

## ENVIRONMENTAL PRODUCT DECLARATION

# TPO MEMBRANE

SINGLE PLY ROOFING MEMBRANE  
INSTALLATION: MECHANICALLY FASTENED



Singly ply, TPO membrane mechanically fastened and representative of 1.1, 1.2, 1.5, and 1.8 mm thicknesses



Holcim Solutions and Products EMEA BV is a leading manufacturer of high-performing synthetic single-ply roofing and lining systems for commercial, industrial and residential applications.

Elevate roofing systems are marketed under the brand names RubberGard™ EPDM, RubberCover™ EPDM and UltraPly™ TPO. Elevate lining systems are marketed under the brand names PondGard™ EPDM and GeoGard™ EPDM.

Holcim Solutions and Products EMEA BV entered the waterproofing industry in 1980. The company has since produced and installed over 1,500,000,000 m<sup>2</sup> of single-ply membranes worldwide.

Contractors, building owners, architects and specifiers trust Holcim Solutions and Products EMEA BV as a leading, single source for superior roofing and lining systems.

Holcim Solutions and Products EMEA BV is part of the Holcim Group, a global leader in innovative and sustainable building solutions.

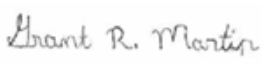



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This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.



PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	Holcim Solutions and Products EMEA BV
DECLARATION NUMBER	4787742079.103.1
DECLARED PRODUCT	TPO Single Ply Roofing Membrane (Mechanically Fastened)
REFERENCE PCR	ASTM International Single Ply Roofing Membranes v.1 (2013) with UL Addendum v.1 (2019)
DATE OF ISSUE	July 1, 2019
PERIOD OF VALIDITY	5 Years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications
The PCR review was conducted by:	ASTM International Panel Review cert@astm.org
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories <input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> EXTERNAL	 Grant R. Martin, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	 Thomas Gloria, Industrial Ecology Consultants

This EPD conforms with ISO 21930:2007 & EN 15804

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## Product Definition

### Description of Product

The product system evaluated in this report is an installed single ply TPO roofing membrane at the finished nominal thicknesses listed in Table 1.

**Table 1: Membrane specification and standard**

Roof System	Declared Thicknesses	Membrane Weight [kg/m <sup>2</sup> ]	Standard
Thermoplastic polyolefin (TPO)	1.1 mm	1.09	ASTM D6878 EN 13956
	1.2 mm	1.20	
	1.5 mm	1.45	
	1.8 mm	1.93	

### Application and Uses

TPO is a flexible sheet single-ply roof membrane made from thermoplastic polyolefin as the principal polymer that is used worldwide in low-slope buildings for commercial, industrial and residential application. Since 1996 Holcim has been offering premium quality TPO membrane – UltraPly TPO membrane with excellent heat and weather resistance. Physical properties of the membrane are enhanced by a strong weft inserted polyester reinforcement that is encapsulated between top and bottom plies, hence providing excellent tensile strength, tear resistance, elongation as well as excellent puncture resistance. It is classified as a thermoplastic material with the seams of the roofing system sealed by heat welding with hot air. UltraPly TPO membranes come in white, gray and tan color, with white being the most common. The membranes are sold in a variety of widths and thicknesses.

## Product Life Cycle Description

### Material Content

Table 2 shows the input material for TPO roofing membranes and their material percentages.

**Table 2: Composition of TPO roofing membrane**

Material	%
Base resin (PP/EPDM)	77.5%
Fire retardants	8.3%
Polyester scrim	4.3%
Pigments	9.4%
Weathering agents	< 1%
Anti-oxidizing agents	< 1%
Stabilizers	< 1%
Compounding agents	< 1%



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**Manufacturing Process**

The main material input into the TPO manufacturing process is the base resin in the form of pellets and processed scrap. Additional materials include those which aid the manufacturing process (e.g., accelerators) and those which enhance the membrane’s performance (e.g., fire retardants, anito-oxidant, biocide, pigments etc). The mixture is blended together, heated, and extruded onto the top and bottom of polyester reinforcing scrim to form laminated layers. The process is run to have the reinforcing scrim sandwiched in the middle of the top and bottom ply, each with a precisely controlled thickness. The TPO membrane is cooled by passing it through a series of rollers with temperatures controlled by closed loop chillers. The membrane is then cut to the desired length, wound onto a cardboard core, and wrapped in plastic film. Membrane rolls are packaged and labelled before they are shipped to construction sites for installation.

Figure 1 shows the manufacturing process for TPO membrane while Figure 2 displays a process schematic for the manufacturing of TPO membrane.

