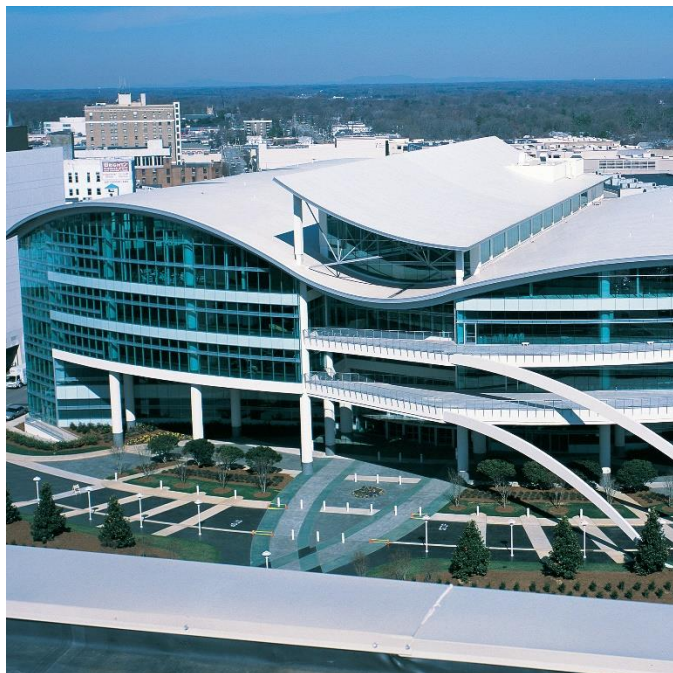


# ENVIRONMENTAL PRODUCT DECLARATION

According to ISO 14025 and ISO 21930:2017

## TPO SINGLE-PLY ROOFING MEMBRANE

VERSICO ROOFING SYSTEMS



### About Versico Roofing Systems

A division of Carlisle Construction Materials LLC, Versico was formed through the acquisition of a major single-ply roofing supplier in 1993. With decades of experience in the single-ply roofing industry, Versico strives to provide the highest quality, longest-lasting and most efficient roofing products in the industry. Versico provides its customers with superior roofing systems and services through a select network of manufacturer's representatives, distributors, and contractors.

Today, Versico's diverse product offering includes EPDM, TPO, PVC, and fleece-backed roofing membranes, as well as a full line of labor-saving flashing accessories and insulation. Backed by industry-leading warranties, Versico's products have been installed on a wide range of buildings including schools, hospitals, warehouses, and cold storage facilities.



**Issue Date:** 17-05-2023

**Valid Until:** 16-05-2028

**Declaration Number:** ASTM-EPD422

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## DECLARATION INFORMATION

| Declaration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Program Operator:</b> ASTM International<br><b>Company:</b> Versico Roofing Systems, a division of Carlisle Construction Materials<br>1285 Ritner Hwy<br>Carlisle, PA 17013<br><a href="http://www.versico.com">www.versico.com</a>                                                                                                                                                                                                                                                                                                                                                                                                                    | <br><a href="http://www.astm.org">www.astm.org</a>                                                                                                                                                                                                                                                |
| Product Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Validity / Applicability                                                                                                                                                                                                                                                                                                                                                             |
| <b>Product Name:</b> TPO Single-Ply Roofing Membrane<br><b>Product Definition:</b> Thermoplastic Polyolefin (TPO) Single-Ply Roofing Membrane<br><b>Declaration Type:</b> Business-to-business (B2B)<br><b>PCR Reference:</b> <ul style="list-style-type: none"> <li>Core PCR: ISO 21930:2017 (ISO, 2017)</li> <li>Sub-category PCR: Product Category Rules for Single-Ply Roofing Membranes (NSF International, 2019)</li> </ul>                                                                                                                                                                                                                         | <b>Period of Validity:</b> This declaration is valid for a period of 5 years from the date of publication.<br><b>Geographic Scope:</b> North America<br><b>PCR Review was conducted by:</b> <ul style="list-style-type: none"> <li>Thomas P. Gloria, Ph.D., Industrial Ecology Consultants</li> <li>Bill Stough, Sustainable Research Group</li> <li>Jack Geibig, EcoForm</li> </ul> |
| Product Application and/or Characteristics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                      |
| Single-ply, TPO roofing membrane representative of 45-, 60-, and 80-mil thicknesses are used as a roofing protective layer for building applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                      |
| Content of the Declaration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                      |
| <ul style="list-style-type: none"> <li>Product definition and physical building-related data</li> <li>Details of raw materials and material origin</li> <li>Description of how the product is manufactured</li> <li>Life Cycle Assessment results</li> <li>Additional environmental information</li> </ul>                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                      |
| Verification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                      |
| This declaration was independently verified in accordance with ISO 21930:2017, ISO 14025:2006 and the reference PCR by Tim Brooke, ASTM International.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <input type="checkbox"/> Internal <input checked="" type="checkbox"/> External                                                                                                                                                                                                                                                                                                       |
| This life cycle assessment was independently verified in accordance with ISO 21930:2017 and ISO 14044:2006 and the reference PCR by Lindita Bushi, Ph.D., Athena Sustainable Materials Institute.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Limitations</b><br><i>The environmental impact results of TPO products in this document are based on a declared unit and therefore do not provide sufficient information to establish comparisons. The results shall not be used for comparisons without knowledge of how the physical properties of the TPO product impact the precise function at the construction level. The environmental impact results shall be converted to a functional unit basis before any comparison is attempted. See Section 3.10 for additional EPD comparability guidelines. Environmental declarations from different programs (ISO 14025) may not be comparable.</i> |                                                                                                                                                                                                                                                                                                                                                                                      |

