ENVIRONMENTAL PRODUCT DECLARATION

Ethylene Propylene Diene Monomer [EPDM]

WHITE NON-REINFORCED MEMBRANE

GENFLEX™ Roofing Systems

AMRIZE

GENERAL INFORMATION

This cradle-to-gate with options Environmental Product Declaration covers an EPDM Single Ply Roofing Membrane product produced at the Prescott Plant. The Life Cycle Assessment (LCA) was prepared in conformity with ISO 21930, ISO 14025, ISO 14040, and ISO 14044 and Sub-category PCR: Product Category Rules for Single Ply Roofing Membranes (ASTM International, 2019). This EPD is intended for business-to-business (B-to-B) audiences.

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EPD# 902

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Valid for 5 years

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ISO 21930:2017 Sustainability in Building Construction-Environmental Declaration of Building Products: serves as the core PCR Product Category Rules for Single Ply Roofing Membranes (ASTM International, 2019) serves as the sub-category PCR.

- Sub-category PCR review was conducted by **Thomas P. Gloria, PhD.** (t.gloria@industrial-ecology.com) • Industrial Ecology Consultants
- Independent verification of the declaration, according to ISO 21930:2017 and ISO 14025:2006.: ☐ internal ☑ external
- Third party verifier Thomas P. Gloria, PhD. (t.gloria@industrial-ecology.com) • Industrial Ecology Consultants
- For additional explanatory material Manufacturer Representative: Sherrie MacWilliams (sherrie.macwilliams@amrize.com)
- This LCA EPD was prepared by: Melissa Diaz, Senior LCA and EPD Project Manager • Climate Earth (www.climateearth.com)

PRODUCER

Amrize Building Envelope LLC delivers high-performance solutions that make the entire building envelope more sustainable for customers around the world. We are committed to raising the standards of building solutions by delivering superior quality and innovation while addressing industry needs.

Our offerings cover a comprehensive range of residential and commercial roofing, wall and lining systems, insulation, and waterproofing solutions for a variety of industries from construction to marine and aerospace. Our powerful portfolio brands include Elevate, Duro-Last, Malarkey Roofing Products, GenFlex, Gaco, and Enverge. Visit amrize.com to learn more.

Amrize's Prescott, AR facility is ISO 9000 certified, and manufactures GenFlex ethylene propylene diene monomer (EPDM) membrane for use in commercial roofing systems. The facility is 556,000 square feet and opened in 1982.

PRODUCT: FlexWhite™ EPDM Membrane

FlexWhite™ EPDM membrane combines the proven performance of EPDM with a highly reflective white surface for regions that have higher cooling costs. FlexWhite™ EPDM is easy to handle, installs quickly and is more flexible than thermoplastic single-ply membranes, making it ideal for year-round applications. FlexWhite™ EPDM can contribute to USGBC / CAGBC LEED® certification. EPDM membranes manufactured at the Prescott facility do not contain hazardous materials.

FIGURE 1

FlexWhite™ EPDM

The products covered in this EPD meet the following physical properties:

TABLE 1

Typical Properties (ASTM D 4637)

PHYSICAL TEST	ASTM MINIMUM VALUE	60 MIL	90 MIL
Thickness (D412)	2.286 mm +0.356 mm/-0.229 mm (0.090″ +0.014″/-0.009″)	1.549 mm (0.061″)	2.235 mm (0.088″)
Tensile Strength (D412, Die C)	9.0 MPa (1305 psi) Minimum	9.2 MPa (1336 psi)	11.0 MPa (1597 psi)
Dynamic Puncture Resistance @ 5J (D5635)	Pass	Pass	Pass
Static Puncture Resistance @ 20 kg [44.1 lbf] (D5602)	Pass	Pass	Pass
Elongation, Ultimate % (D412, Die C)	300% Minimum	420%	495%
Tensile Set (D412, Method A, Die C, 50% elongation)	10% Maximum	Pass	Pass
Tear Resistance (D624, Die C)	26.27 kN/m (150 lbf/in) Minimum	32.757 kN/m (187 lbf/in)	33.97 kN/m (194 lbf/in)
Brittleness Point (D2137)	-45 oC (-49 oF) Maximum	Pass	Pass
Ozone Resistance, no cracks (D1149)	Pass	Pass	Pass
Tensile Strength after Heat Aging*	8.3 MPa (1205 psi) Minimum	10.0 MPa (1445 psi)	Pass
Elongation, Ultimate after Heat Aging*	200% Minimum	380%	Pass
Tear Resistance after Heat Aging*	21.9 kN/m 125 lbf/in Minimum	32.9kN/m (188 lbf/in)	Pass
Linear Dimensional Change after Heat Aging*	± 1%	-1.00%	Pass
Water Absorption by Mass	+8% / -2%	2.00%	Pass
Visual Inspection after Xenon-Arc Weather Resistance**	Pass	Pass	Pass
PRFSE, minimum % after Xenon-Arc Weather Resistance**	30% Minimum	31%	Pass
Elongation, ultimate, minimum % after Xenon-Arc Weather Resistance**	200% Minimum	210%	Pass

