Environmental Product Declaration

BUR (Built-Up Roofng) - Oxidized Asphalt Roofing Membranes

Installation: Hot Asphalt Applied

Founded in 1886, GAF is the leading roofing manufacturer in North America. As a member of the Standard Industries family of companies, GAF is part of the largest roofing and waterproofing business in the world. The company's products include a comprehensive portfolio of roofing and waterproofing solutions for residential and commercial properties as well as for civil engineering applications. The full GAF portfolio of solutions is supported by an extensive national network of factory-certified contractors. GAF continues to be the leader in quality and offers comprehensive warranty protection on its products and systems. The company's success is driven by a commitment to empowering its people to deliver advanced quality and purposeful innovation. For more information about GAF, visit www.gaf.com.

A resilient and durable Modified Bitumen Roofing Membrane for use in multiply roofing assemblies.

NSF Certified Environmental Product Declaration www.nsf.org

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025 and ISO 21930-2017. 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.

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	NSF International, 789 N. Dixboro Rd, Ann Arbor, MI 48105, www.nsf.org
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	NSF Certification Policies for Environmental Product Declarations (EPD): November 1, 2022
MANUFACTURER NAME AND ADDRESS	GAF 1 Campus Drive, Parsippany, NJ 07054
DECLARATION NUMBER	EPD11029
DECLARED PRODUCT & DECLARED UNIT	BUR (Built-Up Roofng) - Oxidized Asphalt Roofing Membranes Declared Unit = 1 m²
REFERENCE PCR AND VERSION NUMBER	UL PCR B: Asphalt Shingles, Built-up Asphalt Membrane Roofing and Modified Bituminous Membrane Roofing EPD Requirements Valid through July 1, 2025
DESCRIPTION OF PRODUCT APPLICATION/USE	Built-Up Asphalt Roofing (BUR)
PRODUCT RSL DESCRIPTION	N/A
MARKETS OF APPLICABILITY	Global
DATE OF ISSUE	July 21, 2025
PERIOD OF VALIDITY	7/21/2025 to 7/21/2030
EPD TYPE	Product Specific
DATASET VARIABILITY	N/A
EPD SCOPE	Cradle-to-Gate withoptions
YEAR(S) OF REPORTED PRIMARY DATA	2021
LCA SOFTWARE & VERSION NUMBER	LCA for Experts v. 10.6 GAF EPD Generator Tool Version 1.0
LCI DATABASE(S) & VERSION NUMBER	Sphera database & USLCI v2.0
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1; CML 4.1
The sub-category PCR review was conducted by:	Tom Gloria, Industrial Ecology Consultants t.gloria@industrial-ecology.com
This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v3.2 (Dec 2018), based on ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017) ☐ INTERNAL ☒ EXTERNAL	Jack Geibig, EcoForm, LLC jgeibig@ecoform.com
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Sustainable Solutions Corporation
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Jack Geibig, EcoForm, LLC jgeibig@ecoform.com

Environmental declarations from different programs (ISO 14025) may not be comparable.

Comparison of the environmental performance using EPD information shall consider all relevant information modules over the full life cycle of the products within the building.

This PCR allows EPD comparability only when the same functional requirements between products are ensured and the requirements of ISO 21930:2017 §5.5 are met. It should be noted that different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

General Information

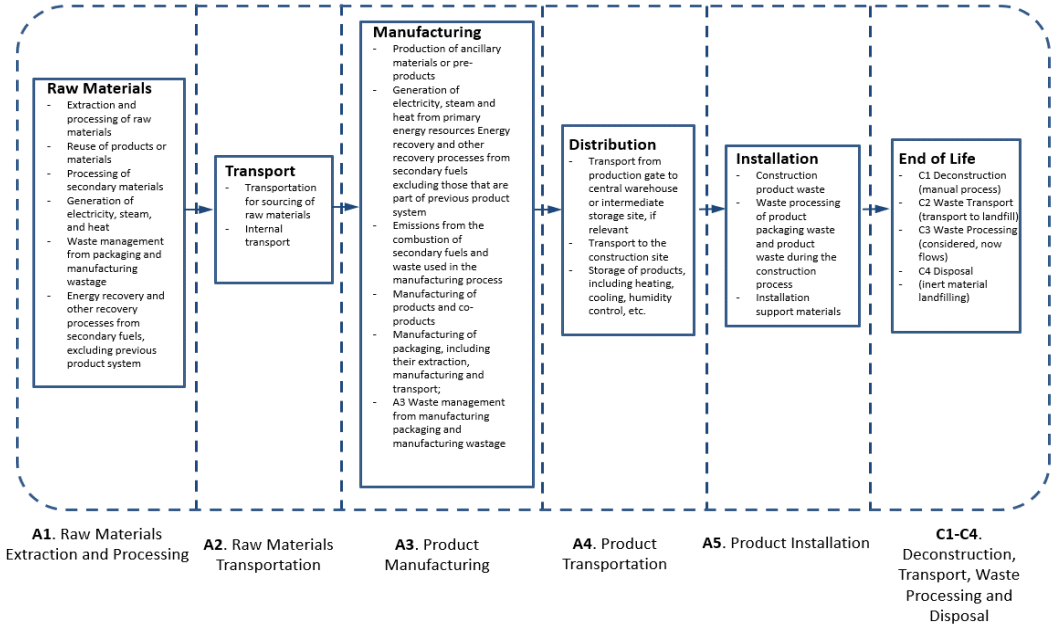
Description of Company/Organization

Founded in 1886, GAF is the leading roofing manufacturer in North America. As a member of the Standard Industries family of companies, GAF is part of the largest roofing and waterproofing business in the world. The company's products include a comprehensive portfolio of roofing and waterproofing solutions for residential and commercial properties as well as for civil engineering applications. The full GAF portfolio of solutions is supported by an extensive national network of factory-certified contractors. GAF continues to be the leader in quality and offers comprehensive warranty protection on its products and systems. The company's success is driven by a commitment to empowering its people to deliver advanced quality and purposeful innovation. For more information about GAF, visit www.gaf.com.

Product Description

BUR roofing technology has been around for over a century. It consists of melting bricks of asphalt in a large metal kettle and mopping that asphalt in-between a base sheet, ply sheets and lastly a cap sheet. Ply sheets and additional layers of asphalt can be added until the desired thickness is reached. In some systems a cold applied cap sheet is installed. While cap sheets are very popular, some jobs are finished with a layer of gravel over the asphalt. Products included within this EPD are: GAFGLAS® Ply 4, Tri-Ply® Ply 4, GAFGLAS® Mineral Surfaced, GAFGLAS® EnergyCap™ Mineral-Surfaced, GAFGLAS® #75, Tri-Ply® #75, GAFGLAS® #80 Ultima, GAFGLAS® Stratavent® Perforated, GAFGLAS® Stratavent® Nailable.

Flow Diagram



Manufacturer Specific EPD

This product-specific EPD was developed based on the cradle-to-gate with options (modules A1-A5, C1-C4) Life Cycle Assessment. The EPD accounts for raw material extraction and processing, transport, product manufacturing, distribution, installation, and disposal. Manufacturing data were gathered directly from company personnel. For any product group EPDs, an impact assessment was completed for each product. Product grouping was considered appropriate if the individual product impacts differed by no more than ±10% in any impact category.

Application

Hot Asphalt or Cold Adhesive Applied

Material Composition

The primary product components and/or materials must be indicated as a percentage mass to enable the user of the EPD to understand the composition of the product in delivery status.
In the following material compositions for Asphalt BUR there are 6 configurations. Layers are not sold separately.
Configurations include three layers: Base Sheet, Ply Sheet, and Cap Sheet.
Average data was implimented to reduce the number of configurations. Averages were only used in the case where impacts of each component in every category was less than 10% different from eachother.

There are three base sheet options that include:
- Average #75 (This is an average of GAFGLAS® #75 and Tri-Ply® #75)
- GAFGLAS® #80 Ultima™
- Average Stratavent® (This is an average of GAFGLAS® Stratavent® Perforated and GAFGLAS® Stratavent® Nailable)

There is one ply sheet option:
- Average ply (This is an average of GAFGLAS® Ply 4, Tri-Ply® Ply 4, and GAFGLAS® Ply 6)

There are two cap sheet options:
- GAFGLAS® EnergyCap™ Mineral-Surfaced
- GAFGLAS® Mineral-Surfaced

The composition of BUR with Average #75, Average ply, and GAFGLAS® EnergyCap™ Mineral-Surfaced is as follows:

Category	Materials	Category %
[BUR] Fiberglass	Fiberglass	5-10%
[BUR] Asphalt Compound	Asphalt Compound	45-55%
[BUR] Sand	Sand	5-10%
[BUR] EnergyCap™ Granules	EnergyCap™ Granules	25-35%
[BUR] LPA	LPA	5-10%
[BUR] 4141 Fines	Limestone or Talc	0%
[BUR] Granules	Small Shaker Granules	0%
*The GAF product modelled in this study contains no substances that are required to be reported as hazardous, nor are any such substances utilized in its production		

The composition of BUR with GAFGLAS® #80 Ultima™, Average ply, and GAFGLAS® EnergyCap™ Mineral-Surfaced is as follows:

Category	Materials	Category %
[BUR] Fiberglass	Fiberglass	2.5-7.5%
[BUR] Asphalt Compound	Asphalt Compound	40-50%
[BUR] Sand	Sand	7.5-12.5%
[BUR] EnergyCap™ Granules	EnergyCap™ Granules	20-30%
[BUR] LPA	LPA	10-20%
[BUR] 4141 Fines	Limestone or Talc	0%
[BUR] Granules	Small Shaker Granules	0%
*The GAF product modelled in this study contains no substances that are required to be reported as hazardous, nor are any such substances utilized in its production		

The composition of BUR with Average Stratavent®, Average ply, and GAFGLAS® EnergyCap™ Mineral-Surfaced is as follows:

