ROOFING
ENVIRONMENTAL PRODUCT DECLARATION - CRADLE-TO-GRAVE
SARNAFIL G 410

ASTM INTERNATIONAL

Sarnafil®

BUILDING TRUST

Sika®

GENERAL INFORMATION

COMPANY
Sika Corporation – Roofing

PRODUCT TYPE
Single Ply Roofing Membrane

PRODUCT
Sarnafil G 410 roofing membrane, with a finished thickness of 60 mils, 72 mils or 80 mils.

MANUFACTURING SITE
Canton, MA 02021

EPD SCOPE
- Cradle-to-Grave

EPD LIMITATIONS
- EPDs from different programs (using different PCR) may not be comparable
- Declarations based on the ASTM SPRM PCR can be used to assist in comparative assertions only with cradle-to-grave assessments with the same product function and functional unit and on the basis of clearly defined scenarios.

FUNCTIONAL UNIT
1,000 m^2 installed for 60 years, Sarnafil G 410

STANDARDS
The three declared Sarnafil G 410 roofing membrane thicknesses (60, 72 and 80 mils) meet the following standards and requirements

- ASTM D4434
- ENERGY STAR® Listed*
- Title 24 Compliant*
- Cool Roof Rating Council Listed*
- FM Approval
- Miami-Dade County Approval
- Underwriters Laboratory Inc.
- Underwrites Laboratories of Canada
- NSF/ANSI 347 Sustainability Assessment for Single Ply Roof Membranes - Platinum

*White, Tan, Reflective Gray only

ORGANIZATION
Sika Corporation, based in Lyndhurst, NJ, is a leading manufacturer of products and systems for the construction and motor vehicle markets.

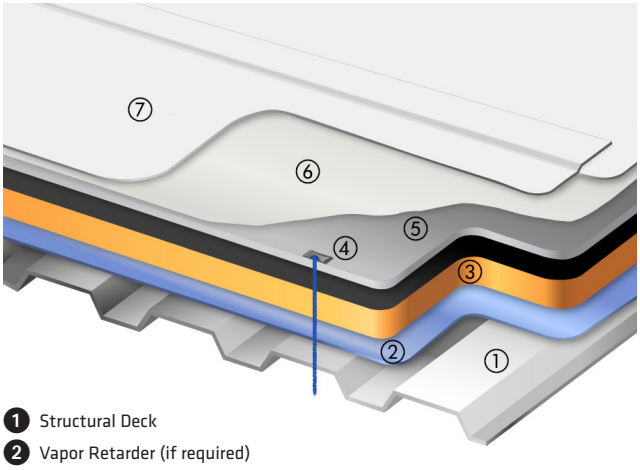
Sika Corporation's roofing division has more than 50 years of experience manufacturing high quality, thermoplastic (PVC), single-ply roofing and waterproofing systems for the non-residential market. Sika is also the first roofing manufacturer to be rated "Platinum" according to NSF/ANSI 347, the leading consensus sustainability standard.

PRODUCT DESCRIPTION AND USE
With a track record of performance of over 50 years, Sarnafil roofing membranes are the products of choice for architects, specifiers and building owners who want the peace of mind that comes with buying from the performance leader.

Sarnafil G 410 roof membrane is a thermoplastic PVC membrane used in adhered systems. Sarnafil G 410 is fiberglass reinforced, offering exceptional dimensional stability and a low coefficient of thermal expansion suitable for adhering the membrane to the roof substrate. A unique lacquer coating is applied to the top surface of the membrane which helps to reduce soiling.

Sika's Thickness Guarantee Program for all Sarnafil branded membranes guarantees they meet or exceed the labeled thickness, rather than following industry standards, which allows for membranes to be manufactured up to 10% below advertised thickness.

INSTALLATION
After proper preparation of the substrate, the Sarnafil G 410 membrane is unrolled into a Sarnacol adhesive in accordance with Sika's Technical requirements and then pressed into place with a minimum 100 lb steel roller. The seams are heat-welded together by trained operators using hot-air welding equipment. For the EPD calculations, the application of the adhesive Sarnacol 2121, which is broadly applied in the U.S., was assumed (0.44 kg/m^2).