## EPD SUMMARY

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This document is a Type III environmental product declaration by Versico Roofing Systems that is certified by ASTM International (ASTM) as conforming to the requirements of ISO 21930 and ISO 14025. ASTM has assessed that the Life Cycle Assessment (LCA) information fulfills the requirements of ISO 14040 in accordance with the instructions listed in the referenced product category rules. The intent of this document is to further the development of environmentally compatible and sustainable construction methods by providing comprehensive environmental information related to potential impacts in accordance with international standards.

No comparisons or benchmarking are included in this EPD. Environmental declarations from different programs based upon differing PCRs may not be comparable. In general, EPDs may not be used for comparability purposes when not considered in a construction works context. Given this PCR ensures products meet the same functional requirements, comparability is permissible provided the information given for such comparison is transparent and the limitations of comparability explained. 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. When comparing EPDs created using this PCR, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.

## SCOPE AND BOUNDARIES OF THE LIFE CYCLE ASSESSMENT

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The Life Cycle Assessment (LCA) was performed according to ISO 14040 (ISO, 2020a) and ISO 14044 (ISO, 2020b) following the requirements of the ASTM EPD Program instructions and the referenced PCR.

**System Boundary:** Cradle-to-gate

**Allocation Method:** Mass 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.

**Declared Unit:** 1 m<sup>2</sup> of single-ply roofing membrane for a stated product thickness. Environmental performance results therefore represent CCM's average production of TPO, normalized to 1 m<sup>2</sup>.

## GENERAL INFORMATION

### DESCRIPTION OF COMPANY/ORGANIZATION

A division of Carlisle Construction Materials LLC, Versico was formed through the acquisition of a major single-ply roofing supplier in 1993. With decades of experience in the single-ply roofing industry, Versico strives to provide the highest quality, longest-lasting and most efficient roofing products in the industry. Versico provides its customers with superior roofing systems and services through a select network of manufacturer's representatives, distributors, and contractors.

Today, Versico's diverse product offering includes EPDM, TPO, PVC, and fleece-backed roofing membranes, as well as a full line of labor-saving flashing accessories and insulation. Backed by industry-leading warranties, Versico's products have been installed on a wide range of buildings including schools, hospitals, warehouses, and cold storage facilities.

### PRODUCT DESCRIPTION

The product system evaluated in this report is a single-ply TPO roofing membrane at the finished nominal thicknesses produced by Versico. See Table 1 for membrane specification and standard.

Versico's VersiWeld TPO reinforced membrane is a premium, heat-weldable, single-ply thermoplastic polyolefin (TPO) sheet designed for new roof construction and re-roofing applications.

VersiWeld TPO membranes use advanced polymerization technology that combines the flexibility of ethylene-propylene (EP) rubber with the heat weldability of polypropylene. All VersiWeld TPO membranes include OctaGuard XT™, an industry-leading, state-of-the-art weathering package. OctaGuard XT technology enables VersiWeld TPO to withstand the extreme weatherability testing that is intended to simulate exposure to severe climates.

