Monolithic Membrane 6125®EU
Hot-Applied Rubberized Asphalt

Environmental Product Declaration

This document constitutes the Environmental Product Declaration (EPD) of **Hydrotech Membrane Corporation's Monolithic Membrane 6125®EU (MM6125®EU) manufactured in Montreal, Canada.** This EPD was developed in compliance with CAN/CSA-ISO 14025, ISO 21930 and has been verified by Lindita Bushi, Athena Sustainable Materials Institute.

This **cradle-to-gate with options** EPD presents the life cycle assessment (LCA) results for raw material supply, transport and manufacturing stages as well as downstream stages such as transport to the project site, installation and end-of-life management. The LCA was performed by Groupe AGÉCO.

For more information about Hydrotech, please go to www.hydrotechmembrane.ca

Issue date: March 12, 2023

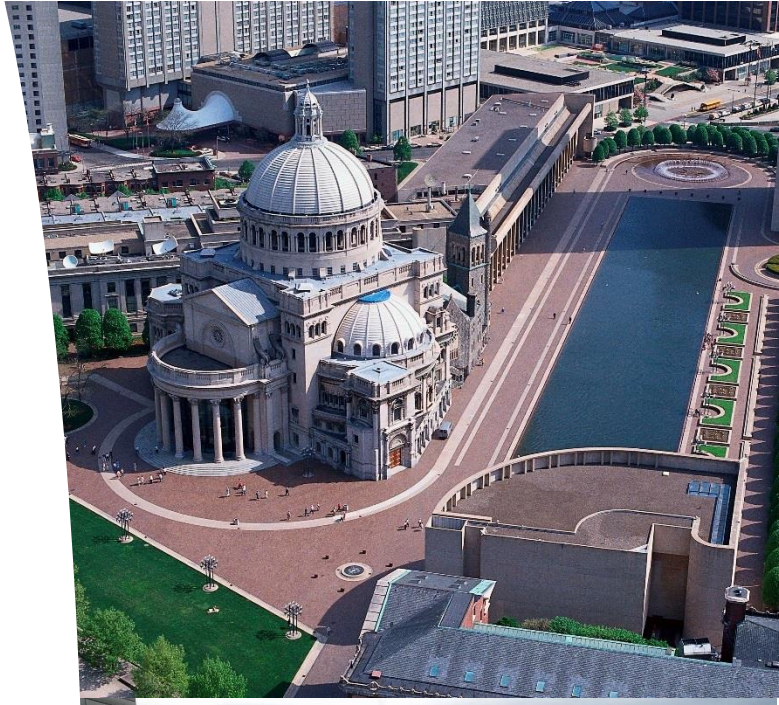
Environmental Product Declaration

CSA Group Registered Based on ISO 14025 and Other Requirements

For more information visit **csaregistries.ca/epd**

#3747-6690

March 2023 - 2028



This environmental product declaration (EPD) for hot-applied rubberized asphalt membrane is in accordance with CAN/CSA-ISO 14025 and ISO 21930. EPDs within the same product category but from different programs may not be comparable. This EPD reports environmental impacts based on established life cycle impact assessment methods. The reported environmental impacts are estimates, and their level of accuracy may differ for a particular product line and reported impact. LCAs do not generally address site-specific environmental issues of related to resource extraction or toxic effects of products on human health. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change and habitat destruction. EPDs do not report product environmental performance against any benchmark.

Program operator	CSA Group 178 Rexdale Blvd, Toronto, ON, Canada M9W 1R3 www.csagroup.org
Product	Monolithic Membrane 6125®EU – Hot-applied rubberized asphalt
EPD registration number	3747-6690
EPD recipient organization	Hydrotech Membrane Corporation 10951 Parkway Blvd. Montreal (Borough Anjou), QC, Canada, H1J 1S1 www.hydrotechmembrane.ca
Reference PCR	Product Category Rules For Preparing an Environmental Product Declaration for Water-Resistive and Air Barriers, version 1 (UNCPC 54530 and/or CSI MasterFormat designations 072500, 072600 and 072700) By ASTM International (2017) Valid until September 2023
Date of issue (approval)	March 12, 2023
Period of validity	March 12, 2023 – March 11, 2028