1. Structural Deck
2. Vapor Retarder (if required)
3. Insulation
4. Insulation Fastener
5. Coverboard (if required)
6. Membrane Adhesive
7. Sarnafil G Membrane

SUSTAINABILITY CERTIFIED NSF
Platinum Certified
NSF/ANSI 347
Sustainable Single Ply Roofing

Sarnafil MEMBRANE THICKNESS GUARANTEE

USE PHASE

In case of Sarnafil G 410 membranes, it is assumed that neither maintenance, refurbishment nor repair is required for the roofing system. Thus, the use phase only includes replacement. With a reference service life of 35 years, this implies one additional application of 1,000 m^2 of membrane plus overlaps and fixation are required to reach the building service life of 60 years.

The reference service life of 35 years of Sarnafil G 410 roofing membrane has been reviewed by the Athena Sustainable Materials Institute based on Sika's product performance data from various sites across North America and a thorough review of various research and certification documents. This reflects the high resistance to weathering and aging of the product when properly installed and used.

END OF LIFE

As adhered roofing systems cannot be recycled, Sarnafil G 410 membranes are sent to landfill at the end of their service life.

PRODUCT SPECIFICATIONS

TECHNICAL DATA	UNITS	ASTM TEST METHOD	ASTM D4434 TYPE III REQUIREMENT	VALUE/TEST RESULTS		
				60 MILS	72 MILS	80 MILS
Weight	[kg/m^2]	–	–	1.8	2.3	2.5
Total Recycled Content (both pre– and post–consumer)[1]	[%]	–	–	10		
Reinforcing Material	–	–	–	Fiberglass mat		
Overall Thickness	[mil]	D751	45	60	72	80
Reflectivity	[%]	ASTM C1549	–	0.85[2] - 0.74[3]		
Emissivity	[%]	ASTM C1371	–	0.86[2] - 0.84[3]		
Solar Reflective Index (white)	–	–	–	107[2] - 90[3]		
Breaking Strength (M.D.), min.	[lbf/in] (KN/m)	D751	55 (245)	80 (356)	100 (445)	110 (489)
Elongation at Break, min.	–	D751	–			
Machine Direction	[%]		250	250	250	250
Cross Direction	[%]		220	220	220	220
Seam Strength, min., (% of original)[4]	[%]	D751	75	Pass		
Retention of Properties After Heat Aging	[%]	D3045	–	–		
Tensile Strength, min., (% of original)	[%]	D751	90	Pass		
Elongation, min., (% of original)	[%]	D751	90	Pass		
Tearing Strength (C.D.), min	[lbf] (N)	D1004	10 (45)	17.5 (78)	20.5 (91)	22 (98)
Low Temperature Bend, -40 °F (-40 °C)	–	D2136	Pass	Pass		
Accelerated Weathering Test (Fluorescent Light, UV exposure)	–	G154	5,000 hours	10,000 hours		
Cracking (7x magnification)		None	None	None		
Discoloration (by observation)		Negligible	Negligible	Negligible		
Crazing (7x magnification)		None	None	None		
Linear Dimensional Change (C.D.), %	[%]	D1204	0.1 max.	-0.02	-0.01	-0.01
Weight Change After Immersion in Water, %	[%]	D570	±3.0 max.	1.9	1.8	1.7
Static Puncture Resistance	[lbf] (kg)	D5602	33 (15)	Pass		
Dynamic Puncture Resistance	[ft-lbf] (J)	D5635	7.3 (10)	Pass		

[1] Pre-consumer material: roofing membrane trimmings from Sika's manufacturing process and market supplied post-industrial PVC scrap material. Post-consumer material: Sika Sarnafil and other PVC roofing material at the end of its service life (total average recycled content: minimum 10%)

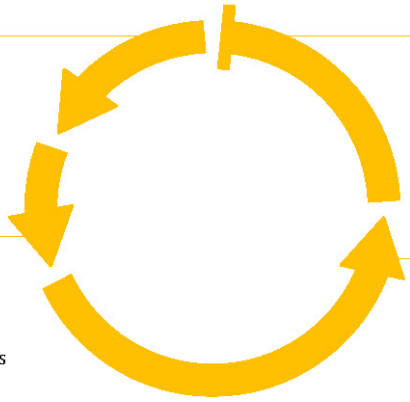
[2] New Membrane

[3] 3 year aged membrane

[4] Failure occurs through membrane rupture not seam failure

Life Cycle Stages

STAGES INCLUDED IN THIS LIFE CYCLE ASSESSMENT (LCA)