Physical properties of the membrane are enhanced by a strong polyester fabric that is encapsulated between the TPO-based top and bottom plies. The combination of the fabric and TPO plies provides high breaking and tearing strength, as well as excellent puncture resistance. The relatively smooth surface of the membrane produces a total surface fusion weld that results in a consistent, watertight, monolithic roof assembly. The membrane is environmentally friendly and safe to install.

*Table 1 Membrane specification and standard*

| Roof System                    | Roof System Component | Declared Thicknesses and Weights                                                                      | Standard   |
|--------------------------------|-----------------------|-------------------------------------------------------------------------------------------------------|------------|
| Thermoplastic Polyolefin (TPO) | Membrane              | 45 mils: 1.25 kg/m <sup>2</sup><br>60 mils: 1.62 kg/m <sup>2</sup><br>80 mils: 2.21 kg/m <sup>2</sup> | ASTM D6878 |

## PRODUCT AVERAGE

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The 2019 production data used in this EPD considers TPO roofing membranes produced by Versico in three (3) sites in North America during the year. The participating facilities are:

- Carlisle, PA
- Tooele, UT
- Senatobia, MS

Results are weighted according to production totals at participating facilities.

## APPLICATION

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Versico's TPO membranes are utilized in mechanically attached, induction weld attached, vent-secured, and fully adhered commercial roofing systems and provide excellent long term weatherability, hail resistance, and repairability. TPO membranes are typically used in low-slope (roof slope < 2:12) applications, however they can also be used in steep-slope applications. The thicker 60- and 80-mil membranes provide added weathering thickness and service life as well as additional puncture resistance, making them a natural choice for longer-term performance. TPO sheets come in a variety of sizes, up to 16-feet wide and typically 100-feet long. TPO membrane is spliced together by overlapping and hot air welding adjacent sheets, creating an extremely strong and durable watertight seam.

## MATERIAL COMPOSITION

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

*Table 2 Average composition of TPO roofing membrane*

| Material               | % Composition |
|------------------------|---------------|
| Base resin (TPO)       | 49.5          |
| TPO scrap (internal)   | 4.8           |
| Fire retardant         | 28.1          |
| Polyester scrim        | 6.4           |
| Weathering concentrate | 10.1          |

## MANUFACTURING

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The main material inputs into the TPO manufacturing process are the base resin in the form of pellets and processed scrap and polyester reinforcing scrim. Additional materials include those which aid the manufacturing process (e.g., accelerators) and those which enhance the membrane's performance (e.g., fire retardants, weathering package ingredients, and pigments). The mix is heated and either extruded simultaneously onto both sides of the reinforcing polyester scrim, or

extruded at approx. half of the specified thickness with reinforcing polyester scrim pressed in between the top and bottom layers, forming the final TPO membrane sheet. Non-reinforced edges are trimmed and this material is ground and recycled directly back into the extrusion process. The product is cooled as it runs through a series of rollers, after which it is transferred onto large cardboard roll cores and wrapped in plastic film to be shipped to building sites for installation.