Category	Materials	Category %
[BUR] Fiberglass	Fiberglass	3-7%
[BUR] Asphalt Compound	Asphalt Compound	40-50%
[BUR] Sand	Sand	5-7%
[BUR] EnergyCap™ Granules	EnergyCap™ Granules	20-26%
[BUR] LPA	LPA	0-2%
[BUR] 4141 Fines	Limestone or Talc	15-25%
[BUR] Granules	Small Shaker Granules	0%
*The GAF product modelled in this study contains no substances that are required to be reported as hazardous, nor are any such substances utilized in its production		

The composition of BUR with Average #75, Average ply, and GAFGLAS® Mineral-Surfaced is as follows:

Disposal	Materials	Category %
[BUR] Fiberglass	Fiberglass	5-10%
[BUR] Asphalt Compound	Asphalt Compound	40-50%
[BUR] Sand	Sand	5-10%
[BUR] EnergyCap™ Granules	EnergyCap™ Granules	0%
[BUR] LPA	LPA	5-10%
[BUR] 4141 Fines	Limestone or Talc	0%
[BUR] Granules	Small Shaker Granules	30-40%
*The GAF product modelled in this study contains no substances that are required to be reported as hazardous, nor are any such substances utilized in its production		

The composition of BUR with GAFGLAS® #80 Ultima™, Average ply, and GAFGLAS® Mineral-Surfaced is as follows:

Disposal	Materials	Category %
[BUR] Fiberglass	Fiberglass	2-7%
[BUR] Asphalt Compound	Asphalt Compound	40-50%
[BUR] Sand	Sand	7.5-12.5%
[BUR] EnergyCap™ Granules	EnergyCap™ Granules	0%
[BUR] LPA	LPA	10-20%
[BUR] 4141 Fines	Limestone or Talc	0%
[BUR] Granules	Small Shaker Granules	20-30%
*The GAF product modelled in this study contains no substances that are required to be reported as hazardous, nor are any such substances utilized in its production		

The composition of BUR with Average Stratavent®, Average ply, and GAFGLAS® Mineral-Surfaced is as follows:

Disposal	Materials	Category %
[BUR] Fiberglass	Fiberglass	3-7%
[BUR] Asphalt Compound	Asphalt Compound	40-50%
[BUR] Sand	Sand	5-10%
[BUR] EnergyCap™ Granules	EnergyCap™ Granules	0%
[BUR] LPA	LPA	0-2%
[BUR] 4141 Fines	Limestone or Talc	15-25%
[BUR] Granules	Small Shaker Granules	20-30%
*The GAF product modelled in this study contains no substances that are required to be reported as hazardous, nor are any such substances utilized in its production		

Technical Data

The appropriate ASTM or CSA product specification shall be provided, including additional pertinent physical properties and technical information.

BUR Ply Sheet (ASTM D2178, Type IV)	Standard Minimum Value	GAF Value: GAFGLAS® Ply 4
Property Ash (glass mat only) (%)	70-88	74
MD breaking strength, lbf/in. (kN/m)	44 (7.7)	49 (9.9)
XMD/CD breaking strength, lbf/in. (kN/m)	44 (7.7)	45 (7.9)
Pliability, 1/2 in. (13 mm) radius bend	No Failures	Pass
Net dry mass, lb./100 ft.2 (g/m2) (Individual Rolls)	6.0 (293)	6.7 (327)
Moisture at time of manufacture, max. (%)	1	≤ 1.0
Mass of desaturated mat, min., (lb./100 ft.2 (g/m2)	1.7 (83)	1.7 (83)
Bituminous saturant, lb./100 ft.2 (g/m2)	3.0 (146)	3.1 (151)
Unrolling @50° F and 140° F (Pass/Fail)	Pass/Fail	Pass

BUR Ply Sheet (ASTM D2178, Type IV)	Standard Minimum Value	GAF Value: Tri-Ply® Ply 4
Property Ash (glass mat only) (%)	70-88	74
MD breaking strength, lbf/in. (kN/m)	44 (7.7)	49 (9.9)
XMD/CD breaking strength, lbf/in. (kN/m)	44 (7.7)	45 (7.9)
Pliability, 1/2 in. (13 mm) radius bend	No Failures	Pass
Net dry mass, lb./100 ft.2 (g/m2) (Individual Rolls)	6.0 (293)	6.7 (327)
Moisture at time of manufacture, max. (%)	1	≤ 1.0
Mass of desaturated mat, min., (lb./100 ft.2 (g/m2)	1.7 (83)	1.7 (83)
Bituminous saturant, lb./100 ft.2 (g/m2)	3.0 (146)	3.1 (151)
Unrolling @50° F and 140° F (Pass/Fail)	Pass/Fail	Pass

BUR Premium Ply Sheet (ASTM D2178, Type VI)	Standard Minimum Value	GAF Value: GAFGLAS® Ply 6
Property Ash (glass mat only) (%)	70-88	71-79
MD breaking strength, lbf/in. (kN/m)	60 (10.5)	65 (11.4)
XMD/CD breaking strength, lbf/in. (kN/m)	60 (10.5)	62 (10.9)
Pliability, 1/2 in. (13 mm) radius bend	No Failures	No Failures
Net dry mass, lb./100 ft.2 (g/m2) (Individual Rolls)	6.0 (293)	8.0 (398)
Moisture at time of manufacture, max. (%)	1	≤ 1.0
Mass of desaturated mat, min., (lb./100 ft.2 (g/m2)	1.9 (93)	2.4 (117)
Bituminous saturant, lb./100 ft.2 (g/m2)	3.0 (146)	3.0 (146)
Unrolling @50° F and 140° F (Pass/Fail)	Pass/Fail	Pass

BUR Granule Cap Sheet (ASTM D3909)	Standard Minimum Value	GAF Value: Tri-Ply® BUR
Average mass per roll, min. lb, (kg) 3-in. (75-mm) selvage	39.0 (31.3)	40.6 (32.5)
Mass per unit area of granule-surfaced sheet, min. lb/100 ft2 (g/m2)	63.2 (3,085)	65.1 (3,207)
MD breaking strength, lbf/in. (kN/m)	8.8 (50.0)	10.8 (95.9)
CMD/CD breaking strength, lbf/in. (kN/m)	7.7 (44.0)	7.9 (70.5)
Mass per unit area of desaturated glass felt, min. lb/100ft2 (g/m2)	1.7 (83)	1.75 (85)
Granule embedment, max. loss (g)	2	1.16
Moisture at time of manufacture (%)	1	≤ 1.0
Mass per unit area of mineral matter passing a 3.35-mm [No. 6] sieve and retained on a 212-µm [No. 70] sieve, min. lb/100 ft2 (g/m2)	24 (1,170)	25 (1,221)
Tear resistance lbf (N)	55 (244)	61 (271)

BUR Cap Sheet (ASTM D3909)	Standard Minimum Value	GAF Value: GAFGLAS® Mineral Surfaced
Average mass per roll, min. lb, (kg) 3-in. (75-mm) selvage	39.0 (31.3)	40.6 (32.5)
Mass per unit area of granule-surfaced sheet, min. lb/100 ft2 (g/m2)	63.2 (3,085)	65.1 (3,207)
MD breaking strength, lbf/in. (kN/m)	8.8 (50.0)	10.8 (95.9)
CMD/CD breaking strength, lbf/in. (kN/m)	7.7 (44.0)	7.9 (70.5)
Mass per unit area of desaturated glass felt, min. lb/100ft2 (g/m2)	1.7 (83)	1.75 (85)
Granule embedment, max. loss (g)	2	1.16
Moisture at time of manufacture (%)	1	≤ 1.0
Mass per unit area of mineral matter passing a 3.35-mm [No. 6] sieve and retained on a 212-µm [No. 70] sieve, min. lb/100 ft2 (g/m2)	24 (1,170)	25 (1,221)
Tear resistance lbf (N)	55 (244)	61 (271)

BUR Cap Sheet (ASTM D3909)	Standard Minimum Value	GAF Value: GAFGLAS® EnergyCap™ Mineral-Surfaced
Average mass per roll, min. lb, (kg) 3-in. (75-mm) selvage	68 (30.8)	69 (31.3)
Mass per unit area of granule-surfaced sheet, min. lb/100 ft2 (g/m2)	63.2 (3,085)	68.5 (3344)
Mass per unit area of desaturated glass felt, min. lb/100ft2 (g/m2)	1.7 (83)	1.9 (93)
Granule embedment, max. loss (g)	2	1.66
Moisture at time of manufacture (%)	1	≤ 1.0
Mass per unit area of mineral matter passing a 3.35-mm [No. 6] sieve and retained on a 212-µm [No. 70] sieve, min. lb/100 ft2 (g/m2)	24 (1,170)	24 (1170)

BUR Base Sheet (ASTM D4601, Type II)	Standard Minimum Value	GAF Value: GAFGLAS® #75
Asphalt lb./100 ft.2 (g/m2)	7.0 (342)	7.22 (352)
Surfacing & stabilizer, max. lb./100 ft.2 (g/m2)	65	65
Ash (glass mat only) (%)	70-88	74
MD breaking strength, lbf/in. (kN/m)	44 (7.7)	70 (12.3)
XMD/CD breaking strength, lbf/in. (kN/m)	44 (7.7)	53 (9.3)
Pliability, 1/2" (13-mm) radius bend	No Failures	No Failures
Net dry mass, lb/100 ft.2 (g/m2)	14.5 (708)	22.6 (1103)
Moisture at time of manufacture (%)	1	≤ 1.0
Mass of desaturated mat, min. lb./100 ft.2 (g/m2)	1.7 (83)	1.7 (83)
Unrolling @40º F and 140º F (Pass/Fail)	Pass/Fail	Pass

BUR Base Sheet (ASTM D4601, Type II)	Standard Minimum Value	GAF Value: Tri-Ply® #75
Asphalt lb./100 ft.2 (g/m2)	7.0 (342)	7.22 (352)
Surfacing & stabilizer, max. lb./100 ft.2 (g/m2)	65	65
Ash (glass mat only) (%)	70-88	74
MD breaking strength, lbf/in. (kN/m)	44 (7.7)	70 (12.3)
XMD/CD breaking strength, lbf/in. (kN/m)	44 (7.7)	53 (9.3)
Pliability, 1/2" (13-mm) radius bend	No Failures	No Failures
Net dry mass, lb/100 ft.2 (g/m2)	14.5 (708)	22.6 (1103)
Moisture at time of manufacture (%)	1	≤ 1.0
Mass of desaturated mat, min. lb./100 ft.2 (g/m2)	1.7 (83)	1.7 (83)
Unrolling @40º F and 140º F (Pass/Fail)	Pass/Fail	Pass