The PCR review was conducted by:	Thomas P. Gloria (Industrial Ecology Consultants)
The LCA was performed by:	Groupe AGÉCO julie-anne.chayer@groupeageco.ca www.groupeageco.ca
This EPD and related data were independently verified by an external verifier, Lindita Bushi, according to CAN/CSA-ISO 14025:2006 and ISO 21930:2007.	__ Internal **x External** Lindita Bushi Lindita Bushi, Ph.D. Athena Sustainable Materials Institute 119 Ross Avenue, Suite 100, Ottawa, Ontario, Canada K1Y 0N6 lindita.bushi@athenasmi.org www.athenasmi.org

Monolithic Membrane 6125®EU Hot-applied rubberized asphalt

Environmental Product Declaration Summary Sheet

This is a summary of the environmental product declaration (EPD) describing the environmental performance of **Monolithic Membrane 6125®EU (MM6125®EU)** manufactured by **Hydrotech Membrane Corporation** in Montréal, Canada.

EPD commissioner and owner	**Period of validity**	**Program operator and registration number**	**Product Category Rule**	**LCA and EPD consultants**
Hydrotech Membrane Corp.	March 12, 2023 to March 11, 2028	CSA Group 3747-6690	Water-Resistive and Air Barriers v.1 (ASTM International, 2017)	Groupe AGÉCO

Product description

Hot-applied rubberized asphalt membrane for waterproofing and roofing applications.

Declared unit

1 m^2 of installed hot-applied rubberized asphalt membrane with a thickness of 5.56 mm and a specific gravity of 1.15 (i.e. 6.39 kg/m^2).

Material content (% of total product mass)

Asphalt	40 – 70%
Oil	7 - 13 %
Polymer (SBS)	7 - 13 %
Inert filler	15 – 40 %
Rubber crumb (SBR)	5 – 10 %

Life cycle stages included:

Raw material supply (A1), raw material transport (A2), manufacturing (A3), transport to site (A4), installation (A5) and end-of-life management (C2-C4) stages.

What is a Life Cycle Assessment (LCA)?

LCA is a science-based and internationally recognized tool to evaluate the relative potential environmental and human health impacts of products and services throughout their life cycle, beginning with raw material extraction and including all aspects of transportation, production, use, and end-of-life treatment. The method is defined by the International Organization for Standardization (ISO) 14040 and 14044 standards.

Why an Environmental Product Declaration (EPD)?

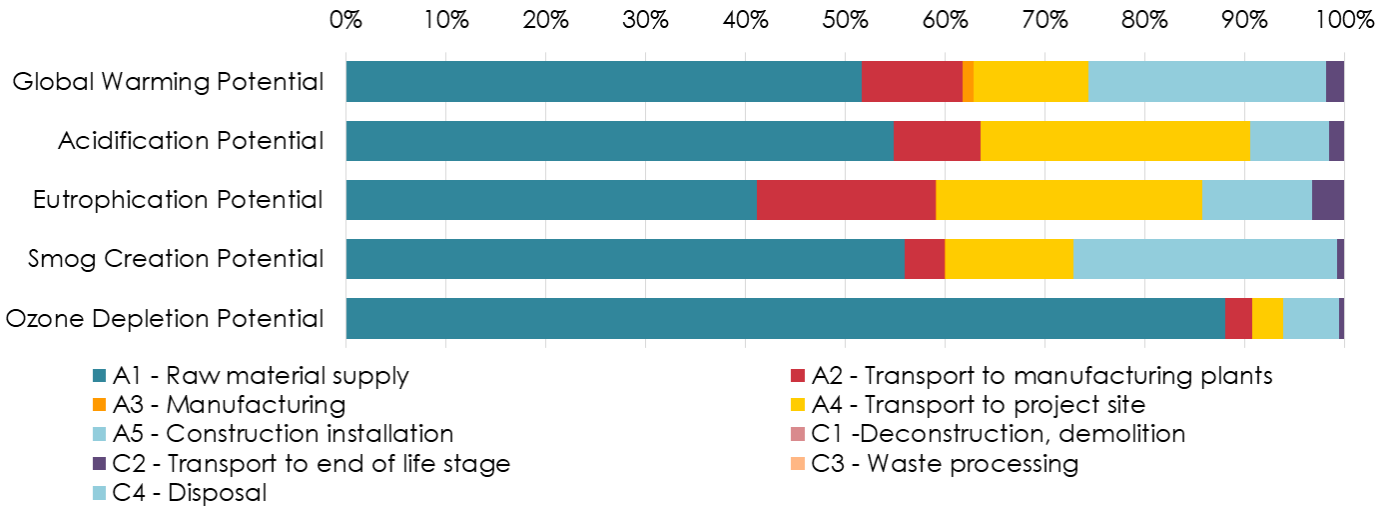
Hydrotech is seeking to communicate its environmental performance to clients and to position its products through a rigorous and recognized approach, an EPD. By selecting products with an EPD, building projects can earn credits towards the Leadership in Energy and Environmental Design (LEED) rating system certification. In the latest version of the program (LEED v4), points are awarded in the Materials and Resources category.