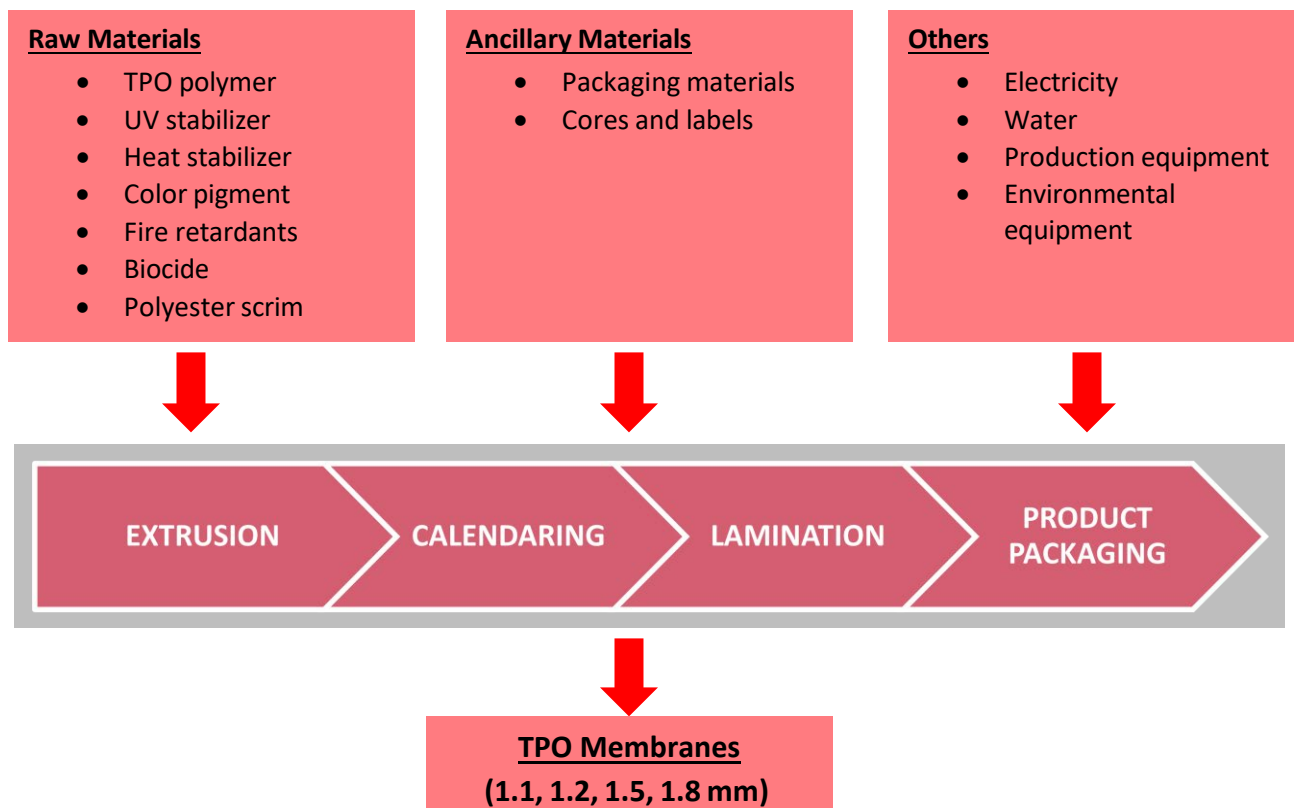


Figure 1: TPO production process map

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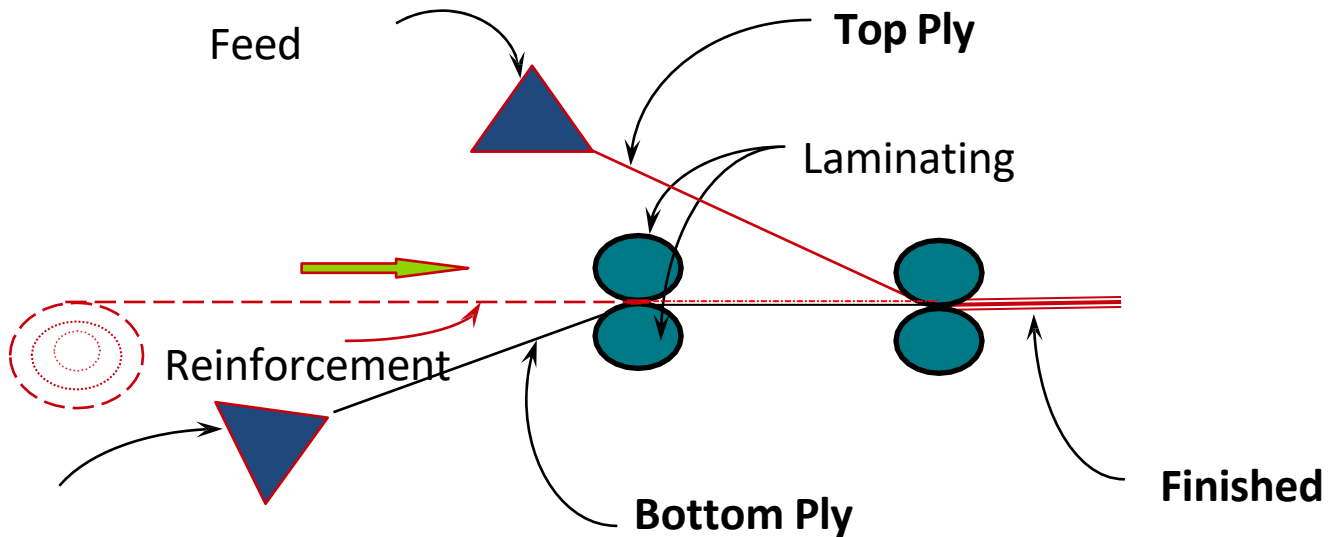