BUR Base Sheet (ASTM D4601, Type II)	Standard Minimum Value	GAF Value: GAFGLAS® #80 Ultima™
Asphalt lb./100 ft.2 (g/m2)	7.0 (342)	7.0 (342)
Surfacing & stabilizer, max. lb./100 ft.2 (g/m2)	65 (317)	65 (317)
Ash (glass mat only) (%)	70-88	71-79
MD breaking strength, lbf/in. (kN/m)	44 (7.7)	63 (11.0)
XMD/CD breaking strength, lbf/in. (kN/m)	44 (7.7)	73 (12.7)
Pliability, 1/2" (13-mm) radius bend	No Failures	No Failures
Net dry mass, lb/100 ft.2 (g/m2)	14.5 (708)	15.0 (732.3)
Moisture at time of manufacture (%)	1	≤ 1.0
Mass of desaturated mat, min. lb./100 ft.2 (g/m2)	1.7 (83)	1.7 (83)
Unrolling @40º F and 140º F (Pass/Fail)	Pass/Fail	Pass

BUR Venting Base Sheet (ASTM D4897, Type II)	Standard Minimum Value	GAF Value: GAFGLAS® Stratavent® Perforated
Mass of asphalt lb./100 ft.2 (g/m2)	12.0 (586.0)	15.5 (756.5)
Surfacing & stabilizer, max., lb./100 ft.2 (g/m2)	15.4 (751)	13.1 (639)
Ash (glass mat only) (%)	70-88	73-79
Mass of mineral matter passing a 212 µm (no. 70) sieve non basis of total mass of mineral stabilized coating and top surface mineral matter max. (%)	60	58.1
Mass of mineral granule retained on 212 µm (no. 70)sieve, min., g/m2 (lb./100 ft.2)	8.0 (391)	8.1(395)
MD breaking strength, lbf/in (kN/m)	44 (7.7)	70 (7.9)
XMD/CD breaking strength, lbf/in (kN/m)	44 (7.7)	55 (6.2)
Pliability	Pass/Fail	Pass
Moisture at time of manufacture, %	1	≤ 1.0
Mass of desaturated mat, min (lb./100 ft.2 (g/m2)	1.7 (83)	1.8 (87)
Mass of total unstabilized coating, filler, and top surfacing min, lb./100 ft.2 (g/m2) (ASTM D228)	22.0 (1,075)	23.2 (1,132)
Unrolling @40° F and 140° F	Pass/Fail	Pass
Diameter of spot-mopping holes, max., in. (mm)	1.0 (25)	3.0 (76)
Spacing of holes, center-to-center, max., in. (mm)	2.0 (51)	3.3 (83)

BUR Venting Base Sheet (ASTM D4897, Type II)	Standard Minimum Value	GAF Value: GAFGLAS® Stratavent® Nailable
Mass of asphalt lb./100 ft.2 (g/m2)	12.0 (586.0)	12.14 (596)
Mass of mineral granule retained on 212 µm (no. 70) sieve, min. g/m2 (lb./100 ft.2)	8.0 (391)	8.1 (395)
Ash (glass mat only) (%)	70-88	73-79
Mass of mineral matter passing a 212 µm (no. 70) sieve non basis of total mass of mineral stabilized coating and top surface mineral matter max. (%)	60	58.1
Mass of mineral granule retained on 212 µm (no. 70)sieve, min., g/m2 (lb./100 ft.2)	8.0 (391)	8.1 (395)
MD breaking strength, lbf/in (kN/m)	44 (7.7)	74.6 (13.1)
XMD/CD breaking strength, lbf/in (kN/m)	44 (7.7)	57.6 (10.1)
Pliability	Pass/Fail	Pass
Net dry mass, lb./100 ft.2 (g/m2)	55.0 (268.0)	56.3 (274.8)
Moisture at time of manufacture, %	1	≤ 1.0
Mass of desaturated mat, min (lb./100 ft.2 (g/m2)	1.7 (83)	1.9 (92)
Mass of total unstabilized coating, filler, and top surfacing min, lb./100 ft.2 (g/m2) (ASTM D228)	22.0 (1,075)	28.0 (1,365)
Unrolling @40° F and 140° F	Pass/Fail	Pass

Placing on the Market / Application Rules

The standards that can be applied for GAF BUR membranes and systems are:
- ASTM D4601
- ASTM D2178
- ASTM D4897
- ASTM D3909
- ASTM D6298 (SBS Flashing Only)

Properties of Declared Product as Shipped

After manufacturing, the product is prepared for shipment to the customer. The membrane is reeled and occasionally a cardboard core is placed inside the center of the roll and wrapped in plastic film tapes at the top and bottom of the roll. Additional packaging materials include product labels, a cardboard protective sheet, steel strap and plastic pallet shroud is placed over the finished rolls. The product is then shipped on wooden pallets to the customer.

Methodological Framework

Declared Unit

The declaration refers to the declared unit of 1 m² as specified in the PCR.

Name	Average #75 + Average Ply Sheet + GAFGLAS® EnergyCap™ Mineral-Surfaced	GAFGLAS® #80 Ultima™ + Average Ply Sheet + GAFGLAS® EnergyCap™ Mineral-Surfaced	Average Stratavent® + Average Ply Sheet + GAFGLAS® EnergyCap™ Mineral-Surfaced	Average #75 + Average Ply Sheet + GAFGLAS® Mineral-Surfaced	GAFGLAS® #80 Ultima™ + Average Ply Sheet + GAFGLAS® Mineral-Surfaced	Average Stratavent® + Average Ply Sheet + GAFGLAS® Mineral-Surfaced	Unit
Declared unit	1 m²						
Weight per declared unit	4.5	5.50	6.52	4.34	5.35	6.37	kg
Thickness to achieve Declared Unit	60	60	60	60	60	60	mm

System Boundary

This is a cradle-to-gate withoptions Environmental Product Declaration. The following life cycle phases were considered:

Product Stage			Construction Process Stage		Use Stage							End-of-Life Stage*				Benefits and Loads Beyond the System Boundaries
Raw material supply	Transport	Manufacturing	Transport from gate to the site	Construction/ installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction /demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	MND

Description of the System Boundary Stages Corresponding to the PCR

(X = Included; MND = Module Not Declared)

*This includes provision of all materials, products and energy, packaging processing and its transport, as well as waste processing up to the end-of waste state or disposal of final residues.

Reference Service Life

The reference service life of GAF is not declared due to the exclusion of the use-phase.

Allocation

The various plants produce a variety of products with differing impacts, so allocation was conducted based on total production mass of the different products. All data from these facilities are primary data and they were collected from facility personnel.
To produce roofing products, energy, water and materials go into the process and waste and emissions are outputs from the manufacturing process. The facility data were allocated by mass (methodology confirmed by site personnel) to determine benchmarked values of manufacturing requirements per unit mass or product. These benchmarked values were averaged for products made at multiple facilities using total production by mass.

Cut-off Criteria

Processes whose total contribution to the final result, with respect to their mass and in relation to all considered impact categories, is less than 1% can be neglected. Energy flows shall be included if they exceed 1 % of renewable primary resource (energy), 1 % nonrenewable primary resource (energy) usage, and 1 % of environmental impacts. The sum of the neglected processes may not exceed 5% by mass, 5% by energy, and 5% by total environmental impact of the considered impact categories. For that a documented assumption is admissible. All future products evaluated in the tool will at a minimum meet this requirement. Inputs to and outputs from the system after 100 years from 2021 shall not be considered in this study. Emissions from landfills 100 years after the product is disposed of will not be considered in this study. No known energy or environmental flows are excluded from the system analysis.

For Hazardous Substances, as defined by the US Occupational Health and Safety Act, the following requirements apply:

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

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

Data Sources

Primary data were collected for every process in the product system under the control of GAF. Secondary data from the Sphera and USLCI databases were utilized when necessary. These data were evaluated and have temporal, geographic, and technical coverage appropriate to the scope of the product category. When a material is not available in the available LCI databases, another chemical which has similar manufacturing and environmental impacts may be used as a proxy, representing the actual chemical.

Data Quality

The data sources used are complete and representative of global systems in terms of the geographic and technological coverage and are a recent vintage (i.e., less than ten years old). The data used for primary data are based on direct information sources of the manufacturers. Secondary data sets were used for raw materials extraction and processing, end of life, transportation, and energy production flows. Wherever secondary data is used, the study adopts critically reviewed data for consistency, precision, and reproducibility to limit uncertainty. Please see Appendix A of the LCA report for the full breakdown of the data sources. The primary data from the manufacturer was from the latest data available. Each secondary dataset used was taken from LCA for Experts v. 10.6 databases, either US LCI or Sphera. These databases are widely distributed and referenced within the LCA community and are either partially or fully critically reviewed. Each material has an overall rating from one to four, one being “very good” and four being “poor.” The data has an overall average rating of 2.0.

Period Under Review

The period under review is the full calendar year of 2021.

Treatment of Biogenic Carbon

The uptake and release of biogenic carbon throughout the product life cycle follows ISO 21930:2017 Section 7.2.7.

Comparability and Benchmarking

A comparison or an evaluation of EPD data is only possible if all data sets to be compared were created according to ISO 21930 and the building context, respectively the product-specific characteristics of performance, are taken into account. Comparison of the environmental performance of asphalt shingles using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. Environmental declarations from different programs may not be comparable. Full conformance with the PCR allows for EPD comparability only when all stages a product's life cycle have been considered. However, variations and deviations are possible. In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differenced 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.

Assumptions

- All products manufactured at each facility were assumed to have similar processing and thus allocation by mass was deemed appropriate.
- Allocation of inputs and outputs between facilities was calculated based on total production of roofing products in the 2021 calendar year.
- Waste streams that were identified as usable secondary material (i.e. materials for recycling) were considered waste with no allocation of burden to the product system.
- Fuel transportation distance was assumed to be 100 km.
- Waste transportation distance was assumed to be 32 km.
- End-of-life transportation was assumed to be 161 km.