Environmental impacts

The environmental impacts of hot-applied rubberized asphalt membrane **to cover 1 square meter (m²) of surface** are summarized below for the main environmental indicators (based on life cycle impact assessment method CML). Refer to the LCA report or full EPD for more detailed results.

Indicators	Per 1 m² of surface covered with MM6125®EU
Global warming potential (kg CO_2 eq.)	4.96
Acidification potential (kg SO_2 eq.)	0.04
Eutrophication potential (kg PO_4 eq.)	3.92×10^{-3}
Smog creation potential (kg C_2H_4 eq.)	2.41×10^{-3}
Ozone depletion potential (kg CFC-11 eq.)	3.53×10^{-6}

Relative contribution of each life cycle stage to the overall environmental impacts



Additional environmental information[1]

MM6125®EU is **made of post-consumer inert filler and recycled tires.** Through the manufacture of its products, Hydrotech thus contributes to the diversion of materials from landfills. The post-consumer recycled content as well as the publication of this EPD can help projects integrating MM6125®EU to earn **up to 3 potential points towards LEED®v4 rating systems.** This third party verified EPD can be used to **improve the MM6125®EU's BREEAM® score.** MM6125®EU is also **REACH compliant**.

For more information: http://www.hydrotechmembrane.ca/

[1] References related to this additional environmental information are detailed in section 5 of the EPD.

1. Description of Hydrotech Membrane Corporation

Hydrotech Membrane Corporation, a Canadian-based company, is a leader in the manufacturing of premium waterproofing and roofing products. The company is the manufacturer of Monolithic Membrane 6125® (MM6125®), a unique hot-applied rubberized asphalt for waterproofing and roofing applications distributed in North America and Internationally. Monolithic Membrane 6125®EU (MM6125®EU) is distributed only in Europe.

Hydrotech Membrane Corporation has achieved continued growth through the addition of new products and assemblies and expansion of marketing efforts. Hydrotech's products are sold through an extensive network of sales representatives, many of whom are recognized industry-wide as roofing and waterproofing experts. Furthermore, Hydrotech's products are only installed by approved contractors to ensure quality of workmanship during installation.

Hydrotech's commitment to environmental sustainability is demonstrated in the development of long lasting waterproofing assemblies and the integration of post-consumer recycled content.

2. Description of product

2.1. Definition and product classification

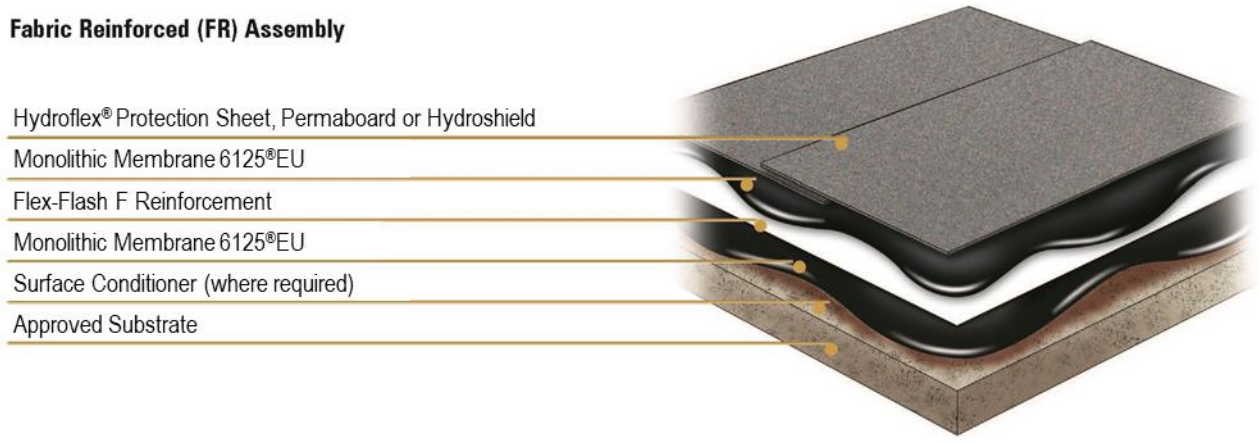
Hydrotech's **Monolithic Membrane 6125®EU** (MM6125®EU), the original hot-applied rubberized asphalt membrane, has been entrusted for more than 50 years with keeping high profile structures around the globe watertight. Monolithic Membrane 6125®EU is designed for use as a waterproofing and roofing membrane, typically on concrete structures in vertical and horizontal applications such as roof decks, parking decks, reflecting pools, plazas, mechanical room sub-floors, foundation walls, mud slabs, tunnels or planters. Monolithic Membrane 6125®EU, classified under the UN CPC Code 54530, is manufactured in Montreal, Canada with rigid quality control under an ISO 9001certified quality management system and in conformance with the requirements of The Canadian General Standards Board, CGSB-37.50-M89 and ASTM applicable methods (ASTM D-92, ASTM E-96 Procedure E, ASTM D-5329, ASTM D-36, ASTM D-08.22 Draft 2, ASTM D-896-84 Procedure 7.1 Note 8). Table 1 summarizes the technical data related to MM6125®EU.