Figure 2: TPO production process schematic

Installation

Table 3 shows the material inputs and outputs associated with the installation of 1 m<sup>2</sup> of TPO membrane. This scenario is based on the industry average EPD (SPRI, 2016) and is intended to represent a typical installation. It is assumed to be representative for all thicknesses. Packaging materials are disposed of after the membrane is installed at the building site.

Table 3: Installation of TPO membrane, unit process (per declared unit)

I/O	Material	Value	Unit
<b>Inputs</b>	TPO roofing membrane (packaged), incl. 2.5% overlap	1.025	m <sup>2</sup>
	Steel fasteners	0.0242	kg
	Electricity for power tools	0.00360	MJ
<b>Outputs</b>	1 m <sup>2</sup> of installed TPO roofing membrane	1	m <sup>2</sup>
	Packaging waste (from membrane)	*	kg

\* varies with membrane thickness

End-of-Life

At the end of the roofing membrane’s useful life, it was assumed that the membrane material, as well as any fasteners or adhesive substances, are manually removed from the building and then landfilled. In the EU, because the membranes are petroleum-based, they have an energy content and are therefore assumed to be incinerated at EoL. Transport to landfill was approximated with 20 miles via large dump truck.



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## Life Cycle Assessment – Product Systems and Modeling

### Declared Unit

The declared unit evaluated is 1 m<sup>2</sup> of single ply roofing membrane for a stated product thickness. As the use stage is excluded from this study, no reference service life is defined.

### Life Cycle Stages Assessed

The life cycle assessment (LCA) conducted includes the production, transport to installation site, installation, and end-of-life (EoL) stages.

### System Boundaries

System boundaries are summarized in Figure 2 for the analysis scope of “cradle-to-building with EoL stage” (i.e., production with installation and EoL stages). Excluded modules are indicated by “MND” or “module not declared”. As is typical of works of life cycle assessment, the construction and maintenance of capital equipment, such as production equipment in the manufacturing stage, are not included in the system, nor are human labor and employee commute. The use stage is also outside the scope of this study.

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END-OF-LIFE STAGE			
Raw material supply	Transport	Manufacturing	Transport	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal
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

Figure 3: Life cycle stages included in system boundary

### Assumptions

In cases where no matching life cycle inventories were available to represent a flow, proxy data were applied based on conservative assumptions regarding environmental impacts.

### Transportation

Unless specified by manufacturers, estimated transportation distances and modes of transport are included for the transport of the raw materials, operating materials and auxiliary materials to production facilities.



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## Period under Consideration

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All primary data were collected for the year 2014. All secondary data come from the GaBi Professional databases and are representative of the years 2010-2013.

## Manufacturing Locations

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Holcim manufactures its membranes in the United States. Installation, use, and end-of-life are considered for the EU. Whenever US background data were not readily available, European data or global data were used as proxies.

## Background Data

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The LCA model was created using the GaBi software system for life cycle engineering, developed by thinkstep AG. The GaBi Professional LCI database provides the life cycle inventory data for several of the raw and process materials obtained from the background system.

## Cut- Off Criteria

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Per the PCR, the cut-off criteria for flows to be considered within each system boundary are as follows:

- **Mass:** If a flow is less than 1% of the cumulative mass of the model flows, it may be excluded, provided its environmental relevance is minor, based on a sensitivity analysis.
- **Energy:** If a flow is less than 1% of the cumulative energy of the system model, it may be excluded, provided its environmental relevance is minor, based on a sensitivity analysis.
- **Environmental relevance:** If a flow meets the above two criteria, but is determined to contribute 2% or more to the selected impact categories of the products underlying the EPD, based on a sensitivity analysis, it is included within the system boundary.

At least 95% of the mass flows shall be included and the life-cycle impact data shall contain at least 95% of all elementary flows that contribute to each of the declared category indicators. A list of hazardous and toxic materials and substances shall be included in the inventory and the cut-off rules do not apply to such substances.

No cut-off criteria had to be applied for this study. All available energy and material flow data were included in the model.