** Heat age EPDM membrane for: 166 ± 1.66 hours at 240 ± 4 ℉ (116 ± 2 ℃), followed by specified physical testing.*
*** Weather Resistance shall be Practices G151 and G155 Xenon-Arc as follows:*

- *Filter Type: Daylight*
- *Irradiance: 0.35 to 0.70 W/(m2·nm) @ 340 nm [42 to 84 W/(m2·nm) @ 300 to 400 nm]*
- *Cycle: 690 minutes ± 15 minutes light, 30 minutes light plus water spray*
- *Un-insulated Black Panel Temp: 176o ± 4oF (80o ± 2oC)*
- *Relative Humidity: 50% ± 5%*
- *Spray Water: De-ionized*
- *Specimen Rotation: Every 315 KJ/(m2·nm) @ 340 nm [37.8 MJ/(m2·nm) @ 300 to 400 nm]*
- *Exposure: 2520 KJ/(m2·nm) @ 340 nm [302.4 MJ/(m2·nm) @ 300 to 400 nm]*

TABLE 2

Product Components

MATERIAL	% WEIGHTED AVERAGE COMPOSITION
EPDM Polymer	20.0 - 35.0
Process Oil & Other Aids	10.0 - 35.0
Carbon Black	0.0 - 35.0
Inorganic Filler	10.0 - 50.0
Cure Package & Other Additives	1.0 - 10.0
Polyester Scrim	0.0 - 5.0

LIFE CYCLE ASSESSMENT

DECLARED UNIT

The declared unit is 1 m^2 of single-ply roofing membrane for a stated product thickness.

SYSTEM BOUNDARY

This EPD is a cradle-to-gate with options EPD, covering the life cycle stages indicated in Table 3. Modules C1 and C3 do not contribute to the end-of-life scenarios considered, so they are declared as zero.

TABLE 3
Life Cycle Product Stages

PRODUCTION STAGE (MANDATORY)			CONSTRUCTION STAGE		USE STAGE							END-OF-LIFE STAGE			
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction / Demolition	Transport to waste processing or disposal	Waste processing	Disposal of waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X

NOTE: MND = module not declared; X = module included.

CUT-OFF

Items excluded from system boundary include:

- production, manufacture and construction of manufacturing capital goods and infrastructure;
- production and manufacture of production equipment, delivery vehicles, and laboratory equipment;
- personnel-related activities (travel, furniture, and office supplies); and
- energy and water use related to company management and sales activities that may be located either within the factory site or at another location.

ALLOCATION PROCEDURE

Allocation follows the requirements and guidance of ISO 14044:2006, Clause 4.3.4; and ISO 21930:2017 section 7.2. Recycling and recycled content is modeled using the cut-off rule