Limitations

The findings in this research are limited by the inherent uncertainty of creating a representative model through LCA. Many assumptions were made in modeling the product system with representative processes and datasets. The authors addressed the uncertainty in modeling decisions by conducting a mass balance and sensitivity analysis as the LCI model was being constructed (data verification/validation relative to cut-off criteria and study goals).
There exists limitation within the secondary data used for the material processes. These limitations include technological process similarities, regional applicability, necessity for chemical proxies, etc.
While quality control was undertaken at each step in building the LCI and conducting the LCIA, uncertainty is still present in the results since the data evaluated represents only one year of manufacturing information. Detailed evaluation of multiple manufacturing plants and time periods would reduce the uncertainty. Some level of uncertainty is inherent in conducting LCA and decision making must reflect this fact.

Units

The LCA results within this EPD are reported in SI units.

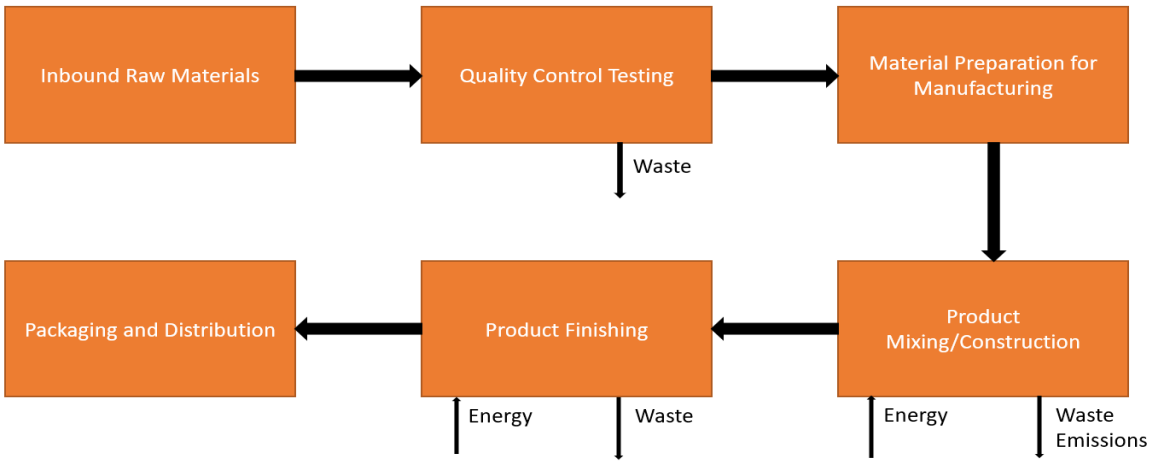
Technical Information

Background data

For life cycle modeling of the considered products, the LCA for Experts Software System for Life Cycle Engineering, developed by Sphera, is used. The Sphera and USLCI databases contain consistent and documented datasets which are documented online. To ensure comparability of results in the LCA, the basic data of the Sphera database were used for energy, transportation, and auxiliary materials.

Manufacturing

Built-Up Asphalt Roofing (BUR) is manufactured in Fontana, California; Savannah, Georgia; Stockton, California. Manufacturing begins with the inbound reception of raw materials. The process begins with adding coating inputs, such as asphalt and minerals, to a mixer. The inputs are mixed and then impregnated and/or coat an underlayment, such as a polyester mat. Mineral granules may be added to the top surface of the product. The product is then cooled, wound into rolls or cut to size, and packaged for shipment.



Below is a list of each of the manufacturing facilities that produce the product type listed. The manufacturing inputs from each of these facilities were averaged using total production of the given product type.

Product Type	Manufacturing location
BUR	Fontana, Savannah, Stockton

Packaging

The packaging material is composed primarily of wood materials. Asphalt roofing products are shipped on pallets and wrapped in plastic film.

	Quantity (% By Weight)
Material	**Value**
Cardboard	1.14%
Wood	20.69%
Paper	2.60%
Plastic	75.58%
Total	**100.00%**

The assumed percent of disposal by packaging material type is listed below.

Material	Landfill Percent	Recycled Percent	Incineration Percent
Cardboard/Paper	20%	75%	5%
Wood	20%	75%	5%
Plastic	68%	17%	15%

Transportation

The default distance of 800 km for product transportation was not used. Instead, primary data was used to determine the distribution distance for this product.

Transport to Building Site (A4)		
Name	**Value**	**Unit**
Fuel type	Diesel	
Vehicle Type	Truck	-
Liters of fuel	38	l/100km
Measured Transport distance	638	km
Capacity utilization (including empty runs)	90	%
Gross density of products transported	13.4-56.2	kg/m^3
Weight of products transported	-	kg
Volume of products transported	-	m^3
Capacity utilization volume factor	-	-

Product Installation

Detailed installation instructions are provided online. Installation equipment is required though not included in the study as these are multi-use tools and the impacts per declared unit is considered negligible. Additionally, this study assumed no materials were required for installation. Note: Compliance with model building codes does not always ensure compliance with state or local building codes, which may be amended versions of these model codes. Always check with local building code officials to confirm compliance.

Installation Into the Building (A5)		
Name	**Value**	**Unit**
Auxiliary materials	-	kg
Water consumption	-	m^3
Other resources	-	kg
Electricity consumption	-	kWh
Other energy carriers	5	MJ
Product loss per declared unit	-	kg
Waste materials at construction site	0.25	kg
Output substance (recycle)	-	kg
Output substance (landfill)	6.37	kg
Output substance (incineration)	-	kg
Packaging waste (recycle)	0.07	kg
Packaging waste (landfill)	0.14	kg
Packaging waste (incineration)	0.04	kg
Direct emissions to ambient air*, soil, and water	0.11	kg
VOC emissions	-	µg/m3

*CO2 emissions to air from disposal of packaging

Disposal

The product is assumed to be 100% landfilled in the end-of-life disposal, in accordance with the PCR.

End of life (C1-C4)		
Name	**Value**	**Unit**
Collected separately	0.00	kg
Collected as mixed construction waste	4.50-6.52	kg
Reuse	0.00	kg
Recycling	0.00	kg
Landfilling	4.50-6.52	kg
Incineration with energy recovery	0.00	kg
Energy conversion	-	%
Removals of biogenic carbon	-	kg

LCA Results Average #75 + Average Ply Sheet + GAFGLAS® EnergyCap™ Mineral-Surfaced

Notes on LCA Results:
*LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
*These six impact categories (those presented in the TRACI 2.1 Impact Assessment table below) are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.

Results shown below were calculated using TRACI 2.1 Methodology.

TRACI 2.1 Impact Assessment

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	4.98E+00	2.60E-01	9.20E-02	0.00E+00	6.56E-02	0.00E+00	7.90E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	4.12E-08	9.82E-12	4.98E-16	0.00E+00	2.48E-12	0.00E+00	2.25E-15
AP	Acidification potential for air emissions	kg SO_2-Eq.	9.65E-03	1.56E-03	1.18E-04	0.00E+00	3.94E-04	0.00E+00	2.45E-03
EP	Eutrophication potential	kg N-Eq.	8.19E-04	8.64E-05	4.40E-05	0.00E+00	2.18E-05	0.00E+00	6.95E-04
SP	Smog formation potential	kg O_3-Eq.	1.70E-01	4.29E-02	7.19E-04	0.00E+00	1.09E-02	0.00E+00	1.55E-02
FFD	Fossil Fuel Depletion	MJ-surplus	1.58E+01	4.59E-01	9.55E-03	0.00E+00	1.16E-01	0.00E+00	1.02E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results shown below were calculated using CML 2001 - April 2013 Methodology.

CML 4.1 Impact Assessment

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	4.93E+00	2.60E-01	1.06E-01	0.00E+00	6.58E-02	0.00E+00	9.24E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	3.79E-08	9.81E-12	2.95E-14	0.00E+00	2.48E-12	0.00E+00	1.33E-13
AP	Acidification potential for air emissions	kg SO_2-Eq.	8.94E-03	1.28E-03	6.93E-05	0.00E+00	3.24E-04	0.00E+00	1.23E-03
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	1.77E-03	2.28E-04	6.08E-05	0.00E+00	5.77E-05	0.00E+00	1.11E-03
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	1.39E-03	1.50E-04	1.20E-05	0.00E+00	3.78E-05	0.00E+00	2.93E-04
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	4.09E-05	1.08E-10	5.20E-09	0.00E+00	2.73E-11	0.00E+00	7.59E-08
ADPF	Abiotic depletion potential for fossil resources	MJ	1.42E+02	3.31E+00	8.29E-02	0.00E+00	8.37E-01	0.00E+00	7.13E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

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

Resource Use

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
RPR_E	Renewable primary energy as energy carrier	MJ	3.85E+00	0.00E+00	1.56E-02	0.00E+00	0.00E+00	0.00E+00	9.39E-02
RPR_M	Renewable primary energy resources as material utilization	MJ	9.84E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	Nonrenewable primary energy as energy carrier	MJ	1.47E+02	3.34E+00	8.79E-02	0.00E+00	8.45E-01	0.00E+00	7.19E+00
$NRPR_M$	Nonrenewable primary energy as material utilization	MJ	6.98E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	Use of secondary material	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	Use of renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	Energy recovered from disposed waste	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	Use of net fresh water	m^3	1.69E-02	0.00E+00	1.95E-04	0.00E+00	0.00E+00	0.00E+00	1.70E-04

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

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

Output Flows and Waste Categories									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
HWD	Hazardous waste disposed	kg	2.48E-04	0.00E+00	3.28E-11	0.00E+00	0.00E+00	0.00E+00	1.01E-09
NHWD	Non-hazardous waste disposed	kg	1.16E-01	0.00E+00	1.59E-01	0.00E+00	0.00E+00	0.00E+00	8.70E-01
HLRW	High-level radioactive waste	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	Intermediate- and low-level radioactive waste	kg	1.89E-03	0.00E+00	1.76E-06	0.00E+00	0.00E+00	0.00E+00	2.03E-05
CRU	Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	Materials for recycling	kg	2.65E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