## Data Quality Requirements

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As the majority of the relevant foreground data are measured data or calculated based on primary information sources of the owner of the technology, precision is considered to be high. Seasonal variations were balanced out by collecting annual data. All background data are sourced from GaBi databases with the documented precision. Each foreground process was checked for mass balance and completeness of the emission inventory. No data were knowingly omitted. Completeness of foreground unit process data is considered to be high. All background data are sourced from GaBi databases with the documented completeness.

## Allocation

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When several products were manufactured at the same plant, Holcim used mass allocation to report data. Mass



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allocation was selected since the environmental burden in the industrial process (energy consumption, emissions, etc.) is primarily governed by the mass throughput of each sub-process.

## Life Cycle Assessment – Results and Analysis

All results for the roofing membranes are presented in the below tables, separated by production (A1-A3), transport to installation site (A4), installation (A5), Use (B1-B7), and EoL (C1-C4) stages.

**Table 4: 1.1 mm TPO membrane overall results, EU scenario, per declared unit**

	Production (A1-A3)	Transport (A4)	Installation (A5)	EoL (C1-C4)	Total
<b>TPO 1.1 mm</b>					
<b>TRACI 2.1 Impact Categories</b>					
GWP (kg CO <sub>2</sub> -eq.)	4.05	0.154	0.0138	0.135	<b>4.35</b>
AP (kg SO <sub>2</sub> eq.)	0.0109	4.08E-03	3.17E-05	3.74E-04	<b>0.0154</b>
EP (kg N-eq.)	5.88E-04	1.42E-04	1.46E-06	1.28E-04	<b>8.60E-04</b>
ODP (kg CFC11-eq.)	4.71E-10	1.08E-12	1.36E-12	1.61E-12	<b>4.75E-10</b>
SFP (kg O <sub>3</sub> -eq.)	0.170	0.0766	4.03E-04	6.72E-03	<b>0.254</b>
<b>CML Impact Categories</b>					
ADPe (kg Sb-eq.)	3.01E-06	1.84E-08	3.24E-09	1.71E-08	<b>3.05E-06</b>
ADPf (MJ)	97.9	1.95	0.148	1.34	<b>101</b>
GWP (kg CO <sub>2</sub> -eq.)	4.05	0.154	0.0138	0.135	<b>4.35</b>
AP (kg SO <sub>2</sub> eq.)	0.0106	3.85E-03	3.24E-05	3.28E-04	<b>0.0148</b>
EP (kg Phosphate-eq.)	1.14E-03	4.12E-04	2.41E-06	2.72E-04	<b>1.83E-03</b>
ODP (kg CFC11-eq.)	4.42E-10	1.02E-12	1.28E-12	1.51E-12	<b>4.46E-10</b>
POCP (kg Ethene-eq.)	1.27E-03	2.36E-04	3.20E-06	5.29E-05	<b>1.56E-03</b>
<b>Inventory metrics</b>					
<i>Total primary energy consumption</i>					
Non-renewable fossil [MJ]	97.9	1.95	0.148	1.34	<b>101</b>
Non-renewable nuclear [MJ]	4.53	0.00942	0.0357	0.0353	<b>4.61</b>
Renewable (solar, wind, hydroelectric, geothermal) [MJ]*	2.68	0.0104	-0.0921	0.0682	<b>2.66</b>
Renewable (biomass) [MJ]	5.80E-11	2.13E-14	1.95E-12	1.75E-12	<b>6.17E-11</b>
<i>Material resource consumption</i>					
Non-renewable materials [kg]	5.18	0.00793	0.0534	0.343	<b>5.58</b>
Renewable materials [kg]	1,400	4.41	23.8	33.7	<b>1,462</b>
Fresh water [L]	21.8	0.0841	0.0728	-0.00491	<b>21.9</b>





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	Production (A1-A3)	Transport (A4)	Installation (A5)	EoL (C1-C4)	Total
Waste generated [kg]	0.312	3.18E-05	1.75E-04	1.24	<b>1.55</b>
<b>FDEN NF EN 15804 Categories</b>					
Air Pollution [m³]	567	263	4.98	14.0	<b>849</b>
Water Pollution [m³]	17.1	4.22	0.0147	0.161	<b>21.5</b>
ADPe (kg Sb-eq.) (incl. complementary factors)	2.99E-06	1.81E-08	3.23E-09	1.70E-08	<b>3.03E-06</b>
<b>EN 15804 Parameters describing resource use</b>					
PERE [MJ]	2.35	0.0104	-0.0921	0.0682	<b>2.33</b>
PERM [MJ]	0.328	-	-	-	<b>0.328</b>
PERT [MJ]	2.68	0.0104	-0.0921	0.0682	<b>2.66</b>
PENRE [MJ]	70.1	1.96	0.183	1.37	<b>74</b>
PENRM [MJ]	32.3	-	-	-	<b>32.3</b>
PENRT [MJ]	102	1.96	0.183	1.37	<b>106</b>
SM [kg]	-	-	-	-	-
RSF [MJ]	-	-	-	-	-
NRSF [MJ]	-	-	-	-	-
Net use of fresh water [m3]	0.0218	8.41E-05	7.28E-05	-4.91E-06	<b>0.0219</b>
<b>EN 15804 Other environmental information describing waste categories</b>					
HWD [kg]	8.72E-06	1.63E-07	1.04E-07	2.55E-07	<b>9.24E-06</b>
NHWD [kg]	0.312	3.18E-05	1.75E-04	1.24	<b>1.55</b>
RWD [kg]	0.00178	3.70E-06	1.42E-05	1.39E-05	<b>0.00182</b>