MANUFACTURING

A1-A3, Production Stage

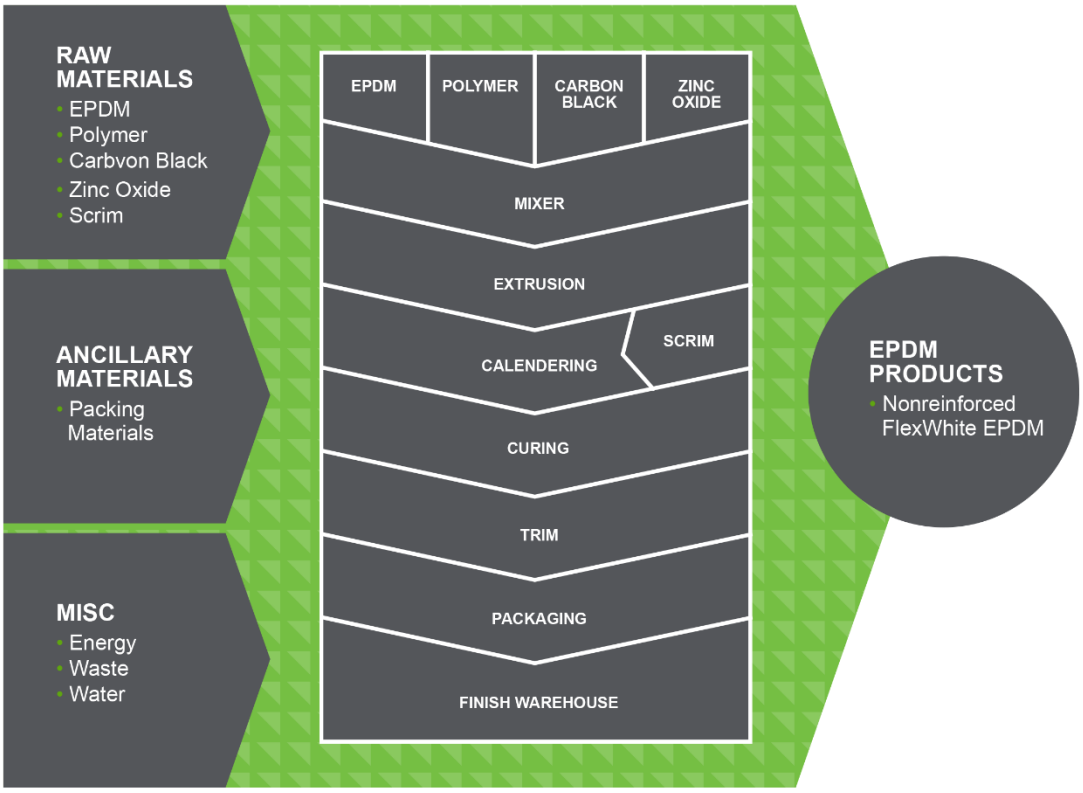
EPDM Membrane Roof Membrane Manufacturing

The main material input into the manufacturing process is EPDM along with various additives, which aid in the manufacturing process (e.g., accelerators) and which enhance the membrane's performance (e.g., fire retardants and pigments). The manufacturing process begins with mixing raw materials together in large batches to create uncured rubber that is slabbed off onto pallets for quality control testing. Once the uncured rubber has passed the quality control, it is extruded into a top and bottom layer and then calendared together. The sheet is dusted with mica to keep the material from sticking to itself though the vulcanization process. The vulcanization process uses heat (steam) and pressure to cure the rubber. Once vulcanized, the membrane is trimmed to size, rolled onto a cardboard core, wrapped and labeled.

For sheets wider than 10 feet, calendered sheets are sent through an automated sheet building machine to create sheets up to 50 feet wide. The large sheets also go through a dusting process prior to being sent through the vulcanization process. Once vulcanized, the membrane is trimmed to size, rolled onto a cardboard core, wrapped and labeled.

FIGURE 2

Process Flow Diagram of EPDM



A4, TRANSPORTATION

An average truck and transport distance from the plant to the construction site is assumed.

A5, INSTALLATION

The installation scenario includes the energy and ancillary materials typically consumed to mechanically install non-reinforced EPDM membrane standard-shaped roof of 20,000 square feet, with a total EPDM membrane weight of 8,200 pounds.

B1 – B7 USE STAGE

Use stage information modules have been omitted from this LCA study.

C1 – C4 END-OF-LIFE STAGE

At the end of building service life and during roof replacement, the EPDM roofing membranes may be reused, recovered and repurposed, or disposed. This study does not take reuse and recovery into account, and it is assumed that insulation is manually removed when the building is decommissioned and disposed in a landfill, for which an average distance and specific end of life LCI is applied. Therefore, it is assumed that there are zero impacts from demolition and waste processing.

LIFE CYCLE ASSESSMENT RESULTS

TABLE 4: **FlexWhite™ EPDM Single Ply Roofing Membrane**, Adhered with Bonding Adhesive Products, per 1 m^2