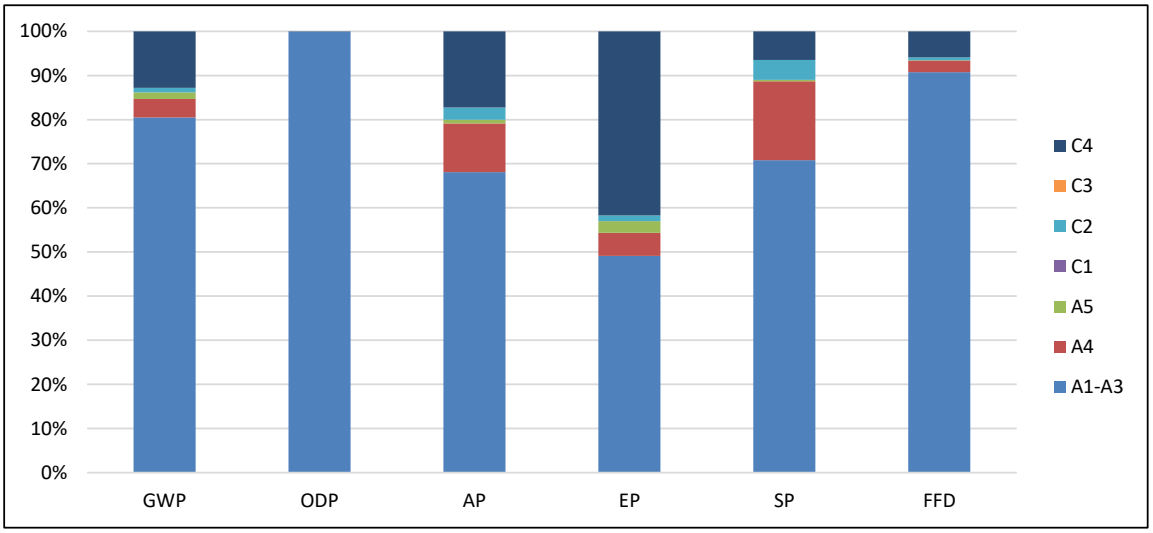
Results below contain direct greenhouse gas emissions and removals throughout the life cycle of the product.

Carbon Emissions and Removals									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
BCRP	Biogenic Carbon Removal from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP	Biogenic Carbon Emissions from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2	1.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	Biogenic Carbon Emissions from Packaging	kg CO_2	0.00E+00	0.00E+00	1.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	Biogenic Carbon Emissions from Combustion of Waste from Renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	Calcination Carbon Emissions	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR	Carbonation Carbon Removal	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR	Carbon Emissions from Combustion of Waste from Non-renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

LCA Interpretation

The production life cycle stage (A1-A3) dominates the impacts across all impact categories. This is due to the upstream production of materials used in the product, along with natural gas use in the manufacturing of the product. The asphalt coating raw material is a petroleum derivative, which creates upstream carbon emissions. Overall, the production of the product is significantly more energy intensive than any other stage. The end-of-life disposal stage (C4) has significant impact in global warming potential, acidification, and eutrophication due to the 100% landfill assumption. Also, third party verified ISO 14040/44 secondary LCI data sets contribute more than 67% of total impact to the impact categories shown above.



LCA Results GAFGLAS® #80 Ultima™ + Average Ply Sheet + GAFGLAS® EnergyCap™ Mineral-Surfaced

Notes on LCA Results:
*LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
*These six impact categories (those presented in the TRACI 2.1 Impact Assessment table below) are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.

Results shown below were calculated using TRACI 2.1 Methodology.

TRACI 2.1 Impact Assessment

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	8.01E+00	3.19E-01	9.20E-02	0.00E+00	8.06E-02	0.00E+00	7.90E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	4.27E-08	1.21E-11	4.98E-16	0.00E+00	3.05E-12	0.00E+00	2.25E-15
AP	Acidification potential for air emissions	kg SO_2-Eq.	1.35E-02	1.92E-03	1.18E-04	0.00E+00	4.84E-04	0.00E+00	2.45E-03
EP	Eutrophication potential	kg N-Eq.	1.27E-03	1.06E-04	4.40E-05	0.00E+00	2.68E-05	0.00E+00	6.95E-04
SP	Smog formation potential	kg O_3-Eq.	2.36E-01	5.27E-02	7.19E-04	0.00E+00	1.33E-02	0.00E+00	1.55E-02
FFD	Fossil Fuel Depletion	MJ-surplus	2.07E+01	5.64E-01	9.55E-03	0.00E+00	1.42E-01	0.00E+00	1.02E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results shown below were calculated using CML 2001 - April 2013 Methodology.

CML 4.1 Impact Assessment

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	8.00E+00	3.20E-01	1.06E-01	0.00E+00	8.08E-02	0.00E+00	9.24E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	3.92E-08	1.20E-11	2.95E-14	0.00E+00	3.04E-12	0.00E+00	1.33E-13
AP	Acidification potential for air emissions	kg SO_2-Eq.	1.24E-02	1.57E-03	6.93E-05	0.00E+00	3.98E-04	0.00E+00	1.23E-03
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	2.25E-03	2.80E-04	6.08E-05	0.00E+00	7.08E-05	0.00E+00	1.11E-03
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	1.75E-03	1.84E-04	1.20E-05	0.00E+00	4.64E-05	0.00E+00	2.93E-04
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	5.18E-05	1.33E-10	5.20E-09	0.00E+00	3.35E-11	0.00E+00	7.59E-08
ADPF	Abiotic depletion potential for fossil resources	MJ	1.78E+02	4.07E+00	8.29E-02	0.00E+00	1.03E+00	0.00E+00	7.13E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

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

Resource Use

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
RPR_E	Renewable primary energy as energy carrier	MJ	8.33E+00	0.00E+00	1.56E-02	0.00E+00	0.00E+00	0.00E+00	9.39E-02
RPR_M	Renewable primary energy resources as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	Nonrenewable primary energy as energy carrier	MJ	1.87E+02	4.11E+00	8.79E-02	0.00E+00	1.04E+00	0.00E+00	7.19E+00
$NRPR_M$	Nonrenewable primary energy as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	Use of secondary material	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	Use of renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	Energy recovered from disposed waste	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	Use of net fresh water	m^3	3.24E-02	0.00E+00	1.95E-04	0.00E+00	0.00E+00	0.00E+00	1.70E-04

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

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

Output Flows and Waste Categories									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
HWD	Hazardous waste disposed	kg	1.91E-04	0.00E+00	3.28E-11	0.00E+00	0.00E+00	0.00E+00	1.01E-09
NHWD	Non-hazardous waste disposed	kg	1.86E-01	0.00E+00	1.59E-01	0.00E+00	0.00E+00	0.00E+00	8.70E-01
HLRW	High-level radioactive waste	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	Intermediate- and low-level radioactive waste	kg	3.16E-03	0.00E+00	1.76E-06	0.00E+00	0.00E+00	0.00E+00	2.03E-05
CRU	Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	Materials for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

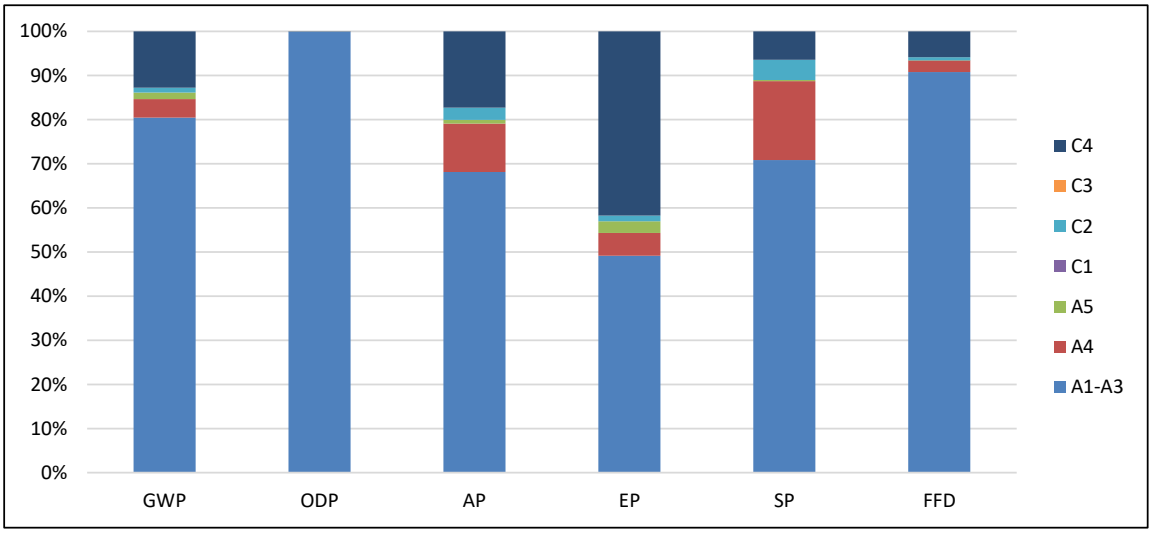
Results below contain direct greenhouse gas emissions and removals throughout the life cycle of the product.

Carbon Emissions and Removals									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
BCRP	Biogenic Carbon Removal from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP	Biogenic Carbon Emissions from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2	1.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	Biogenic Carbon Emissions from Packaging	kg CO_2	0.00E+00	0.00E+00	1.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	Biogenic Carbon Emissions from Combustion of Waste from Renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	Calcination Carbon Emissions	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR	Carbonation Carbon Removal	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR	Carbon Emissions from Combustion of Waste from Non-renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

LCA Interpretation

Notes on LCA Results:
*LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
*These six impact categories (those presented in the TRACI 2.1 Impact Assessment table below) are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.



LCA Results Average Stratavent® + Average Ply Sheet + GAFGLAS® EnergyCap™ Mineral-Surfaced

Notes on LCA Results:
*LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
*These six impact categories (those presented in the TRACI 2.1 Impact Assessment table below) are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.