Table 1: Technical data for MM6125®EU

Product type and performance	Selected physical properties
Waterproofing, fluid-applied	**Color:** black **Thickness:** depending on the roofing system, different thicknesses could be applied **Specific gravity:** 1.15 **Water vapor permeance:** 1.1 ng/Pa.s.m2 (=0.02 perms) – ASTM E96 Procedure E **Water vapor permeability:** 0.005 ng/Pa.s.m (= 0.004 perms inch) – ASTM E96 Procedure E

More information on MM6125®EU is available on the product's website:
http://www.hydrotechmembrane.ca/assemblies/waterproofing

Figure 1 : Monolithic Membrane 6125®EU



2.2. Production of Monolithic Membrane 6125®EU

MM6125®EU is made of asphalt, polymer (SBS), rubber crumb (SBR), oil and inert filler using the following formulation described in Table 2.

Table 2: Material content of MM6125®EU

Material	% of total mass
Asphalt	40 – 70%
Oil	7 - 13 %
Polymer (SBS)	7 - 13 %
Inert filler	15 – 40 %
Rubber crumb (SBR)	5 – 10 %

3. Scope of EPD

3.1. Declared unit

A declared unit is used in lieu of a functional unit since this cradle-to-gate with options EPD does not include all of the life cycle stages (i.e. the maintenance stage is not considered). It is the reference unit on which the quantities of material inputs, energy inputs, emissions and waste are based for the modeling of the life cycle of MM6125®EU. LCA results are also reported on the basis of this reference unit. The declared unit is defined as follows:

1 m² of installed hot-applied rubberized asphalt membrane with a thickness of 5.56mm and a specific gravity of 1,15

The weight of the membrane required to fulfill the declared unit is 6.39 kg per m².