**Table 5: 1.2 mm TPO membrane overall results, EU scenario, per declared unit**

	Production (A1-A3)	Transport (A4)	Installation (A5)	EoL (C1-C4)	Total
<b>TPO 1.2 mm</b>					
<b>TRACI 2.1 Impact Categories</b>					
GWP (kg CO <sub>2</sub> -eq.)	4.57	0.170	0.0136	0.149	4.91
AP (kg SO <sub>2</sub> eq.)	0.0135	0.0044898	3.10E-05	4.11E-04	0.0185
EP (kg N-eq.)	6.81E-04	1.56E-04	1.35E-06	1.41E-04	9.79E-04
ODP (kg CFC11-eq.)	5.31E-10	1.19E-12	1.36E-12	1.73E-12	5.36E-10
SFP (kg O <sub>3</sub> -eq.)	0.201	0.0842	3.90E-04	0.0073827	0.293
<b>CML Impact Categories</b>					



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	Production (A1-A3)	Transport (A4)	Installation (A5)	EoL (C1-C4)	Total
ADPe (kg Sb-eq.)	3.66E-06	2.02E-08	3.20E-09	1.87E-08	3.71E-06
ADPf (MJ)	107	2.15	0.144	1.47	111
GWP (kg CO <sub>2</sub> -eq.)	4.57	0.170	0.0136	0.149	4.91
AP (kg SO <sub>2</sub> eq.)	0.0134	0.00424	3.18E-05	3.61E-04	0.0180
EP (kg Phosphate-eq.)	0.00133	4.53E-04	2.29E-06	2.99E-04	0.00208
ODP (kg CFC11-eq.)	5.00E-10	1.12E-12	1.28E-12	1.63E-12	5.04E-10
POCP (kg Ethene-eq.)	0.00150	2.60E-04	3.16E-06	5.83E-05	0.00182
<b>Inventory metrics</b>					
<i>Total primary energy consumption</i>					
Non-renewable fossil [MJ]	107	2.15	0.144	1.47	111
Non-renewable nuclear [MJ]	5.14	0.0104	0.0355	0.0385	5.23
Renewable (solar, wind, hydroelectric, geothermal) [MJ]*	3.11	0.0115	-0.105	0.0748	3.09
Renewable (biomass) [MJ]	6.86E-11	2.35E-14	1.94E-12	1.92E-12	7.24E-11
<i>Material resource consumption</i>					
Non-renewable materials [kg]	6.52	0.00874	0.0528	0.377	6.96
Renewable materials [kg]	1652	4.86	23.6	36.9	1718
Fresh water [L]	22.6	0.0928	0.0721	-0.00573	22.8
Waste generated [kg]	0.480	3.50E-05	1.72E-04	1.36	1.84
<b>FDES NF EN 15804 Categories</b>					
Air Pollution [m <sup>3</sup> ]	315	22.1	0.504	21.3	359
Water Pollution [m <sup>3</sup> ]	4.29	0.0284	0.00249	4.42	8.74
ADPe (kg Sb-eq.) (incl. complementary factors)	3.65E-06	2.00E-08	3.19E-09	1.87E-08	3.69E-06
<b>EN 15804 Parameters describing resource use</b>					
PERE [MJ]	2.11	0.0115	-0.105	0.0748	2.11
PERM [MJ]	1.00	-	-	-	1.00
PERT [MJ]	3.11	0.0115	-0.105	0.0748	3.11
PENRE [MJ]	78.8	2.16	0.179	1.51	78.8
PENRM [MJ]	33.8	-	-	-	33.8
PENRT [MJ]	113	2.16	0.179	1.51	113
SM [kg]	-	-	-	-	-
RSF [MJ]	-	-	-	-	-



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	Production (A1-A3)	Transport (A4)	Installation (A5)	EoL (C1-C4)	Total
NRSF [MJ]	-	-	-	-	-
Net use of fresh water [m3]	0.0226	9.3E-05	7.2E-05	-5.7E-06	0.0226
<b>EN 15804 Other environmental information describing waste categories</b>					
HWD [kg]	1.05E-05	1.79E-07	1.01E-07	2.80E-07	1.05E-05
NHWD [kg]	0.480	3.50E-05	1.72E-04	1.36	0.480
RWD [kg]	0.00202	4.08E-06	1.41E-05	1.51E-05	0.00202