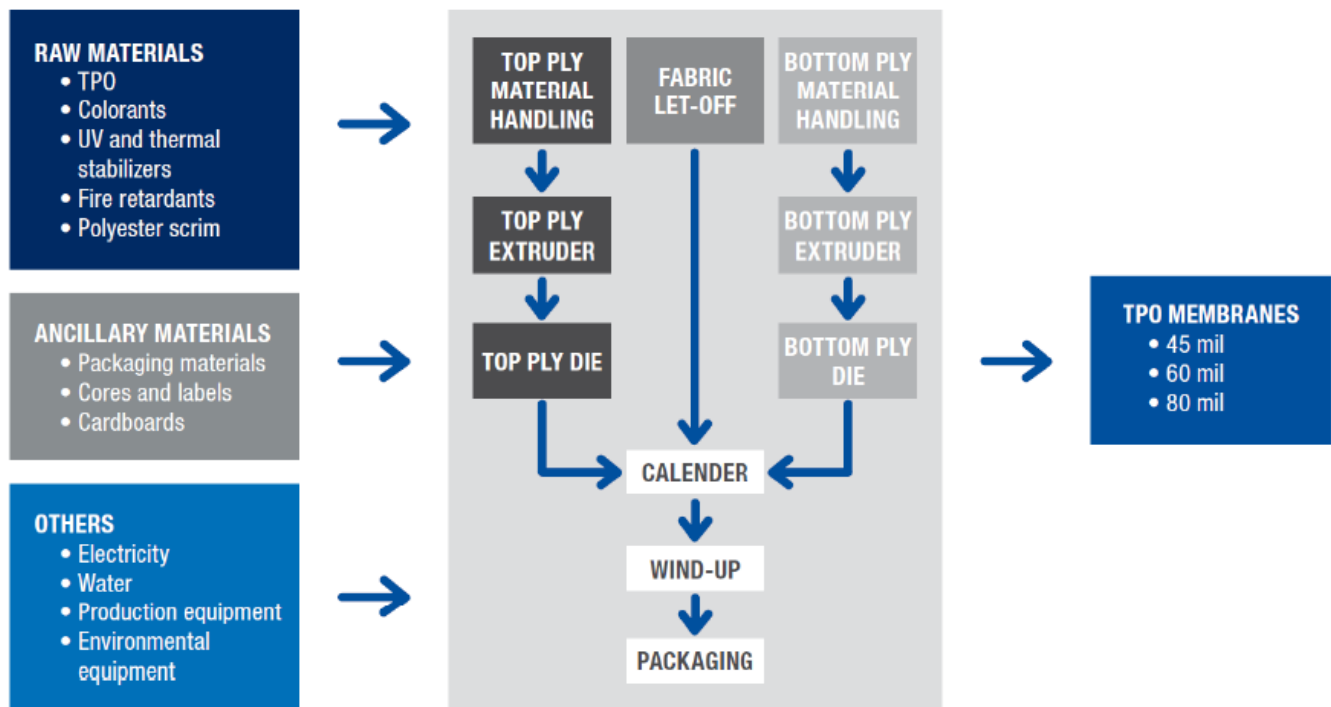


Figure 1: TPO production process map

## TRANSPORTATION

Primary data on inbound transportation of raw materials and packaging material were collected. These materials included base resin (TPO), scrim, fire retardants, weathering concentrates, etc. Transportation to the customer or construction site is outside the scope of this EPD.

## PRODUCT INSTALLATION

Installation is outside the scope of this EPD.

Versico's TPO membrane can be installed using various attachment methods including mechanical fastening with fasteners and plates, induction welded or spot attachment, and adhered using various approved adhesive systems.

## **USE**

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Product use is outside the scope of this EPD.

## **REUSE, RECYCLING, AND ENERGY RECOVERY**

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Product reuse, recycling, and incineration for energy recovery is outside the scope of this EPD.

Versico TPO may contain up to 10% recycled content. This content is primarily from recycling scrap from the manufacturing process back into the bottom ply of the membrane. Non-reinforced material that is trimmed from the edges during manufacturing is ground and recycled directly back into the extrusion process. Other scrap material that is generated during the manufacturing process is also ground, elutriated, and processed back into usable polymer pellets that can be recycled back into the TPO manufacturing process or used in the manufacture of other thermoplastic-based building products.

In many cases TPO can also be recycled at the end of its service life. TPO that is free from adhesive and large debris such as plates and fasteners can be collected from the jobsite for recycling. The membrane can be re-used in unexposed or temporary waterproofing applications or can be cleaned and processed to extract polymer material to be reused in manufacturing.

Highly reflective white and tan TPO membranes can also help reduce the cooling load for buildings in high heat and UV climates. VersiWeld TPO is registered and rated by the Cool Roof Rating Council (CRRCC) and features some of the highest solar reflectance and thermal emissivity values available for single-ply roofing.

## **DISPOSAL**

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Product disposal is outside the scope of this EPD.

TPO membrane and insulation from mechanically attached systems can be repurposed or recycled when fasteners and plates are cut out or removed.

## METHODOLOGICAL FRAMEWORK

### DECLARED UNIT

The declared unit for this study is :

#### **1 m<sup>2</sup> of single-ply roofing membrane for a stated product thickness**

Environmental performance results therefore represent Versico's average production of TPO, normalized to 1 m<sup>2</sup>. The reference service life is not specified. Since the use stage is not included in the system boundary, no reference service life needs to be defined for the analysis.