1 PRODUCT STAGE
Included in System Boundary

A1: Raw Material Supply
A2: Transport
A3: Manufacturing

2 CONSTRUCTION STAGE
Included in System Boundary

A4: Transport
A5: Construction/Installation Process

3 USE STAGE
Included in System Boundary

B1: Use
B2: Maintenance
B3: Repair
B4: Replacement
B5: Refurbishment
B6: Operational Energy Use
B7: Operational Water Use

4 END OF LIFE STAGE
Included in System Boundary

C1: De-construction/Demolition
C2: Transport
C3: Waste Processing
C4: Disposal

SYSTEM BOUNDARY

INCLUDED	
A1-A3	• Extraction and processing of raw materials, including fuels used in product manufacturing; • Transportation of raw materials including empty backhauls; • Manufacturing of the product; • Packaging of the product ready for shipment; • Transportation from the manufacturing site to recycling/reuse for pre-consumer waste and unutilized byproducts from manufacturing, including empty backhauls; and • Recycling/reuse of pre-consumer waste and by-products of production.
A4-A5	• Transportation of product from manufacturing site to building site, including empty backhauls; • Installation on the building site including adhesive for adhered system (0.44 kg/m^2 of Sarnacol 2121 Adhesive); and • Disposal (landfill) of waste produced on the building site.
B1-B7	• Reference service life of the building is assumed to be 60 years according to the PCR and the number of replacements of the building product are declared accordingly (note that an assumed 60-year reference service life for the building is the accepted time period for the purpose of comparative analysis); • Any replacement of the building product (B4) required to attain the reference service life of the building based on a verifiable product performance history; • As the product reference service life (35 years) is less than the assumed building service life (60 years), the aggregated product stage, construction process stage and end of life stage impacts (modules A1 – A5 and C1 – C4) associated with the number of roof replacements necessary to equal the service life of the building are included; • The combined impacts of the original product and any roof replacements are determined by dividing the building service life (60 years) by the service life of the product, and the impacts are multiplied by the result. In this case, the impacts are multiplied by 1.7, thus normalizing the roof replacements during the assumed 60-year building service life. • It is assumed that no use inputs/outputs (B1), maintenance (B2), repair (B3), refurbishment (B5) or operational water (B6) and energy (B7) use is required for the roofing system.
C1-C4	• Dismantling/demolition of the roof system (assumed to be carried out manually using hand tools); • Average transport from building site to landfill, including empty backhauls; and • Landfilling processes.
NOT INCLUDED	
ALL MODULES	• Capital goods & infrastructure, production, equipment, delivery vehicles, lab equipment, personnel-related activities and energy and water use related to company management and sales, have been excluded in the scope of the study.

MATERIAL CONTENT DECLARATION

The material average percentage by weight for 1 m^2 for the Sarnafil G 410 60, 72 and 80 mils is provided.

MATERIAL AVERAGE PERCENTAGE BY WEIGHT FOR 1 M^2: SARNAFIL G 410 60, 72 AND 80 MILS		PACKAGING MATERIAL	DECLARED PRODUCT [MILS]		
RAW MATERIAL INPUT	**TOTAL WEIGHT BY [%]**		**60**	**72**	**80**
PVC resin new material	43	Cardboard Core [kg]	0.05	0.05	0.05
PVC resin recycled content	14	Wooden Pallet [kg]	0.13	0.22	0.22
Plasticizer	28	PE Film [kg]	0.005	0.006	0.006
Fiberglass mat	2				
Rest of chemicals	13				
Total weight (Input)	**100**	**Total [kg/m^2]**	**0.18**	**0.27**	**0.27**

LIFE CYCLE IMPACTS

The results displayed below apply to Sarnafil G 410 with a thickness of 60 mils, 72 mils and 80 mils.