3.2. System boundaries

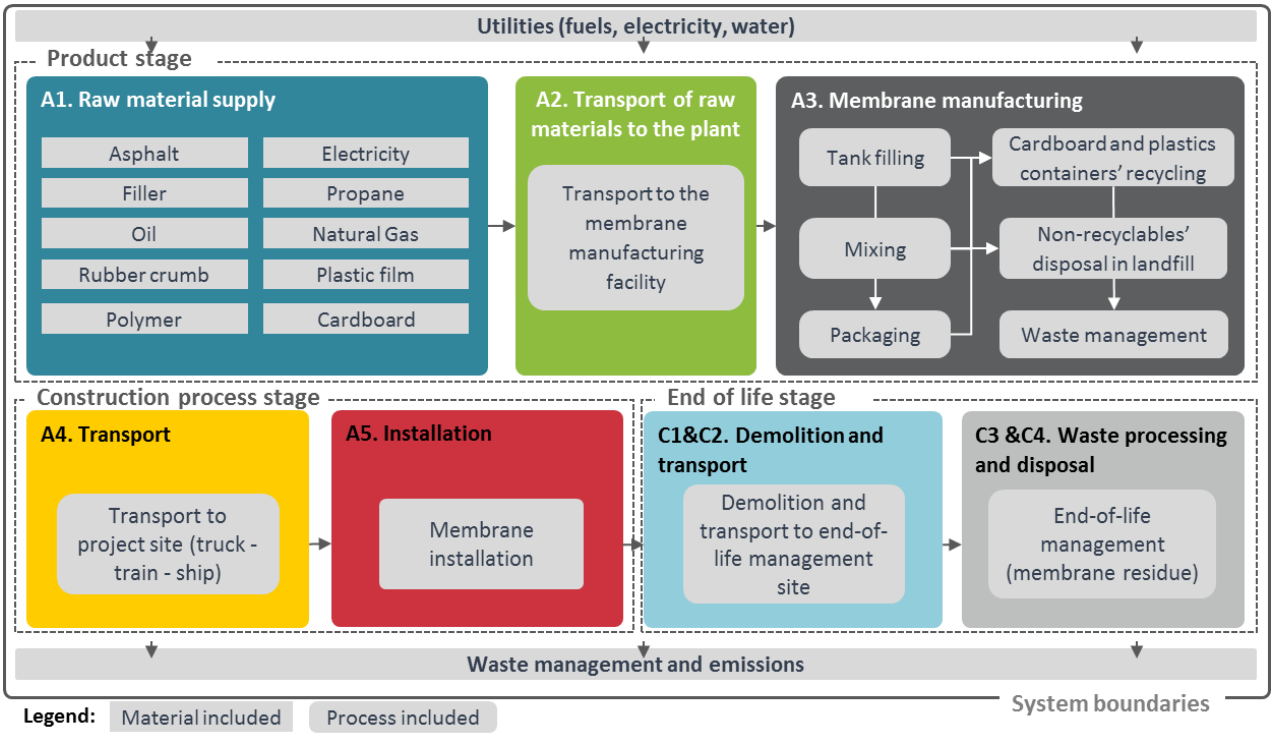
The product, construction process and end of life stages included in this cradle-to-gate with options EPD are shown in Table 3 and Figure 2.

Table 3: Life cycle stages considered according to 21930

Product stage			Construction process stage		Use stage							End of life stage			
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
Raw material supply	Transport	Manufacturing	Transport	Construction – installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction, demolition	Transport	Waste processing	Disposal
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X

Legend: **x** - Considered in the cradle-to-gate with options LCA *MND* - Module not declared

Figure 2: Process flow for the life cycle of Monolithic Membrane 6125®EU



More precisely, the life cycle stages include the following processes:

A1. Raw material Supply

This stage includes the extraction and processing of raw materials that make up the membrane such as bitumen, polymer (SBS) and oil. It also takes into account the recycling process of secondary materials used in the membrane such as inert filler and rubber crumb (SBR). The transport for the collection of secondary materials is also considered in this stage. The generation of electricity, extraction and refining of natural gas and propane used in the manufacturing process are also included.

A2. Transport of raw materials to the plant

All processed and secondary materials are transported from the suppliers to Hydrotech's facility by truck, except for the oil which is transported by both train and truck.

A3. Membrane manufacturing

The membrane manufacturing process requires natural gas (heating tanks and facility), electricity (lighting, pumps and motors) and propane (forklifts). At this stage, all the raw materials are put into the mixing equipment and mixed. All equipment is heated to keep the mixture in a fluid state. Once the mixing process is over, the membranes (in a fluid state) are poured into cardboard boxes that contain a LDPE plastic bag. In each batch, samples are collected and tested.

A4. Transportation to project site

The membrane is transported from the manufacturing plant directly to our distributor warehouse or project sites. For membranes sold in Europe, the transport is done by truck and ship.

A5. Installation: membrane application

Once the membrane is delivered to the project site, it is melted and agitated using a melter (e.g. "Air- or oil-jacketed hot rubber melter") powered by propane and gasoline or diesel fuel or electricity[2]. The membrane is then applied to the substrate with a squeegee. With this process, there is virtually no product loss since only the quantity of membrane needed is melted and applied and the unused membrane can be kept for another project.

C1. Deconstruction, demolition

The deconstruction of the membranes is usually done with rest of the building. As mentioned in section 4.2, the energy used for the deconstruction of the membrane is considered negligible in comparison with the deconstruction of the whole building and therefore excluded from the system boundaries.

C2. Transportation to end-of-life management site

The membrane is transported by truck to landfill sites only when the structure (i.e. building) on which it was applied reaches the end of its useful life and is then deconstructed or demolished. MM6125®EU is expected to have the same useful lifetime as the structure.