### SYSTEM BOUNDARY

System boundaries are summarized in Figure 2 for the analysis scope of "cradle-to-gate". 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 |           |                  |           | BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY |
|---------------------|-----------|---------------|-----------------------------|------------------|-----------|-------------|-----------|-------------|---------------|----------------------------------------------------|---------------------------------------------------|-------------------|-----------|------------------|-----------|-----------------------------------------------|
| Raw material supply | Transport | Manufacturing | Transport from gate to site | Assembly/Install | Use       | Maintenance | Repair    | Replacement | Refurbishment | Building Operational Energy Use During Product Use | Building Operational Water Use During Product Use | Deconstruction    | Transport | Waste processing | Disposal  | Reuse, Recovery, Recycling Potential          |
| <b>A1</b>           | <b>A2</b> | <b>A3</b>     | <b>A4</b>                   | <b>A5</b>        | <b>B1</b> | <b>B2</b>   | <b>B3</b> | <b>B4</b>   | <b>B5</b>     | <b>B6</b>                                          | <b>B7</b>                                         | <b>C1</b>         | <b>C2</b> | <b>C3</b>        | <b>C4</b> | <b>D</b>                                      |
| X                   | X         | X             | MND                         | MND              | MND       | MND         | MND       | MND         | MND           | MND                                                | MND                                               | MND               | MND       | MND              | MND       | MND                                           |

Figure 1 Life cycle stages included in system boundary

### CUT-OFF RULES

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 SOURCES**

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The LCA model was created using the GaBi Software system for life cycle engineering, version 10, developed by Sphera (Sphera, 2022). Background life cycle inventory data for raw materials and processes were obtained from the GaBi 2022 databases. Primary manufacturing data were provided by the participating companies.

## **DATA QUALITY**

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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 using yearly averages that were then weighted according to each manufacturer's production volume. 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.

## **GEOGRAPHICAL COVERAGE**

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This study represents production at Versico facilities in North America. As such, the geographical coverage for this study is based on North American system boundaries for all processes and products.

Regionally specific datasets, where available, were used to represent each manufacturing location's energy consumption. Proxy datasets were used as needed for raw material inputs to address lack of data for a specific material or for a specific geographical region. These proxy datasets were chosen for their technological representativeness of the actual materials.

## **PERIOD UNDER REVIEW**

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Primary data collected represent production during the 2019 calendar year. This analysis is intended to represent production in 2019. All secondary data come from the GaBi Professional databases and are representative of the years 2018-2021.

## **ALLOCATION**

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As several products are often manufactured at the same plant, participating facilities used mass allocation to report data. Mass 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.

Allocation of background data (energy and materials) taken from the GaBi 2022 databases is documented online at <http://www.gabi-software.com/support/gabi/gabi-database-2022-lci-documentation/>.

## ESTIMATES AND 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.

## LIFE CYCLE ASSESSMENT RESULTS

The environmental impacts associated with the TPO roofing membrane is presented below in Table 3 for the production stage (A1-A3).

*Table 3: Environmental impact indicators for 1m<sup>2</sup> of TPO Single-Ply Roofing Membrane*