RESULTS SARNAFIL G 410 [60 MILS]	FUNCTIONAL UNIT OF 1,000 M^2 INSTALLED MEMBRANE				
CATEGORY INDICATOR	**TOTAL**	**PRODUCT STAGE**	**CONSTRUCTION STAGE**	**USE STAGE**	**END OF LIFE STAGE**
		A1-A3	**A4-A5**	**B4**	**C1-C4**
Global Warming Air, incl. biogenic carbon [kg CO_2-eq.]	1.21E+04	5.32E+03	1.54E+03	5.03E+03	1.73E+02
Acidification Potential [kg SO_2-eq.]	1.08E+02	5.26E+01	7.97E+00	4.50E+01	2.43E+00
Eutrophication Potential [kg N-eq.]	3.63E+00	8.90E-01	5.21E-01	1.51E+00	7.06E-01
Smog Creation Potential [kg O_3-eq.]	9.37E+02	3.16E+02	1.95E+02	3.90E+02	3.53E+01
Ozone Depletion Potential [kg ethene-eq.]	1.76E-04	7.27E-05	2.98E-05	7.32E-05	4.17E-09
TOTAL PRIMARY ENERGY CONSUMPTION[5]					
Non-renewable fossil [MJ]	2.92E+05	1.31E+05	3.64E+04	1.21E+05	2.76E+03
Non-renewable nuclear [MJ]	1.37E+04	6.61E+03	1.31E+03	5.70E+03	5.79E+01
Renewable (solar, wind, hydropower, geothermal) [MJ]	6.24E+03	2.97E+03	5.46E+02	2.60E+03	1.21E+02
Renewable (biomass) [MJ]	8.85E+00	1.40E+00	3.77E+00	3.69E+00	0
MATERIAL RESOURCES CONSUMPTION[6]					
Non-renewable materials [kg]	3.13E+03	1.72E+03	1.09E+02	1.31E+03	0
Renewable materials [kg]	3.19E+02	1.75E+02	1.11E+01	1.33E+02	0
Fresh water [l]	1.78E+05	3.45E+04	6.99E+04	7.42E+04	-4.89E+02
WASTE GENERATED					
Non-hazardous [kg]	4.95E+03	2.50E+02	1.33E+02	2.06E+03	2.50E+03
Hazardous [kg]	5.15E-05	1.62E-05	7.51E-06	2.14E-05	6.30E-06

[5] Total Primary Energy includes both feedstock energy and process energy.

[6] The nonrenewable and renewable materials were calculated by summing up the mass of the main components with high heating value.

RESULTS SARNAFIL G 410 [72 MILS]	FUNCTIONAL UNIT OF 1,000 M² INSTALLED MEMBRANE				
CATEGORY INDICATOR	**TOTAL**	**PRODUCT STAGE**	**CONSTRUCTION STAGE**	**USE STAGE**	**END OF LIFE STAGE**
		A1-A3	**A4-A5**	**B4**	**C1-C4**
Global Warming Air, incl. biogenic carbon [kg CO_2-eq.]	1.41E+04	6.39E+03	1.64E+03	5.88E+03	1.96E+02
Acidification Potential [kg SO_2-eq.]	1.28E+02	6.31E+01	8.83E+00	5.33E+01	2.74E+00
Eutrophication Potential [kg N-eq.]	4.16E+00	1.07E+00	5.44E-01	1.73E+00	8.17E-01
Smog Creation Potential [kg O_3-eq.]	1.06E+03	3.78E+02	2.04E+02	4.43E+02	3.85E+01
Ozone Depletion Potential [kg ethene-eq.]	2.02E-04	8.73E-05	3.08E-05	8.44E-05	4.63E-09
TOTAL PRIMARY ENERGY CONSUMPTION[5]					
Non-renewable fossil [MJ]	3.40E+05	1.57E+05	3.85E+04	1.42E+05	3.13E+03
Non-renewable nuclear [MJ]	1.60E+04	7.89E+03	1.40E+03	6.68E+03	6.57E+01
Renewable (solar, wind, hydropower, geothermal) [MJ]	7.32E+03	3.55E+03	5.83E+02	3.05E+03	1.41E+02
Renewable (biomass) [MJ]	8.91E+00	1.43E+00	3.77E+00	3.71E+00	0
MATERIAL RESOURCES CONSUMPTION[6]					
Non-renewable materials [kg]	3.75E+03	2.06E+03	1.31E+02	1.56E+03	0
Renewable materials [kg]	4.83E+02	2.65E+02	1.69E+01	2.01E+02	0
Fresh water [l]	1.87E+05	3.95E+04	7.02E+04	7.80E+04	-5.68E+02
WASTE GENERATED					
Non-hazardous [kg]	5.76E+03	3.05E+02	1.41E+02	2.40E+03	2.91E+03
Hazardous [kg]	5.73E-05	1.84E-05	7.67E-06	2.39E-05	7.33E-06

[5] Total Primary Energy includes both feedstock energy and process energy.

[6] The nonrenewable and renewable materials were calculated by summing up the mass of the main components with high heating value.