Results shown below were calculated using TRACI 2.1 Methodology.

TRACI 2.1 Impact Assessment

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	3.45E+00	3.80E-01	9.20E-02	0.00E+00	9.55E-02	0.00E+00	7.90E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	4.23E-08	1.44E-11	4.98E-16	0.00E+00	3.61E-12	0.00E+00	2.25E-15
AP	Acidification potential for air emissions	kg SO_2-Eq.	7.99E-03	2.28E-03	1.18E-04	0.00E+00	5.74E-04	0.00E+00	2.45E-03
EP	Eutrophication potential	kg N-Eq.	5.91E-04	1.27E-04	4.40E-05	0.00E+00	3.18E-05	0.00E+00	6.95E-04
SP	Smog formation potential	kg O_3-Eq.	1.46E-01	6.29E-02	7.19E-04	0.00E+00	1.58E-02	0.00E+00	1.55E-02
FFD	Fossil Fuel Depletion	MJ-surplus	1.33E+01	6.72E-01	9.55E-03	0.00E+00	1.69E-01	0.00E+00	1.02E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results shown below were calculated using CML 2001 - April 2013 Methodology.

CML 4.1 Impact Assessment

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	3.38E+00	3.81E-01	1.06E-01	0.00E+00	9.58E-02	0.00E+00	9.24E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	3.88E-08	1.44E-11	2.95E-14	0.00E+00	3.61E-12	0.00E+00	1.33E-13
AP	Acidification potential for air emissions	kg SO_2-Eq.	7.38E-03	1.88E-03	6.93E-05	0.00E+00	4.71E-04	0.00E+00	1.23E-03
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	1.60E-03	3.34E-04	6.08E-05	0.00E+00	8.39E-05	0.00E+00	1.11E-03
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	1.25E-03	2.19E-04	1.20E-05	0.00E+00	5.50E-05	0.00E+00	2.93E-04
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	3.52E-05	1.58E-10	5.20E-09	0.00E+00	3.97E-11	0.00E+00	7.59E-08
ADPF	Abiotic depletion potential for fossil resources	MJ	1.25E+02	4.85E+00	8.29E-02	0.00E+00	1.22E+00	0.00E+00	7.13E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

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

Resource Use

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
RPR_E	Renewable primary energy as energy carrier	MJ	3.15E+00	0.00E+00	1.56E-02	0.00E+00	0.00E+00	0.00E+00	9.39E-02
RPR_M	Renewable primary energy resources as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	Nonrenewable primary energy as energy carrier	MJ	1.29E+02	4.89E+00	8.79E-02	0.00E+00	1.23E+00	0.00E+00	7.19E+00
$NRPR_M$	Nonrenewable primary energy as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	Use of secondary material	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	Use of renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	Energy recovered from disposed waste	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	Use of net fresh water	m^3	7.62E-03	0.00E+00	1.95E-04	0.00E+00	0.00E+00	0.00E+00	1.70E-04

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

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

Output Flows and Waste Categories									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
HWD	Hazardous waste disposed	kg	2.91E-04	0.00E+00	3.28E-11	0.00E+00	0.00E+00	0.00E+00	1.01E-09
NHWD	Non-hazardous waste disposed	kg	1.08E-01	0.00E+00	1.59E-01	0.00E+00	0.00E+00	0.00E+00	8.70E-01
HLRW	High-level radioactive waste	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	Intermediate- and low-level radioactive waste	kg	1.31E-03	0.00E+00	1.76E-06	0.00E+00	0.00E+00	0.00E+00	2.03E-05
CRU	Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	Materials for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

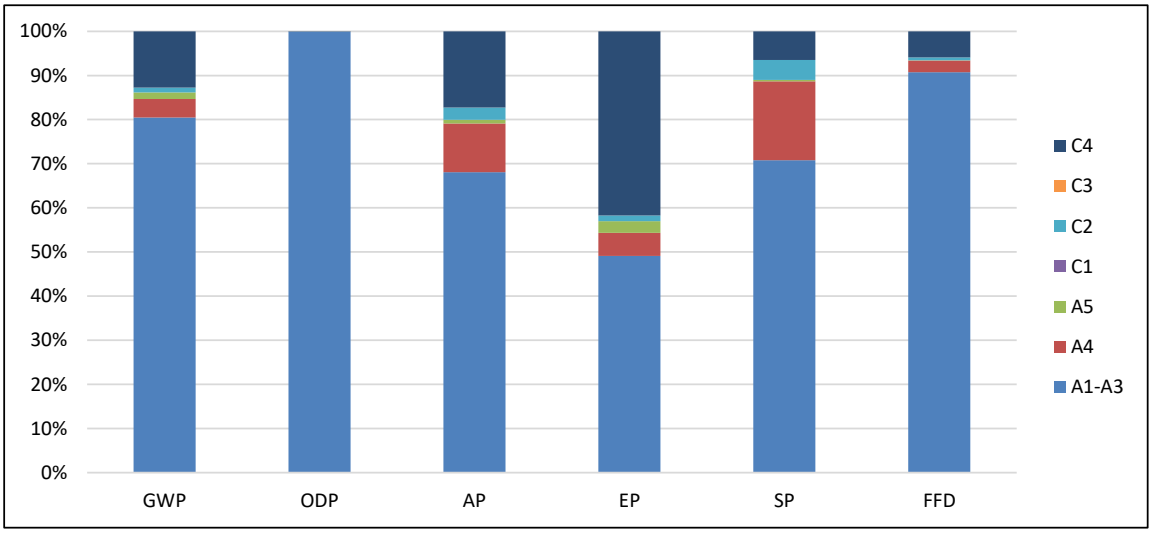
Results below contain direct greenhouse gas emissions and removals throughout the life cycle of the product.

Carbon Emissions and Removals									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
BCRP	Biogenic Carbon Removal from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP	Biogenic Carbon Emissions from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2	1.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	Biogenic Carbon Emissions from Packaging	kg CO_2	0.00E+00	0.00E+00	1.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	Biogenic Carbon Emissions from Combustion of Waste from Renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	Calcination Carbon Emissions	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR	Carbonation Carbon Removal	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR	Carbon Emissions from Combustion of Waste from Non-renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

LCA Interpretation

Notes on LCA Results:
*LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
*These six impact categories (those presented in the TRACI 2.1 Impact Assessment table below) are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.



LCA Results Average #75 + Average Ply Sheet + GAFGLAS® Mineral-Surfaced

Notes on LCA Results:
*LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
*These six impact categories (those presented in the TRACI 2.1 Impact Assessment table below) are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.

Results shown below were calculated using TRACI 2.1 Methodology.

TRACI 2.1 Impact Assessment

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	4.33E+00	2.57E-01	5.55E-01	0.00E+00	6.49E-02	0.00E+00	3.27E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	4.12E-08	9.72E-12	1.72E-15	0.00E+00	2.46E-12	0.00E+00	1.03E-15
AP	Acidification potential for air emissions	kg SO_2-Eq.	9.21E-03	1.54E-03	5.64E-04	0.00E+00	3.90E-04	0.00E+00	2.00E-03
EP	Eutrophication potential	kg N-Eq.	7.69E-04	8.55E-05	7.33E-05	0.00E+00	2.16E-05	0.00E+00	6.66E-04
SP	Smog formation potential	kg O_3-Eq.	1.61E-01	4.25E-02	1.06E-02	0.00E+00	1.07E-02	0.00E+00	5.57E-03
FFD	Fossil Fuel Depletion	MJ-surplus	1.32E+01	4.54E-01	9.89E-01	0.00E+00	1.15E-01	0.00E+00	4.19E-02

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results shown below were calculated using CML 2001 - April 2013 Methodology.

CML 4.1 Impact Assessment

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	4.27E+00	2.58E-01	5.71E-01	0.00E+00	6.51E-02	0.00E+00	4.59E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	3.78E-08	9.70E-12	1.01E-13	0.00E+00	2.45E-12	0.00E+00	6.10E-14
AP	Acidification potential for air emissions	kg SO_2-Eq.	8.52E-03	1.27E-03	4.26E-04	0.00E+00	3.20E-04	0.00E+00	8.77E-04
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	1.61E-03	2.26E-04	1.40E-04	0.00E+00	5.70E-05	0.00E+00	1.03E-03
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	1.24E-03	1.48E-04	6.70E-05	0.00E+00	3.74E-05	0.00E+00	2.38E-04
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	4.07E-05	1.07E-10	7.42E-08	0.00E+00	2.70E-11	0.00E+00	6.92E-09
ADPF	Abiotic depletion potential for fossil resources	MJ	1.20E+02	3.28E+00	6.90E+00	0.00E+00	8.28E-01	0.00E+00	3.13E-01

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

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

Resource Use

Parameter	Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
RPR_E	Renewable primary energy as energy carrier	MJ	4.57E+00	0.00E+00	6.92E-02	0.00E+00	0.00E+00	0.00E+00	4.04E-02
RPR_M	Renewable primary energy resources as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	Nonrenewable primary energy as energy carrier	MJ	1.24E+02	3.31E+00	6.96E+00	0.00E+00	8.35E-01	0.00E+00	3.23E-01
$NRPR_M$	Nonrenewable primary energy as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	Use of secondary material	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	Use of renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	Energy recovered from disposed waste	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	Use of net fresh water	m^3	1.62E-02	0.00E+00	2.74E-04	0.00E+00	0.00E+00	0.00E+00	9.14E-05

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

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

Output Flows and Waste Categories									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
HWD	Hazardous waste disposed	kg	1.98E-04	0.00E+00	9.62E-10	0.00E+00	0.00E+00	0.00E+00	8.02E-11
NHWD	Non-hazardous waste disposed	kg	1.12E-01	0.00E+00	1.60E-01	0.00E+00	0.00E+00	0.00E+00	8.70E-01
HLRW	High-level radioactive waste	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	Intermediate- and low-level radioactive waste	kg	1.78E-03	0.00E+00	1.86E-05	0.00E+00	0.00E+00	0.00E+00	3.42E-06
CRU	Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	Materials for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