Table 6: 1.5 mm TPO membrane overall results, EU scenario, per declared unit

	Production (A1-A3)	Transport (A4)	Installation (A5)	EoL (C1-C4)	Total
<b>TPO 1.5 mm</b>					
<b>TRACI 2.1 Impact Categories</b>					
GWP (kg CO <sub>2</sub> -eq.)	5.32	0.204	0.0133	0.179	<b>5.71</b>
AP (kg SO <sub>2</sub> eq.)	0.0139	5.39E-03	2.95E-05	4.93E-04	<b>0.0199</b>
EP (kg N-eq.)	7.68E-04	1.87E-04	1.08E-06	1.70E-04	<b>1.13E-03</b>
ODP (kg CFC11-eq.)	6.18E-10	1.43E-12	1.34E-12	2.13E-12	<b>6.23E-10</b>
SFP (kg O <sub>3</sub> -eq.)	0.221	0.101	3.61E-04	8.85E-03	<b>0.331</b>
<b>CML Impact Categories</b>					
ADPe (kg Sb-eq.)	3.88E-06	2.43E-08	3.12E-09	2.25E-08	<b>3.93E-06</b>
ADPf (MJ)	129	2.58	0.135	1.77	<b>134</b>
GWP (kg CO <sub>2</sub> -eq.)	5.32	0.204	0.0133	0.179	<b>5.71</b>
AP (kg SO <sub>2</sub> eq.)	0.0135	5.09E-03	3.05E-05	4.33E-04	<b>0.0191</b>
EP (kg Phosphate-eq.)	1.49E-03	5.44E-04	1.99E-06	3.59E-04	<b>2.39E-03</b>
ODP (kg CFC11-eq.)	5.81E-10	1.35E-12	1.26E-12	2.01E-12	<b>5.86E-10</b>
POCP (kg Ethene-eq.)	1.65E-03	3.12E-04	3.06E-06	6.97E-05	<b>2.03E-03</b>
<b>Inventory metrics</b>					
<i>Total primary energy consumption</i>					
Non-renewable fossil [MJ]	129	2.58	0.135	1.77	<b>134</b>
Non-renewable nuclear [MJ]	5.94	0.0124	0.0349	0.0467	<b>6.04</b>
Renewable (solar, wind, hydroelectric, geothermal) [MJ]*	3.49	0.0137	-0.135	0.0901	<b>3.46</b>
Renewable (biomass) [MJ]	7.53E-11	2.81E-14	1.90E-12	2.32E-12	<b>7.96E-11</b>
<i>Material resource consumption</i>					



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	Production (A1-A3)	Transport (A4)	Installation (A5)	EoL (C1-C4)	Total
Non-renewable materials [kg]	6.61	0.0105	0.0514	0.453	<b>7.13</b>
Renewable materials [kg]	1,820	5.82	23.2	44.5	<b>1,893</b>
Fresh water [L]	29.1	0.1109	0.0703	-0.00674	<b>29.3</b>
Waste generated [kg]	0.375	4.18E-05	1.65E-04	1.63	<b>2.01</b>
<b>FDES NF EN 15804 Categories</b>					
Air Pollution [m <sup>3</sup> ]	282	26.6	0.477	25.5	<b>335</b>
Water Pollution [m <sup>3</sup> ]	4.40	0.034	2.33E-03	5.32	<b>9.75</b>
ADPe (kg Sb-eq.) (incl. complementary factors)	3.86E-06	2.39E-08	3.11E-09	2.24E-08	<b>3.91E-06</b>
<b>EN 15804 Parameters describing resource use</b>					
PERE [MJ]	2.96	0.0137	-0.1346	0.0901	<b>2.93</b>
PERM [MJ]	0.533	-	-	-	<b>0.533</b>
PERT [MJ]	3.49	0.0137	-0.1346	0.0901	<b>3.46</b>
PENRE [MJ]	92.2	2.59	0.170	1.81	<b>97</b>
PENRM [MJ]	43.1	-	-	-	<b>43.1</b>
PENRT [MJ]	135	2.59	0.170	1.81	<b>140</b>
SM [kg]	-	-	-	-	-
RSF [MJ]	-	-	-	-	-
NRSF [MJ]	-	-	-	-	-
Net use of fresh water [m <sup>3</sup> ]	0.0291	1.11E-04	7.03E-05	-6.74E-06	<b>0.0293</b>
<b>EN 15804 Other environmental information describing waste categories</b>					
HWD [kg]	1.13E-05	2.14E-07	9.38E-08	3.36E-07	<b>1.19E-05</b>
NHWD [kg]	0.375	4.18E-05	1.65E-04	1.63	<b>2.01</b>
RWD [kg]	0.00234	4.89E-06	1.39E-05	1.83E-05	<b>0.00238</b>