RESULTS SARNAFIL G 410 [80 MILS]	FUNCTIONAL UNIT OF 1,000 M² INSTALLED MEMBRANE				
CATEGORY INDICATOR	**TOTAL**	**PRODUCT STAGE**	**CONSTRUCTION STAGE**	**USE STAGE**	**END OF LIFE STAGE**
		A1-A3	**A4-A5**	**B4**	**C1-C4**
Global Warming Air, incl. biogenic carbon [kg CO_2-eq.]	1.55E+04	7.11E+03	1.71E+03	6.45E+03	2.11E+02
Acidification Potential [kg SO_2-eq.]	1.41E+02	7.00E+01	9.40E+00	5.89E+01	2.95E+00
Eutrophication Potential [kg N-eq.]	4.54E+00	1.20E+00	5.59E-01	1.89E+00	8.90E-01
Smog Creation Potential [kg O_3-eq.]	1.15E+03	4.19E+02	2.11E+02	4.79E+02	4.06E+01
Ozone Depletion Potential [kg ethene-eq.]	2.20E-04	9.68E-05	3.14E-05	9.16E-05	4.92E-09
TOTAL PRIMARY ENERGY CONSUMPTION[5]					
Non-renewable fossil [MJ]	3.73E+05	1.74E+05	3.98E+04	1.55E+05	3.37E+03
Non-renewable nuclear [MJ]	1.76E+04	8.75E+03	1.45E+03	7.34E+03	7.09E+01
Renewable (solar, wind, hydropower, geothermal) [MJ]	8.04E+03	3.93E+03	6.07E+02	3.35E+03	1.54E+02
Renewable (biomass) [MJ]	8.94E+00	1.44E+00	3.77E+00	3.72E+00	0
MATERIAL RESOURCES CONSUMPTION[6]					
Non-renewable materials [kg]	4.16E+03	2.28E+03	1.45E+02	1.73E+03	0
Renewable materials [kg]	4.83E+02	2.65E+02	1.69E+01	2.01E+02	0
Fresh water [l]	1.93E+05	4.27E+04	7.04E+04	8.04E+04	-6.21E+02
WASTE GENERATED					
Non-hazardous [kg]	6.30E+03	3.43E+02	1.47E+02	2.62E+03	3.18E+03
Hazardous [kg]	6.07E-05	1.96E-05	7.75E-06	2.53E-05	8.01E-06

[5] Total Primary Energy includes both feedstock energy and process energy.

[6] The nonrenewable and renewable materials were calculated by summing up the mass of the main components with high heating value.

Interpretation of the Results

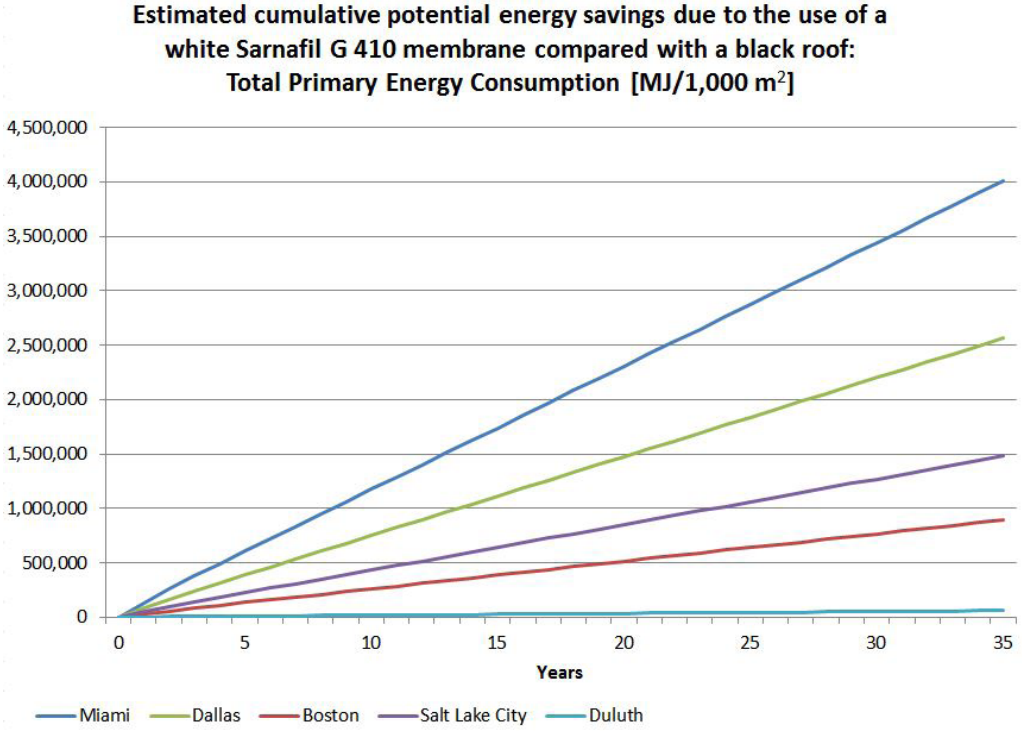
The results for the Cradle-to-Grave assessment of Sarnafil G 410 show that most impacts come from module A1-A3 and, consequently, also from module B. Raw materials extraction and production, summed up across modules A1-A3 and B, account between 44% and 99% of the total impacts, except for fresh water use, non-hazardous waste and renewable energy from biomass. The impacts from raw materials and production are particularly high for global warming potential, acidification potential, non-renewable primary energy consumption, renewable primary energy consumption (solar, wind, hydropower and geothermal) as well as non-renewable and renewable materials (all at least 76%). Within A1-A3, raw materials extraction accounts for the highest percentage, especially for primary energy indicators (non-renewable fossil and renewable) and the ozone depletion potential. Manufacturing is the second largest contributor, while transport of raw materials to manufacturing was found to have a minor relative impact.