| Indicator                                                          | A1       | A2       | A3       | Total    |
|--------------------------------------------------------------------|----------|----------|----------|----------|
| <b>Global Warming Potential [kg CO<sub>2</sub> eq.]</b>            |          |          |          |          |
| TPO 45 mils                                                        | 2.59E+00 | 7.78E-02 | 2.25E-01 | 2.90E+00 |
| TPO 60 mils                                                        | 3.37E+00 | 1.09E-01 | 2.90E-01 | 3.77E+00 |
| TPO 80 mils                                                        | 4.72E+00 | 1.57E-01 | 4.00E-01 | 5.28E+00 |
| <b>Ozone Depletion Potential [kg CFC-11 eq.]</b>                   |          |          |          |          |
| TPO 45 mils                                                        | 1.00E-13 | 1.40E-16 | 3.90E-10 | 3.90E-10 |
| TPO 60 mils                                                        | 1.31E-13 | 1.93E-16 | 3.51E-10 | 3.51E-10 |
| TPO 80 mils                                                        | 1.83E-13 | 2.73E-16 | 3.92E-10 | 3.93E-10 |
| <b>Acidification Potential [kg SO<sub>2</sub> eq.]</b>             |          |          |          |          |
| TPO 45 mils                                                        | 5.79E-03 | 5.55E-04 | 3.57E-04 | 6.70E-03 |
| TPO 60 mils                                                        | 7.52E-03 | 8.66E-04 | 4.40E-04 | 8.83E-03 |
| TPO 80 mils                                                        | 1.06E-02 | 1.37E-03 | 5.98E-04 | 1.25E-02 |
| <b>Eutrophication Potential [kg N eq.]</b>                         |          |          |          |          |
| TPO 45 mils                                                        | 1.61E-03 | 4.23E-05 | 5.99E-05 | 1.72E-03 |
| TPO 60 mils                                                        | 2.09E-03 | 6.31E-05 | 7.55E-05 | 2.23E-03 |
| TPO 80 mils                                                        | 2.92E-03 | 9.67E-05 | 1.04E-04 | 3.12E-03 |
| <b>Smog Formation Potential [kg O<sub>3</sub> eq.]<sup>1</sup></b> |          |          |          |          |
| TPO 45 mils                                                        | 1.11E-01 | 1.62E-02 | 5.68E-03 | 1.33E-01 |
| TPO 60 mils                                                        | 1.44E-01 | 2.53E-02 | 7.06E-03 | 1.76E-01 |
| TPO 80 mils                                                        | 2.02E-01 | 4.02E-02 | 9.63E-03 | 2.51E-01 |

<sup>1</sup> Per ISO 21930, TRACI Smog Formation Potential (SFP) is reported instead of Photochemical Oxidant Creation Potential (POCP)

The resource use associated with the TPO roofing membrane is presented below in Table 4 for the production stage (A1-A3).

Table 4: Resource use indicators for 1m<sup>2</sup> of TPO Single Ply Roofing Membrane

| Indicator                                                            | A1       | A2       | A3       | Total    |
|----------------------------------------------------------------------|----------|----------|----------|----------|
| <b>Renewable Primary Energy Resources as Energy (RPRE) [MJ]</b>      |          |          |          |          |
| TPO 45 mils                                                          | 4.12E+00 | 4.35E-02 | 6.92E-01 | 4.85E+00 |
| TPO 60 mils                                                          | 5.36E+00 | 6.02E-02 | 9.39E-01 | 6.35E+00 |
| TPO 80 mils                                                          | 7.51E+00 | 8.59E-02 | 1.34E+00 | 8.94E+00 |
| <b>Renewable Primary Resources as Material (RPRM) [MJ]</b>           |          |          |          |          |
| TPO 45 mils                                                          | 0.00E+00 | 0.00E+00 | 1.20E-01 | 1.20E-01 |
| TPO 60 mils                                                          | 0.00E+00 | 0.00E+00 | 1.30E-01 | 1.30E-01 |
| TPO 80 mils                                                          | 0.00E+00 | 0.00E+00 | 1.74E-01 | 1.74E-01 |
| <b>Non-Renewable Primary Resources as Energy (fuel) (NRPRE) [MJ]</b> |          |          |          |          |
| TPO 45 mils                                                          | 4.96E+01 | 1.12E+00 | 3.59E+00 | 5.43E+01 |
| TPO 60 mils                                                          | 6.41E+01 | 1.57E+00 | 4.64E+00 | 7.03E+01 |
| TPO 80 mils                                                          | 8.95E+01 | 2.25E+00 | 6.43E+00 | 9.82E+01 |
| <b>Non-Renewable Primary Resources as Material (NRPRM) [MJ]</b>      |          |          |          |          |
| TPO 45 mils                                                          | 3.03E+01 | 0.00E+00 | 8.67E-02 | 3.03E+01 |
| TPO 60 mils                                                          | 3.94E+01 | 0.00E+00 | 1.01E-01 | 3.95E+01 |
| TPO 80 mils                                                          | 5.53E+01 | 0.00E+00 | 1.28E-01 | 5.54E+01 |
| <b>Secondary Materials (SM) [kg]</b>                                 |          |          |          |          |
| TPO 45 mils                                                          | 0.00E+00 | 0.00E+00 | 6.73E-02 | 6.73E-02 |
| TPO 60 mils                                                          | 0.00E+00 | 0.00E+00 | 8.00E-02 | 8.00E-02 |
| TPO 80 mils                                                          | 0.00E+00 | 0.00E+00 | 1.04E-01 | 1.04E-01 |
| <b>Renewable Secondary Fuels (RSF) [MJ]</b>                          |          |          |          |          |
| TPO 45 mils                                                          | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| TPO 60 mils                                                          | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| TPO 80 mils                                                          | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| <b>Non-Renewable Secondary Fuels (NRSF) [MJ]</b>                     |          |          |          |          |
| TPO 45 mils                                                          | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| TPO 60 mils                                                          | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| TPO 80 mils                                                          | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

The waste generation associated with the TPO roofing membrane is presented below in Table 5 for the production stage (A1-A3).