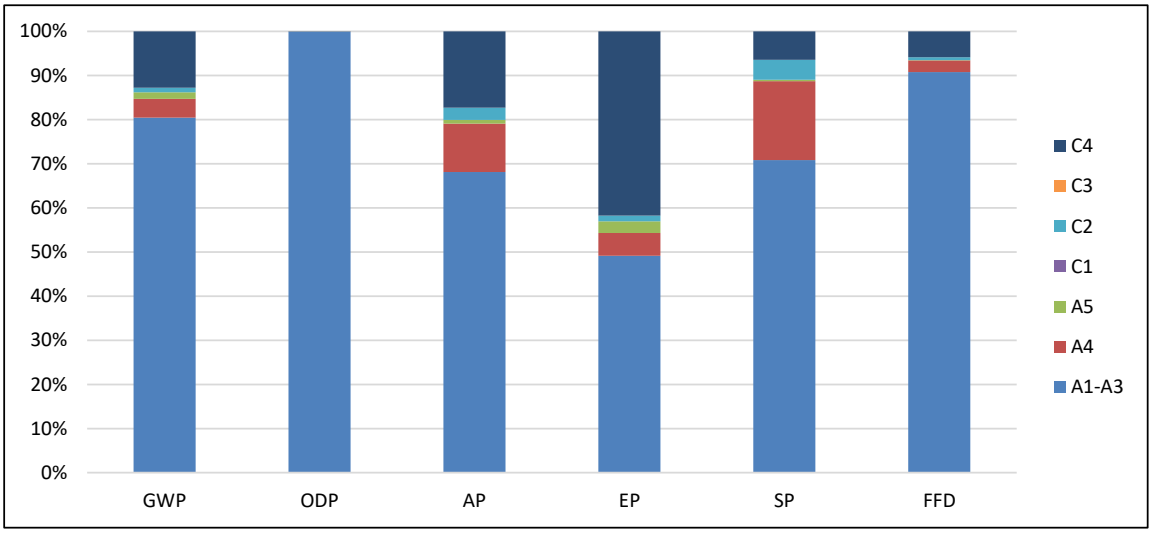
Results below contain direct greenhouse gas emissions and removals throughout the life cycle of the product.

Carbon Emissions and Removals									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
BCRP	Biogenic Carbon Removal from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP	Biogenic Carbon Emissions from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2	1.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	Biogenic Carbon Emissions from Packaging	kg CO_2	0.00E+00	0.00E+00	1.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	Biogenic Carbon Emissions from Combustion of Waste from Renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	Calcination Carbon Emissions	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR	Carbonation Carbon Removal	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR	Carbon Emissions from Combustion of Waste from Non-renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

LCA Interpretation

Notes on LCA Results:
*LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
*These six impact categories (those presented in the TRACI 2.1 Impact Assessment table below) are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.



LCA Results GAFGLAS® #80 Ultima™ + Average Ply Sheet + GAFGLAS® Mineral-Surfaced

Notes on LCA Results:
*LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
*These six impact categories (those presented in the TRACI 2.1 Impact Assessment table below) are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.

Results shown below were calculated using TRACI 2.1 Methodology.

TRACI 2.1 Impact Assessment									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	7.36E+00	3.16E-01	5.55E-01	0.00E+00	7.98E-02	0.00E+00	3.27E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	4.26E-08	1.20E-11	1.72E-15	0.00E+00	3.02E-12	0.00E+00	1.03E-15
AP	Acidification potential for air emissions	kg SO_2-Eq.	1.31E-02	1.90E-03	5.64E-04	0.00E+00	4.80E-04	0.00E+00	2.00E-03
EP	Eutrophication potential	kg N-Eq.	1.22E-03	1.05E-04	7.33E-05	0.00E+00	2.66E-05	0.00E+00	6.66E-04
SP	Smog formation potential	kg O_3-Eq.	2.28E-01	5.23E-02	1.06E-02	0.00E+00	1.32E-02	0.00E+00	5.57E-03
FFD	Fossil Fuel Depletion	MJ-surplus	1.82E+01	5.59E-01	9.89E-01	0.00E+00	1.41E-01	0.00E+00	4.19E-02

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results shown below were calculated using CML 2001 - April 2013 Methodology.

CML 4.1 Impact Assessment									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	7.34E+00	3.17E-01	5.71E-01	0.00E+00	8.01E-02	0.00E+00	4.59E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	3.91E-08	1.19E-11	1.01E-13	0.00E+00	3.02E-12	0.00E+00	6.10E-14
AP	Acidification potential for air emissions	kg SO_2-Eq.	1.20E-02	1.56E-03	4.26E-04	0.00E+00	3.94E-04	0.00E+00	8.77E-04
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	2.08E-03	2.78E-04	1.40E-04	0.00E+00	7.02E-05	0.00E+00	1.03E-03
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	1.61E-03	1.82E-04	6.70E-05	0.00E+00	4.60E-05	0.00E+00	2.38E-04
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	5.15E-05	1.31E-10	7.42E-08	0.00E+00	3.32E-11	0.00E+00	6.92E-09
ADPF	Abiotic depletion potential for fossil resources	MJ	1.55E+02	4.03E+00	6.90E+00	0.00E+00	1.02E+00	0.00E+00	3.13E-01

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

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

Resource Use									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
RPR_E	Renewable primary energy as energy carrier	MJ	8.07E+00	0.00E+00	6.92E-02	0.00E+00	0.00E+00	0.00E+00	4.04E-02
RPR_M	Renewable primary energy resources as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	Nonrenewable primary energy as energy carrier	MJ	1.64E+02	4.07E+00	6.96E+00	0.00E+00	1.03E+00	0.00E+00	3.23E-01
$NRPR_M$	Nonrenewable primary energy as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	Use of secondary material	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	Use of renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	Energy recovered from disposed waste	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	Use of net fresh water	m^3	3.17E-02	0.00E+00	2.74E-04	0.00E+00	0.00E+00	0.00E+00	9.14E-05

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

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

Output Flows and Waste Categories									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
HWD	Hazardous waste disposed	kg	1.42E-04	0.00E+00	9.62E-10	0.00E+00	0.00E+00	0.00E+00	8.02E-11
NHWD	Non-hazardous waste disposed	kg	1.81E-01	0.00E+00	1.60E-01	0.00E+00	0.00E+00	0.00E+00	8.70E-01
HLRW	High-level radioactive waste	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	Intermediate- and low-level radioactive waste	kg	3.06E-03	0.00E+00	1.86E-05	0.00E+00	0.00E+00	0.00E+00	3.42E-06
CRU	Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	Materials for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

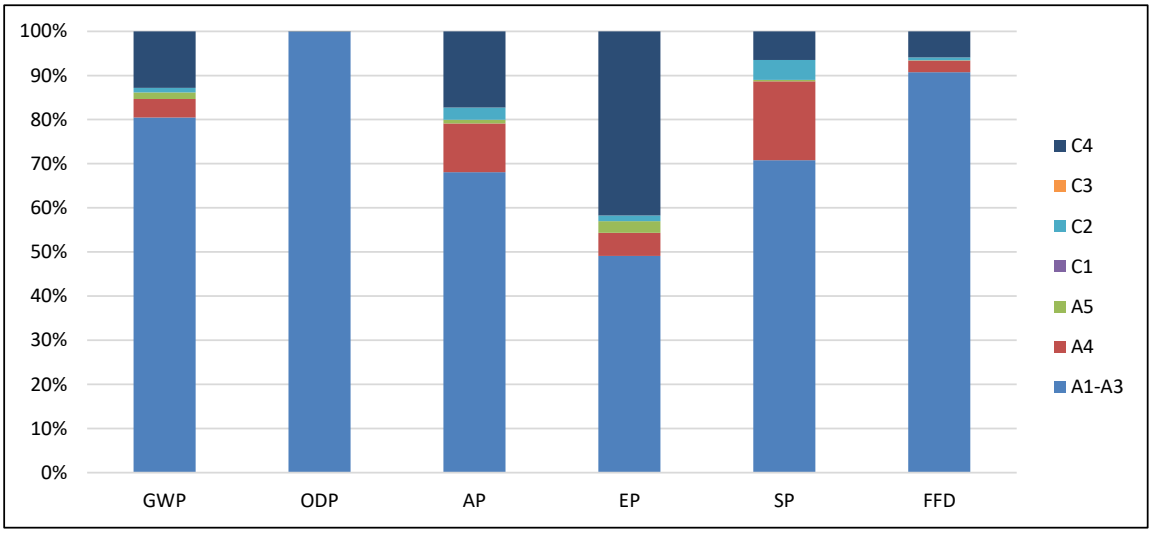
Results below contain direct greenhouse gas emissions and removals throughout the life cycle of the product.

Carbon Emissions and Removals									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
BCRP	Biogenic Carbon Removal from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP	Biogenic Carbon Emissions from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2	1.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	Biogenic Carbon Emissions from Packaging	kg CO_2	0.00E+00	0.00E+00	1.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	Biogenic Carbon Emissions from Combustion of Waste from Renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	Calcination Carbon Emissions	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR	Carbonation Carbon Removal	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR	Carbon Emissions from Combustion of Waste from Non-renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

LCA Interpretation

Notes on LCA Results:
*LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
*These six impact categories (those presented in the TRACI 2.1 Impact Assessment table below) are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.



LCA Results Average Stratavent® + Average Ply Sheet + GAFGLAS® Mineral-Surfaced

Notes on LCA Results:
*LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
*These six impact categories (those presented in the TRACI 2.1 Impact Assessment table below) are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.

Results shown below were calculated using TRACI 2.1 Methodology.

TRACI 2.1 Impact Assessment									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	2.80E+00	3.77E-01	5.55E-01	0.00E+00	9.55E-02	0.00E+00	3.27E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	4.23E-08	1.43E-11	1.72E-15	0.00E+00	3.61E-12	0.00E+00	1.03E-15
AP	Acidification potential for air emissions	kg SO_2-Eq.	7.54E-03	2.27E-03	5.64E-04	0.00E+00	5.74E-04	0.00E+00	2.00E-03
EP	Eutrophication potential	kg N-Eq.	5.42E-04	1.26E-04	7.33E-05	0.00E+00	3.18E-05	0.00E+00	6.66E-04
SP	Smog formation potential	kg O_3-Eq.	1.38E-01	6.24E-02	1.06E-02	0.00E+00	1.58E-02	0.00E+00	5.57E-03
FFD	Fossil Fuel Depletion	MJ-surplus	1.07E+01	6.67E-01	9.89E-01	0.00E+00	1.69E-01	0.00E+00	4.19E-02

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results shown below were calculated using CML 2001 - April 2013 Methodology.