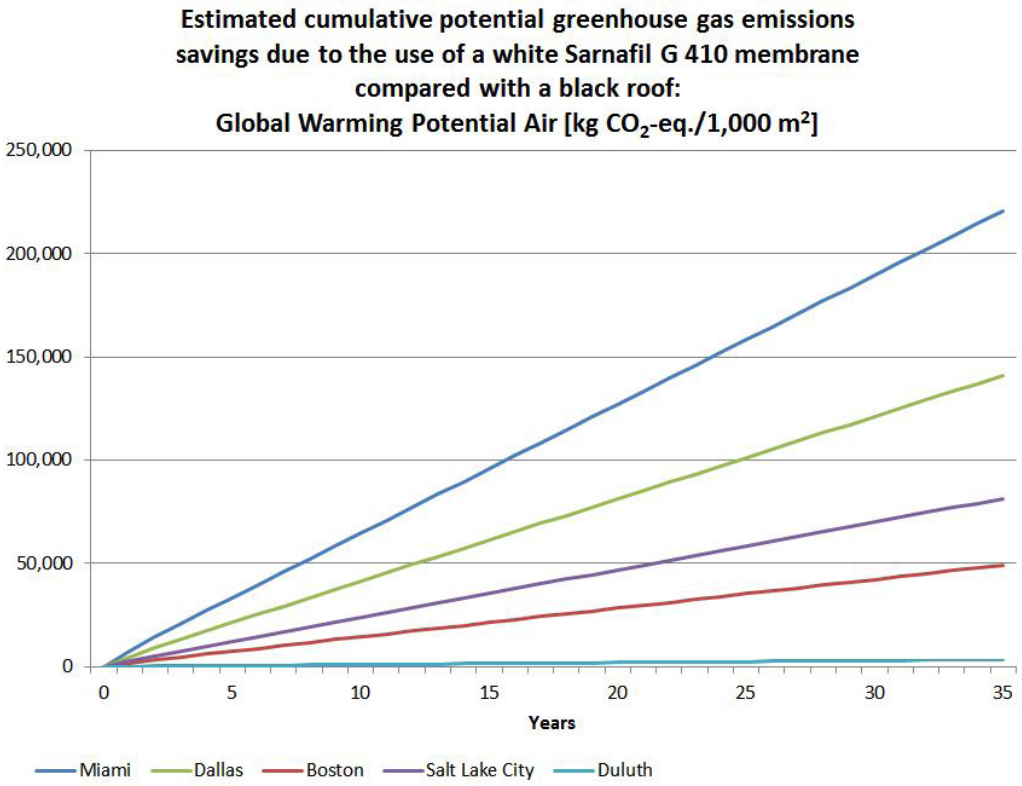
Additional Environmental Information

- Sarnafil roofing membranes were the first products to achieve Platinum certification to the NSF/ANSI 347 Sustainability Assessment for Single Ply Roofing Membranes.
- The Sarnafil EnergySmart® membrane has a highly reflective, lacquer-coated surface that can reduce cooling and overall energy consumption in conditioned buildings. Sarnafil roof membranes exceed the cool roof requirements of ENERGYSTAR,® California's Building Energy Code (Title 24), LEED® and Green Globes®.
- Sika's Roof Recycling Program has diverted more than 57 million pounds of pre-consumer and post-consumer vinyl membrane from landfill, recycling it back into roofing and waterproofing membrane products.
- Sarnafil 5-foot and 10-foot membranes have been validated by UL Environment to contain an average of 10% recycled content.
- Sarnafil roof membranes help building owners achieve LEED and Green Globes certification.
- The reference service life of 35 years was reviewed by the Athena Sustainable Materials Institute, based on the results of various field surveys.

