MJ]		3.39E+00		
	FE [MJ]		5.15E+01		
	BE [MJ]		1.68E+00		
	NE [MJ]		1.35E+01		
	OE [MJ]		1.35E+00		

Interpretation

For all the products in study, the majority of the environmental impacts come from the Product Stage, which includes raw material sourcing, transportation and manufacturing. The only exception is POCP whose dominant source is Use & Maintenance Stage because of VOC emission in the curing process. From a functional unit perspective, the lifetime of the product and the coverage rate play a major role in scaling the impacts. This explains why products of coarse finishes have a higher impact than those of fine finishes.

Reference

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