Table 7: 1.8 mm TPO membrane overall results, EU scenario, per declared unit

	Production (A1-A3)	Transport (A4)	Installation (A5)	EoL (C1-C4)	Total
<b>TPO 1.8 mm</b>					
<b>TRACI 2.1 Impact Categories</b>					
GWP (kg CO <sub>2</sub> -eq.)	7.03	0.272	0.0125	0.238	<b>7.55</b>
AP (kg SO <sub>2</sub> eq.)	0.0178	7.18E-03	2.65E-05	6.56E-04	<b>0.0257</b>
EP (kg N-eq.)	1.01E-03	2.50E-04	5.46E-07	2.26E-04	<b>1.48E-03</b>



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	Production (A1-A3)	Transport (A4)	Installation (A5)	EoL (C1-C4)	Total
ODP (kg CFC11-eq.)	8.17E-10	1.91E-12	1.31E-12	2.86E-12	<b>8.23E-10</b>
SFP (kg O <sub>3</sub> -eq.)	0.288	0.135	3.02E-04	0.0118	<b>0.434</b>
<b>CML Impact Categories</b>					
ADPe (kg Sb-eq.)	5.00E-06	3.24E-08	2.96E-09	3.00E-08	<b>5.06E-06</b>
ADPf (MJ)	173	3.43	0.119	2.35	<b>178</b>
GWP (kg CO <sub>2</sub> -eq.)	7.03	0.272	0.0125	0.238	<b>7.55</b>
AP (kg SO <sub>2</sub> eq.)	0.0172	6.78E-03	2.78E-05	5.76E-04	<b>0.0246</b>
EP (kg Phosphate-eq.)	1.95E-03	7.25E-04	1.42E-06	4.78E-04	<b>3.15E-03</b>
ODP (kg R11-eq.)	7.68E-10	1.79E-12	1.23E-12	2.69E-12	<b>7.74E-10</b>
POCP (kg Ethene-eq.)	2.15E-03	4.16E-04	2.86E-06	9.27E-05	<b>2.66E-03</b>
<b>Inventory metrics</b>					
<i>Total primary energy consumption</i>					
Non-renewable fossil [MJ]	173	3.43	0.119	2.35	<b>178</b>
Non-renewable nuclear [MJ]	7.84	0.0166	0.0337	0.0623	<b>7.96</b>
Renewable (solar, wind, hydroelectric, geothermal) [MJ]*	4.57	0.0181	-0.193	0.120	<b>4.52</b>
Renewable (biomass) [MJ]	9.81E-11	3.73E-14	1.83E-12	3.08E-12	<b>1.03E-10</b>
<i>Material resource consumption</i>					
Non-renewable materials [kg]	8.42	0.0139	0.0487	0.603	<b>9.08</b>
Renewable materials [kg]	2,371	7.74	22.3	59.4	<b>2,460</b>
Fresh water [L]	39.4	0.1474	0.0670	-0.00919	<b>39.6</b>
Waste generated [kg]	0.434	5.55E-05	1.51E-04	2.17	<b>2.60</b>
<b>FDES NF EN 15804 Categories</b>					
Air Pollution [m <sup>3</sup> ]	344	35.4	0.423	34.0	<b>414</b>
Water Pollution [m <sup>3</sup> ]	5.62	0.0454	2.02E-03	7.09	<b>12.8</b>
ADPe (kg Sb-eq.) (incl. complementary factors)	4.97E-06	3.19E-08	2.95E-09	2.98E-08	<b>5.03E-06</b>
<b>EN 15804 Parameters describing resource use</b>					
PERE [MJ]	3.69	0.0181	-0.1927	0.1199	<b>3.63</b>
PERM [MJ]	0.883	-	-	-	<b>0.883</b>
PERT [MJ]	4.57	0.0181	-0.1927	0.1199	<b>4.52</b>
PENRE [MJ]	122	3.45	0.152	2.41	<b>128</b>
PENRM [MJ]	58.3	-	-	-	<b>58.3</b>



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	Production (A1-A3)	Transport (A4)	Installation (A5)	EoL (C1-C4)	Total
PENRT [MJ]	180	3.45	0.152	2.41	<b>186</b>
SM [kg]	-	-	-	-	-
RSF [MJ]	-	-	-	-	-
NRSF [MJ]	-	-	-	-	-
Net use of fresh water [m3]	0.0394	1.47E-04	6.70E-05	-9.19E-06	<b>0.0396</b>
<b>EN 15804 Other environmental information describing waste categories</b>					
HWD [kg]	1.46E-05	2.85E-07	7.94E-08	4.47E-07	<b>1.54E-05</b>
NHWD [kg]	0.434	5.55E-05	1.51E-04	2.17	<b>2.60</b>
RWD [kg]	0.00309	6.51E-06	1.34E-05	2.45E-05	<b>0.00313</b>