USE PHASE BENEFITS

- Using white, highly reflective Sarnafil roofing membranes can help reduce net annual energy consumption by reducing cooling energy use of buildings and thus reduce the operational carbon emissions over time. The estimated potential net energy savings resulting from the installation of the white, highly reflective Sarnafil roofing membrane compared to a black roof were calculated for different climatic zones (five locations) in the USA using the USEPA DOE Roof Calculator (version 1.2), developed by the U.S. Department of Energy's Oak Ridge National Laboratory. The properties of the insulation represent the minimum insulation requirements in the building codes of the different locations. The initial solar reflectance is assumed to be 85% and the initial infrared emittance is set as 86%.
- It is estimated that using white, highly reflective Sarnafil roofing membrane, about 4,011 GJ energy could potentially be saved in Miami on a roof area of 1,000 m^2 compared with the black colored membrane over a period of 35 years (all thicknesses). This results in avoided greenhouse gas emissions of about 220.797 t CO_2-eq. per 1,000 m^2 of roof surface.





EPD VERIFICATION

This EPD was independently verified by ASTM in accordance with ISO 14025:

Internal ☐	**External** ☒	Lindita Bushi, Ph.D., Senior Research Associate Athena Sustainable Materials Institute 100-119 Ross Avenue Ottawa, Ontario, Canada K1Y0N6 lindita.bushi@athenasmi.org	**Signed:** Lindita Bushi
Program Operator		Timothy Brooke ASTM International 100 Bar Harbor Drive West Conshohocken, PA 19428 tbrooke@astm.org	**Signed:** Timothy L Brooke

Declaration Holder	Sika Corporation		
Product group	**Date of Issue**	**Period of Validity**	**Declaration Number**
	12/20/2017	5 years	EPD077

DECLARATION TYPE

A "Cradle-to-Grave" EPD for three selected thicknesses of the Sarnafil G 410 roofing membrane (60, 72 and 80 mils).

The modules included are A1-A3, A4-A5, B1-B7 and C1-C4. The declaration is intended for use in Business to Business (B2B) communication.

PRODUCT APPLICABILITY AND CHARACTERISTICS

The declared Sarnafil G 410 roofing membrane thicknesses (60, 72 and 80 mils) are designed for low-slope and steep slope roofing applications. The membranes include an internal polyester reinforcement to provide the tear resistance required for mechanically-fastened roof systems.

CONTENT OF THE DECLARATION

This declaration follows Section 11, Content of the EPD, ASTM International Product Category Rules for Preparing an Environmental Product Declaration for Single-Ply Roofing Membranes, January 2016.