CML 4.1 Impact Assessment									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	2.71E+00	3.78E-01	5.71E-01	0.00E+00	9.58E-02	0.00E+00	4.59E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	3.88E-08	1.43E-11	1.01E-13	0.00E+00	3.61E-12	0.00E+00	6.10E-14
AP	Acidification potential for air emissions	kg SO_2-Eq.	6.96E-03	1.86E-03	4.26E-04	0.00E+00	4.71E-04	0.00E+00	8.77E-04
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	1.44E-03	3.32E-04	1.40E-04	0.00E+00	8.39E-05	0.00E+00	1.03E-03
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	1.10E-03	2.18E-04	6.70E-05	0.00E+00	5.50E-05	0.00E+00	2.38E-04
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	3.50E-05	1.57E-10	7.42E-08	0.00E+00	3.97E-11	0.00E+00	6.92E-09
ADPF	Abiotic depletion potential for fossil resources	MJ	1.02E+02	4.81E+00	6.90E+00	0.00E+00	1.22E+00	0.00E+00	3.13E-01

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

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

Resource Use									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
RPR_E	Renewable primary energy as energy carrier	MJ	2.91E+00	0.00E+00	6.92E-02	0.00E+00	0.00E+00	0.00E+00	4.04E-02
RPR_M	Renewable primary energy resources as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	Nonrenewable primary energy as energy carrier	MJ	1.06E+02	4.86E+00	6.96E+00	0.00E+00	1.23E+00	0.00E+00	3.23E-01
$NRPR_M$	Nonrenewable primary energy as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	Use of secondary material	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	Use of renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	Energy recovered from disposed waste	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	Use of net fresh water	m^3	6.97E-03	0.00E+00	2.74E-04	0.00E+00	0.00E+00	0.00E+00	9.14E-05

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

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

Output Flows and Waste Categories									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
HWD	Hazardous waste disposed	kg	2.42E-04	0.00E+00	9.62E-10	0.00E+00	0.00E+00	0.00E+00	8.02E-11
NHWD	Non-hazardous waste disposed	kg	1.04E-01	0.00E+00	1.60E-01	0.00E+00	0.00E+00	0.00E+00	8.70E-01
HLRW	High-level radioactive waste	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	Intermediate- and low-level radioactive waste	kg	1.21E-03	0.00E+00	1.86E-05	0.00E+00	0.00E+00	0.00E+00	3.42E-06
CRU	Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	Materials for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

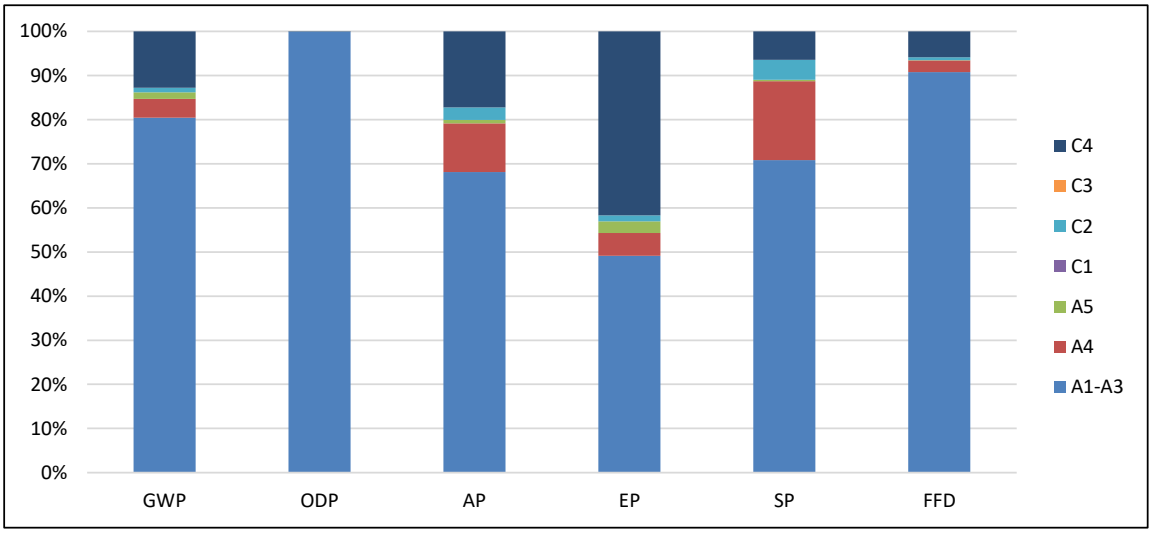
Results below contain direct greenhouse gas emissions and removals throughout the life cycle of the product.

Carbon Emissions and Removals									
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**
BCRP	Biogenic Carbon Removal from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP	Biogenic Carbon Emissions from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2	1.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	Biogenic Carbon Emissions from Packaging	kg CO_2	0.00E+00	0.00E+00	1.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	Biogenic Carbon Emissions from Combustion of Waste from Renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	Calcination Carbon Emissions	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR	Carbonation Carbon Removal	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR	Carbon Emissions from Combustion of Waste from Non-renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

LCA Interpretation

Notes on LCA Results:
*LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
*These six impact categories (those presented in the TRACI 2.1 Impact Assessment table below) are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.



Additional Environmental Information

Environmental and Health During Manufacturing

During the manufacturing of all asphalt products, all legal regulations regarding emissions to air, wastewater discharge, solid waste disposal and noise emissions are followed. GAF manufacturing operations follow strict internal procedures to ensure safe and healthy working conditions for all employees and contractors working onsite.

Environmental and Health During Installation

There is no harmful emissive potential. No damage to health or impairment is expected under normal use corresponding to the intended use of the product. To insure safe and proper installation of GAF products please refer to the installation guide found on GAF product website https://www.gaf.com/.

Extraordinary Effects

Fire
Resistance by the roofing system to fire applied to the exterior roof surface is important. Typically, a UL Class A, B or C rating is required by building code. Occasionally, depending on the use of the building, special resistance to fire applied from within the building is required. This is normally expressed in the form of hourly ratings, and usually requires the use of a specialized roof assembly. Refer to current GAFGLAS® and Tri-Ply® listings in the appropriate UL directory to verify roof assembly requirements for specific fire ratings. Refer to UL Product iQ for specific assemblies.

Water
Contain no substances that have any impact on water in case of flood.

Mechanical Destruction
No danger to the environment can be anticipated during mechanical destruction.

Delayed Emissions

Global warming potential is calculated using the TRACI 2.1 and CML 4.1 impact assessment methodologies. Delayed emissions are not considered.

Further Information

GAF
1 Campus Drive, Parsippany, NJ 07054

References

- General Program Instructions	UL Environment General Program Instructions February 2018, version 2.3.
- PCR Part A	UL Environment: Product Category Rules for Building-Related Products and Services in North America, Part A: Life Cycle Assessment Calculation Rules and Report Requirements, v.3.2, December 2018.
- PCR Part B	UL PCR for Asphalt Shingles, Built-up Asphalt Membrane Roofing and Modified Bituminous Membrane Roofing
- LCA for Experts	thinkstep.one. LCA for Experts v. 10.6 (software).
- ISO 14025	ISO 14025:2011-10, Environmental labels and declarations — Type III environmental declarations — Principles and procedures.
- ISO 14040	ISO 14040:2009-11, Environmental management — Life cycle assessment — Principles and framework.
- ISO 14044	ISO 14044:2006-10, Environmental management — Life cycle assessment — Requirements and guidelines.
- ISO 14046	ISO 14046:2013 - Environmental management- Water footprint- Principles, requirements and guidelines
- ISO 21930: 2017	ISO 21930:2017, Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
- ISO 15392	ISO 15392:2008 - Sustainability in building construction- General principles
- ISO 15686	ISO 15686-1:2011 - Buildings and constructed assets- Service life planning Part 1: General principles; ISO 15686-2:2008 - Part 2: Service life prediction procedures; ISO 15686-7:2008 - Part 7: Performance evaluation for feedback of service life data from practice; ISO 15686-8:2008 - Part 8: Reference service life and service life estimation
- EN 15804	EN 15804:2012-04: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction product
- NSF International	NSF Program Operator Rules, NSF International – National Center for Sustainability Standards, 2015
- Characterization Method	IPPC. 2014. Climate Change 2013. The Physical Science Basis. Cambridge University Press. (http://www.ipcc.ch/report/ar5/wg1/).
- Characterization Method	Hauschild M.Z., & Wenzel H. Environmental Assessment of Products. Springer, US, Vol. 2, 1998.
- Characterization Method	Heijungs R., Guinée J.B., Huppes G., Lankreijer R.M., Udo de Haes H.A., Wegener Sleeswijk A. Environmental Life Cycle Assessment of Products: Guide and Backgrounds. CML. Leiden University, Leiden, 1992.
- Characterization Method	Jenkin M.E., & Hayman G.D. Photochemical ozone creation potentials for oxygenated volatile organic compounds: sensitivity to variations in kinetic and mechanistic parameters. Atmospheric Environment. 1999. 33 (8) pp. 1275-1293
- Characterization Method	WMO. 1999. Scientific Assessment of Ozone Depletion: 1998, World Meteorological Organization Global Ozone Research and Monitoring Project - Report No. 44, WMO, Geneva.

Contact Information

Study Commissioner

GAF
Aly Perez
Sustainability Manager
1 Campus Drive
Parsippany, NJ 07054
alyson.perez@gaf.com

LCA Practitioner

Sustainable Solutions Corporation
155 Railroad Plaza, Suite 203
Royersford, PA 19468 USA
(+1) 610 569-1047
info@sustainablesolutionscorporation.com
www.sustainablesolutionscorporation.com