*Table 5: Output flows & waste categories for 1m<sup>2</sup> of TPO Single-Ply Roofing Membrane*

| Indicator                                       | A1       | A2       | A3       | Total    |
|-------------------------------------------------|----------|----------|----------|----------|
| <b>Hazardous Waste Disposed (HWD) [kg]</b>      |          |          |          |          |
| TPO 45 mils                                     | 4.85E-09 | 4.64E-12 | 7.66E-07 | 7.69E-07 |
| TPO 60 mils                                     | 6.29E-09 | 6.46E-12 | 6.95E-07 | 6.99E-07 |
| TPO 80 mils                                     | 8.79E-09 | 9.25E-12 | 7.81E-07 | 7.88E-07 |
| <b>Non-Hazardous Waste Disposed (NHWD) [kg]</b> |          |          |          |          |
| TPO 45 mils                                     | 1.26E-01 | 9.82E-05 | 2.66E-02 | 1.53E-01 |
| TPO 60 mils                                     | 1.66E-01 | 1.37E-04 | 2.70E-02 | 1.93E-01 |
| TPO 80 mils                                     | 2.40E-01 | 1.96E-04 | 3.35E-02 | 2.73E-01 |
| <b>Radioactive Waste Disposed (RWD) [kg]</b>    |          |          |          |          |
| TPO 45 mils                                     | 8.31E-04 | 2.91E-06 | 2.93E-04 | 1.13E-03 |
| TPO 60 mils                                     | 1.08E-03 | 4.02E-06 | 3.91E-04 | 1.48E-03 |
| TPO 80 mils                                     | 1.52E-03 | 5.70E-06 | 5.56E-04 | 2.08E-03 |

## LCA INTERPRETATION

The major contributor for almost every impact is raw materials (A1) followed by manufacturing (A3) and inbound transportation (A2). The exception is ODP, which is dominated by manufacturing (A3) due to the manufacturing of bio-based packaging materials.

### Disclaimer (quoted from sub-category PCR):

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:

- Renewable primary energy resources as energy (fuel), (RPRE);
- Renewable primary resources as material, (RPRM);
- Non-renewable primary resources as energy (fuel) ,(NRPRE);
- Non-renewable primary resources as material (NRPRM);
- Secondary materials (SM);
- Renewable secondary fuels (RSF);

- Non-renewable secondary fuels (NRSF);
- Hazardous waste disposed;
- Non-hazardous waste disposed;
- Radioactive waste disposed (RWD);

The EPDs are comparable only if they comply with the document ISO 21930, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

## ADDITIONAL ENVIRONMENTAL INFORMATION

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**Pollution abatement equipment** – The Carlisle plant employs pollution abatement equipment, including scrubbers, filter boxes, and dust collectors, whereas no such equipment is present in the Senatobia and Tooele plants.

**Clarification regarding hazardous substances in the final product** – Per EPDM Safety Data Sheet (SDS), the finished product declared in this EPD is considered "Articles" as defined in OSHA Hazardous Communication Standard. This finished product is not hazardous and does not contain any regulated substances of very high concern. No components in the product are listed under the SDS Section 15 Regulatory Requirements, specifically U.S. Federal Regulations, SARA Section 311/312, California Prop 65, or the Canadian WHMIS IDL. Information on ingredients and regulatory information can be found in the SDS.

**Clarification regarding release of dangerous substances from the final product** – The finished product declared in the EPD is classified as an article with no release of dangerous substances.

**Clarification regarding hazardous waste generated during production** – No hazardous waste is generated during the production of the product declared in this EPD.

## REFERENCES

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## CONTACT INFORMATION

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### STUDY COMMISSIONER

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### LCA PRACTITIONER

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