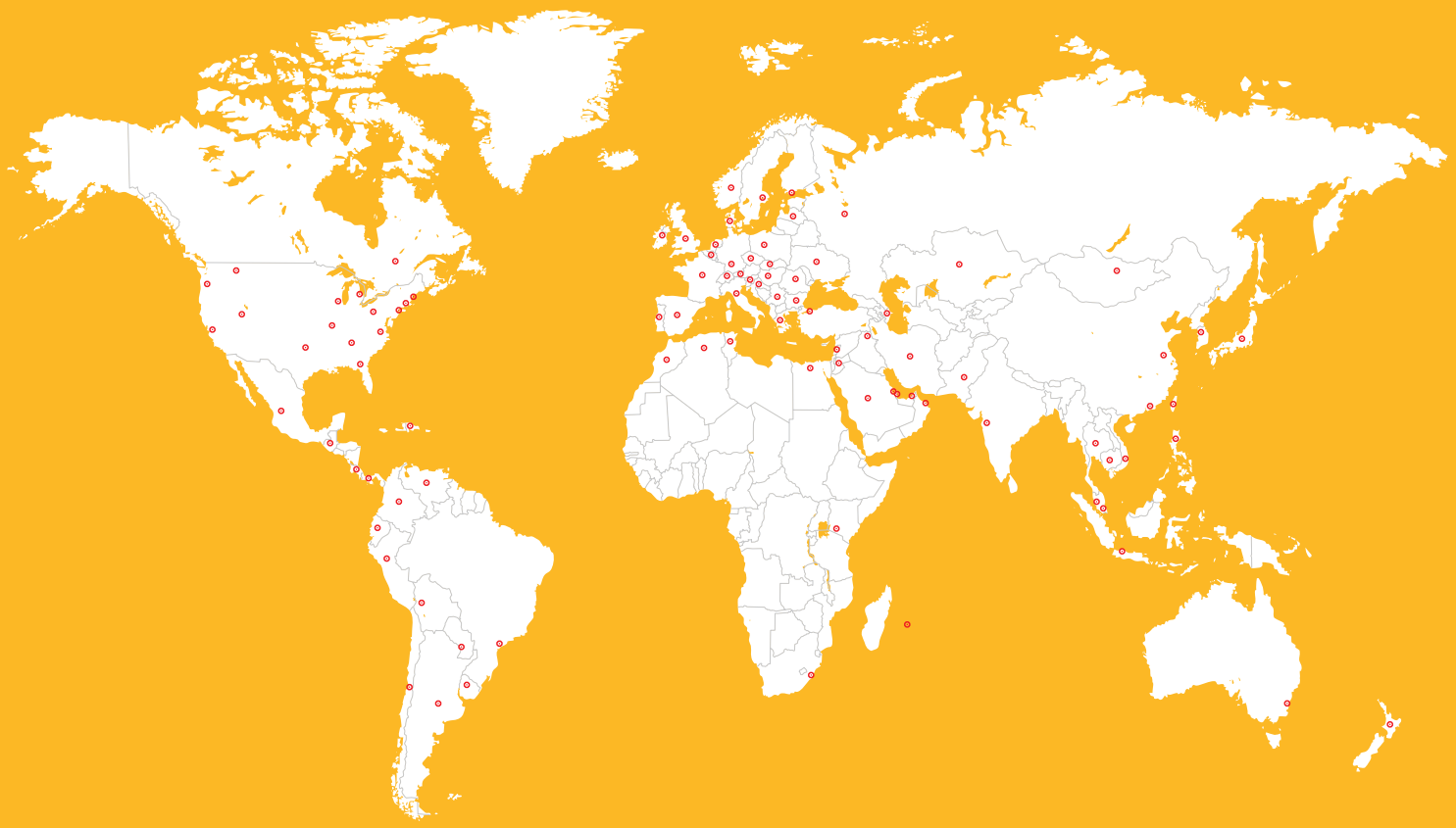
EPD PROJECT REPORT INFORMATION

EPD PROJECT REPORT	A "Cradle-to-Grave" Life Cycle Assessment for three thicknesses of Sarnafil G 410 (60, 72 and 80 mils), 11/28/2017
LCA AND EPD PREPARED BY:	Global Poduct Sustainability Sika Services AG Tüffenwies 16 8048 Zürich Switzerland product.sustainability@ch.sika.com

PCR INFORMATION

PROGRAM OPERATOR	ASTM International
REFERENCE PCR	ASTM International, Product Category Rules for Preparing an Environmental Product Declaration for Single Ply Roofing Membranes
DATE OF ISSUE	01/15/16, version 2 (version 1 issued November 2013)
PCR REVIEW WAS CONDUCTED BY:	Francois Charron-Doucet Quantis International Email: francois.charron@quantis-intl.com

GLOBAL BUT LOCAL PARTNERSHIP



WHO WE ARE

Sika AG, located in Baar, Switzerland, is a specialty chemicals company with a leading position in the development and production of systems and products for bonding, sealing, damping, reinforcing and protecting in the building sector and the motor vehicle industry.

The corporation has subsidiaries in 98 countries, employs more than 17,000 people worldwide, and has more than 190 manufacturing facilities around the globe.

Our most current General Sales Conditions shall apply.
Please consult the Product Data Sheet prior to any use and processing.
ISO 14001: 2004-Compliant

ENERGY STAR® for roofing products is only valid in the United States.
ENERGY STAR® is a trademark of the U.S. EPA.
LEED® is a trademark of the U.S. Green Building Council.
Green Globes® is a trademark of the Green Building Initiative.

SIKA CORPORATION–ROOFING
100 Dan Road
Canton, MA 02021
Tel: 800-451-2504
Fax: 781-828-5365
usa.sarnafil.sika.com
webmaster.sarnafil@us.sika.com

Sarnafil®

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