### Additional Environmental Information

#### Excellent weathering performance:

The ability of TPO (FPO) membranes to resist ageing due to heat exposure and UV radiation is critical and is directly related to the formulation and the thickness of the layer over scrim. Holcim UltraPly TPO membrane exhibits an excellent resistance to UV and heat ageing, which is proven by the fact that there is no change in formulation of UltraPly TPO membrane since start (in 1996) and it is still performing very well. Holcim UltraPly TPO membrane is tested for its UV performance as per both ASTM and EN requirement, it exceeds the standard requirement by many times. When tested as per EN 13956 standard, the UltraPly TPO membrane, and this for all available thicknesses, still meets UEAtc requirements after 7,500 hours of exposure to a combination of UV radiation, elevated temperature and water. In addition to a visual inspection for defects (blisters, cracks, holes, scratches, indentations), membrane samples are also tested on foldability at low temperature. The performance of the UltraPly TPO membrane is better than any value declared by TPO (FPO) competition.

#### Environmentally green:

UltraPly TPO membranes do not contain chlorine, unlike some other thermoplastic membranes, and no chlorine containing ingredients are added during manufacturing. The Holcim membranes also do not contain any plasticizers that can migrate from the sheet in the long term. The water quality upon contact with the UltraPly TPO membrane is compliant with environmental standards for recuperation of surface water and does not present any abnormal bacterial presence. Physical tests at Eurofins, an accredited Belgian laboratory recognised for environmental analyses, have shown that the UltraPly membrane and its assembly system allow the recovery of rainwater. It is therefore possible to recycle the collected water for use as domestic water for sanitation purposes.

In addition, TPO (FPO) membranes in general require less energy than any other type of membrane during manufacturing. The UltraPly TPO membrane and accessories are therefore classified as “environmentally safe and green” products.



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### **Recyclability**

UltraPly TPO membranes do not contain halogenated flame retardants, chlorine, heavy metals or plasticizers and can therefore be recycled more easily. The membrane can be ground into “rework” and this regrind can be incorporated into the bottom ply during the extrusion process to produce a new product, resulting in a 100 % reuse of the recycled material.

### **High reflectivity**

UltraPly TPO membranes are available in light colors (white & light grey) and offer a high level of reflectivity. White UltraPly TPO membranes can meet and substantially exceed the US Environmental Protection Agency’s Energy Star performance levels as well as Cool Roof Rating Council (CRRC) and LEED requirements. White UltraPly TPO membranes typically display reflectivity ratings in the high 80 percent range when new and in the low 60 percent range after a 3-year rooftop exposure. Unlike other thermoplastic membranes, UltraPly TPO remains resistant to mold and algae growth over time, which can degrade the overall reflectivity of the roof and reduce energy savings. Aged reflectivity of UltraPly TPO membranes remains therefore high. If necessary, cleaning of the membrane after years of exposure can easily be done.

### **High puncture and hail resistance**

UltraPly TPO membranes offer excellent puncture resistance thanks to their PP-based compound with high rubber content, the weft inserted scrim and a safe thickness over scrim. This characteristic is crucial in order to withstand mechanical stresses that the membrane can undergo during its installation, service or when exposed to weather related stress such as hail.

### **References**

- AFNOR. (2016). Contribution of construction works to sustainable development - Environmental product declarations - Rules governing categories of construction products - National complement to NF EN 15804 + A1.
- CEN. (2012). EN 15804:2012-04: Sustainability of construction works -Environmental Product Declarations - Core rules for the product category of construction products. Retrieved from [https://standards.cen.eu/dyn/www/f?p=204:110:0:::FSP\\_PROJECT,FSP\\_ORG\\_ID:40703,481830&cs=1B0F862919A7304F13AE6688330BBA2FF](https://standards.cen.eu/dyn/www/f?p=204:110:0:::FSP_PROJECT,FSP_ORG_ID:40703,481830&cs=1B0F862919A7304F13AE6688330BBA2FF)
- ISO. (2007). ISO 21930:2007 Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services.
- SPRI. (2016). *EPD - TPO Membrane - Single ply roofing membrane*. UL Environment. Retrieved from <http://spot.ulprospector.com/en/na/BuiltEnvironment/Detail/33062/704678/TPO-Membrane---Single-ply-roofing-membrane?st=1>
- thinkstep. (2014). GaBi LCA Database Documentation. Retrieved from thinkstep AG: <http://database->

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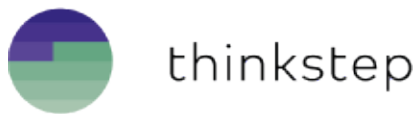
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[documentation.gabi-software.com](http://documentation.gabi-software.com)

- UL Environment. (2019). Product Category Rule for Preparing an Environmental Product Declaration: ASTM PCR for Single Ply Roofing Membranes, v1. Addendum

### LCA Development



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