IMPACT ASSESSMENT UNIT	PRODUCTION (A1-A3)	TRANSPORT (A4)	INSTALLATION (A5)	TRANSPORT TO DISPOSAL OF WASTE (C2)	DISPOSAL OF WASTE (C4)
Global warming potential (GWP)[1]; kg CO_2 eq					
60 mils	5.80	0.28	1.27	7.27E-03	5.74E-03
90 mils	7.90	0.39	1.27	9.91E-03	7.82E-03
Depletion potential of the stratospheric ozone layer (ODP); kg CFC-11 eq					
60 mils	1.09E-06	1.18E-11	3.66E-07	1.45E-09	9.76E-10
90 mils	1.49E-06	1.61E-11	3.66E-07	1.97E-09	1.33E-09
Eutrophication potential (EP); kg N eq					
60 mils	1.27E-02	2.25E-04	1.42E-03	4.69E-06	5.68E-06
90 mils	1.73E-02	3.06E-04	1.42E-03	6.39E-06	7.74E-06
Acidification potential of soil and water sources (AP); kg SO_2 eq					
60 mils	3.96E-02	3.72E-03	4.73E-03	4.56E-05	5.52E-05
90 mils	5.40E-02	5.08E-03	4.73E-03	6.22E-05	7.53E-05
Formation potential of tropospheric ozone (POCP); kg O_3 eq					
60 mils	0.58	9.59E-02	4.84E-02	1.41E-03	1.66E-03
90 mils	0.79	0.13	4.84E-02	1.92E-03	2.27E-03
Resource Use					
Abiotic depletion potential for non-fossil mineral resources ($ADP_{elements}$); kg Sb eq					
60 mils	5.34E-05	0.00	1.68E-05	8.28E-12	8.71E-12
90 mils	7.29E-05	0.00	1.68E-05	1.13E-11	1.19E-11
Abiotic depletion potential for fossil resources (ADP_{fossil}); MJ, NCV					
60 mils	111	4.01	47.6	9.67E-02	7.95E-02
90 mils	152	5.47	47.6	0.13	0.11
Renewable primary energy resources as energy (fuel) (RPRE)[2]; MJ, NCV					
60 mils	2.74	0.00	0.53	1.51E-04	1.65E-04
90 mils	3.73	0.00	0.53	2.06E-04	2.25E-04
Renewable primary resources as material (RPRM)[2]; MJ, NCV					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Non-renewable primary resources as energy (fuel) (NRPRE)[2]; MJ, NCV					
60 mils	122	4.01	49.5	9.73E-02	8.02E-02
90 mils	167	5.47	49.5	0.13	0.11
Non-renewable primary resources as material (NRPRM)[2]; MJ, NCV					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Consumption of fresh water (FW)[2]; m^3					
60 mils	0.17	0.00	5.13E-02	1.63E-05	1.39E-05
90 mils	0.23	0.00	5.13E-02	2.23E-05	1.89E-05
Secondary Material, Fuel and Recovered Energy					
Secondary Materials (SM)[2]; kg					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Renewable secondary fuels (RSF)[2]; MJ, NCV					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Non-renewable secondary fuels (NRSF)[2]; MJ, NCV					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Recovered energy (RE)[2]; MJ, NCV					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Waste & Output Flows					
Hazardous waste disposed (HW)[2]; kg					
60 mils	3.90E-07	0.00	0.00	0.00	0.00
90 mils	5.32E-07	0.00	0.00	0.00	0.00
Non-hazardous waste disposed (NHWD)[2]; kg					
60 mils	8.80E-04	0.00	0.00	0.00	0.00
90 mils	1.20E-03	0.00	0.00	0.00	0.00
High-level radioactive waste (HLRW)[2]; kg					
60 mils	7.42E-09	0.00	6.14E-10	3.28E-13	3.58E-13
90 mils	1.01E-08	0.00	6.14E-10	4.48E-13	4.88E-13
Intermediate and low-level radioactive waste (ILLRW)[3]; kg					
60 mils	3.13E-08	0.00	2.96E-09	1.58E-12	1.72E-12

[1] GWP 100; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5). CO_2 from biogenic secondary fuels used in kiln are climate-neutral (CO_2 sink = CO_2 emissions), ISO 21930, 7.2.7.
[2] Calculated per ACLCA ISO 21930 Guidance.
[3] Calculated per ACLCA ISO 21930 Guidance.

IMPACT ASSESSMENT UNIT	PRODUCTION (A1-A3)	TRANSPORT (A4)	INSTALLATION (A5)	TRANSPORT TO DISPOSAL OF WASTE (C2)	DISPOSAL OF WASTE (C4)
90 mils	4.27E-08	0.00	2.96E-09	2.16E-12	2.35E-12
Components for reuse (CRU)[3]; kg					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Materials for recycling (MR)[3]; kg					
60 mils	2.66E-04	0.00	0.00	0.00	0.00
90 mils	3.63E-04	0.00	0.00	0.00	0.00
Materials for energy recovery (MER)[3]; kg					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Recovered energy exported from the product system (EE)[3]; MJ, NCV					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00

** Emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in these categories. The following optional indicators are not reported and also have high levels of uncertainty: Land use related impacts, toxicological aspects, and emissions from land use change*

***Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, quantified by the same functional unit, and taking account of replacement based on the product reference service life (RSL) relative to an assumed building service life, can be used to assist purchasers and users in making informed comparisons between products.*

TABLE 5: **FlexWhite™ EPDM Single Ply Roofing Membrane**, Adhered with Quick Jet Products, per 1 m^2

IMPACT ASSESSMENT UNIT	PRODUCTION (A1-A3)	TRANSPORT (A4)	INSTALLATION (A5)	TRANSPORT TO DISPOSAL OF WASTE (C2)	DISPOSAL OF WASTE (C4)
Global warming potential (GWP)[4]; kg CO_2 eq					
60 mils	5.80	0.28	0.92	7.27E-03	5.74E-03
90 mils	7.90	0.39	0.92	9.91E-03	7.82E-03
Depletion potential of the stratospheric ozone layer (ODP); kg CFC-11 eq					
60 mils	1.09E-06	1.18E-11	6.38E-08	1.45E-09	9.76E-10
90 mils	1.49E-06	1.61E-11	6.38E-08	1.97E-09	1.33E-09
Eutrophication potential (EP); kg N eq					
60 mils	1.27E-02	2.25E-04	1.09E-03	4.69E-06	5.68E-06
90 mils	1.73E-02	3.06E-04	1.09E-03	6.39E-06	7.74E-06
Acidification potential of soil and water sources (AP); kg SO_2 eq					
60 mils	3.96E-02	3.72E-03	2.77E-03	4.56E-05	5.52E-05
90 mils	5.40E-02	5.08E-03	2.77E-03	6.22E-05	7.53E-05
Formation potential of tropospheric ozone (POCP); kg O_3 eq					
60 mils	0.58	9.59E-02	3.74E-02	1.41E-03	1.66E-03
90 mils	0.79	0.13	3.74E-02	1.92E-03	2.27E-03
Resource Use					
Abiotic depletion potential for non-fossil mineral resources ($ADP_{elements}$); kg Sb eq					
60 mils	5.34E-05	0.00	3.20E-08	8.28E-12	8.71E-12
90 mils	7.29E-05	0.00	3.20E-08	1.13E-11	1.19E-11
Abiotic depletion potential for fossil resources (ADP_{fossil}); MJ, NCV					
60 mils	111	4.01	25.5	9.67E-02	7.95E-02
90 mils	152	5.47	25.5	0.13	0.11
Renewable primary energy resources as energy (fuel) (RPRE)[5]; MJ, NCV					
60 mils	2.74	0.00	0.19	1.51E-04	1.65E-04
90 mils	3.73	0.00	0.19	2.06E-04	2.25E-04
Renewable primary resources as material (RPRM)[5]; MJ, NCV					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Non-renewable primary resources as energy (fuel) (NRPRE)[5]; MJ, NCV					
60 mils	122	4.01	26.6	9.73E-02	8.02E-02
90 mils	167	5.47	26.6	0.13	0.11
Non-renewable primary resources as material (NRPRM)[5]; MJ, NCV					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Consumption of fresh water (FW)[5]; m^3					
60 mils	0.17	0.00	4.23E-02	1.63E-05	1.39E-05
90 mils	0.23	0.00	4.23E-02	2.23E-05	1.89E-05
Secondary Material, Fuel and Recovered Energy					
Secondary Materials (SM)5; kg					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Renewable secondary fuels (RSF)[6]; MJ, NCV					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Non-renewable secondary fuels (NRSF)[6]; MJ, NCV					

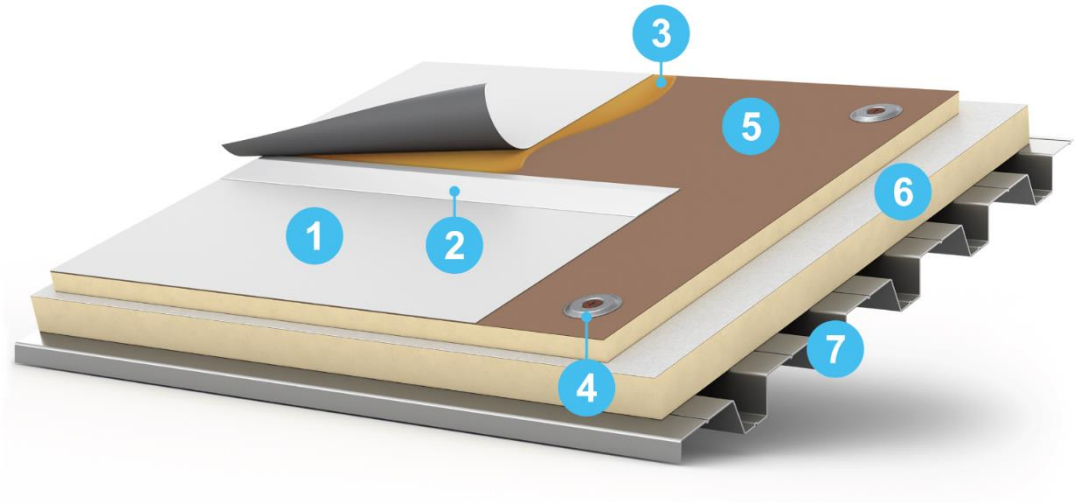
[4] GWP 100; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5). CO_2 from biogenic secondary fuels used in kiln are climate-neutral (CO_2 sink = CO_2 emissions), ISO 21930, 7.2.7.
[5] Calculated per ACLCA ISO 21930 Guidance.
[6] Calculated per ACLCA ISO 21930 Guidance.

IMPACT ASSESSMENT UNIT	PRODUCTION (A1-A3)	TRANSPORT (A4)	INSTALLATION (A5)	TRANSPORT TO DISPOSAL OF WASTE (C2)	DISPOSAL OF WASTE (C4)
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Recovered energy (RE)[6]; MJ, NCV					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Waste & Output Flows					
Hazardous waste disposed (HW)[6]; kg					
60 mils	3.90E-07	0.00	0.00	0.00	0.00
90 mils	5.32E-07	0.00	0.00	0.00	0.00
Non-hazardous waste disposed (NHWD)[6]; kg					
60 mils	8.80E-04	0.00	0.00	0.00	0.00
90 mils	1.20E-03	0.00	0.00	0.00	0.00
High-level radioactive waste (HLRW)[6]; kg					
60 mils	7.42E-09	0.00	2.84E-10	3.28E-13	3.58E-13
90 mils	1.01E-08	0.00	2.84E-10	4.48E-13	4.88E-13
Intermediate and low-level radioactive waste (ILLRW)[6]; kg					
60 mils	3.13E-08	0.00	1.37E-09	1.58E-12	1.72E-12
90 mils	4.27E-08	0.00	1.37E-09	2.16E-12	2.35E-12
Components for reuse (CRU)[6]; kg					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Materials for recycling (MR)[6]; kg					
60 mils	2.66E-04	0.00	0.00	0.00	0.00
90 mils	3.63E-04	0.00	0.00	0.00	0.00
Materials for energy recovery (MER)[6]; kg					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00
Recovered energy exported from the product system (EE)[6]; MJ, NCV					
60 mils	0.00	0.00	0.00	0.00	0.00
90 mils	0.00	0.00	0.00	0.00	0.00

** Emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in these categories. The following optional indicators are not reported and also have high levels of uncertainty: Land use related impacts, toxicological aspects, and emissions from land use change*

***Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, quantified by the same functional unit, and taking account of replacement based on the product reference service life (RSL) relative to an assumed building service life, can be used to assist purchasers and users in making informed comparisons between products.*

ADDITIONAL ENVIRONMENTAL INFORMATION



FlexWhite™ EPDM Roof System

1. **FlexWhite™ EPDM Membrane**
2. **Seam Tape**
3. **Bonding Adhesive**
4. **Metal Insulation Plates and Fasteners**
5. **HD Cover Board** (optional) – **Mechanically Attached**
6. **ISO GL or ISO CG Insulation - Adhered**
    - All GenFlex polyisocyanurate insulations use EPA accepted blowing agents. GenFlex HD Cover Board, ISO GL, and ISO CG insulation products incorporate a HCFC-free blowing agent that does not contribute to ozone layer depletion (ODP-free).
    - The thermal performance of ISO GL polyisocyanurate insulation is up to 40% better than major competitors when tested by an independent third party in cold temperature 40°F (4°C) applications according to ASTM C1289 standards. The increased R-value per inch means better thermal performance from the same roofing systems using the same amount of insulation compared to leading competitive products on the market today.
7. **Steel Deck**

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