[2] Over the past years, the propane and gasoline melter was the most widely used. The diesel-powered melter is only used 8% of the time and electricity-powered melter, 2% of the time. The results published in this report are based solely on the use of a propane and gasoline melter.

C3 & C4. WASTE PROCESSING AND DISPOSAL

Since the membrane applied to the structure is rarely removed by mechanical means, but rather coated-over, it is assumed that it is all disposed of at the landfill at the end of structure's life.

3.3 Geographical and temporal boundaries

The geographical boundaries are representative of current equipment and processes associated with hot-applied rubberized asphalt membrane manufacturing in Canada, as well as use and disposal in North America, and worldwide. Since the data was collected for the year 2016-2017, it is considered temporarily representative (i.e. less than 5 years old).

4. Environmental impacts

This cradle-to-gate with options life cycle assessment has been conducted according to ISO 14040 and 14044 standards and the Product Category Rules For Preparing an Environmental Product Declaration for Water-resistive and Air Barriers, version 1 (ASTM International, 2017). Environmental impacts were calculated with the impact assessment method CML baseline 4.08. The Cumulative Energy Demand method (CED) (version 2.0) was used to calculate Total Primary Energy Consumption. The description of these indicators reported is provided in the glossary (section 0).

4.1. Assumptions

The main assumptions included in this LCA were related to the average distances for the transport of raw materials, the modes used to transport raw materials (to Hydrotech's facility) and finished product (to project sites), the origin of the crude oil used for asphalt manufacturing and the energy consumption at the manufacturing plant.

4.2. Criteria for the exclusion of inputs and outputs

Based on the requirements of the PCR, input and output flows may be excluded if they represent less than 1% of the cumulative mass of the unit processes or 1% of the cumulative energy of the system model. However, the life cycle inventory (LCI) data must amount to a minimum of 95% of all energy usage and mass flows and the life-cycle impact data must represent a minimum of 95% of all elementary flows for each environmental indicator assessed. All product components and production processes are included when the necessary information is readily available or a reasonable estimate can be made. Based on Groupe AGÉCO's past experience or the relatively low contribution of the life cycle stages to which they pertain, the following processes were excluded:

- Production, maintenance and disposal of machinery and buildings[3].
- Heat transfer oil (used to heat the piping system at the plant).
- Energy used for the deconstruction of the structure with the membrane.

[3] As per the PCR, capital goods, infrastructure, production equipment, delivery vehicles, laboratory equipment that are not directly consumed in the production process were excluded as well as personnel-related activities and company management and sales activities.

4.3. Data quality

Data sources

Specific data was collected from Hydrotech for operations occurring in the year 2016-2017 (less than 5 years old). **Generic data** collected for the upstream and downstream stages were representative of the North American and worldwide contexts and technologies used.

The LCA model was developed with the SimaPro 8.3 software using ecoinvent 3.3 database which was released in 2016 (less than 1 year). Since most of the data within ecoinvent is of European origin and represent European industrial conditions and processes, several data were adapted to enhance their representativeness of the products and contexts being examined. Ecoinvent is the most complete and recognized internationally LCA database.

Data quality

The overall data quality ratings show that the data used were either very good or good. This data quality assessment confirms the high reliability, representativeness (technological, geographical and time-related), completeness and consistency of the information and data used for this study.

4.4. Allocation

When a process in the membrane's life cycle generates co-products or is directly connected to another system (i.e. the life cycle of another product), the following allocations methods were applied to distribute the impacts between the co-products or linked systems.

Allocation for electricity and natural gas consumption at Hydrotech's manufacturing plant

Since Hydrotech's plant only produced MM6125® and MM6125EU® in the year of reference (September 2016 – August 2017), the energy consumption at the plant is fully (100%) allocated to these products. Also, the energy consumed per kg of membrane is assumed to be the same since the manufacturing process for both membrane is similar. An economic allocation would generate the same results due to their relatively similar cost per kg of membrane.

Allocation for Recycling

As requested in the PCR, recycled materials used by Hydrotech (i.e. rubber crumb, filler) are considered raw materials. The reprocessing, handing, sorting and transportation of these recycled materials are allocated to MM6125®EU's life cycle.

Allocation for Transport

For the transport of raw materials and finished membrane, all relevant flows are allocated based on the mass of the transported product.

Ecoinvent Processes with Allocation

Many of the processes in the ecoinvent database also provide multiple functions, and allocation is required to provide inventory data per function (or per process). This study accepts the allocation method used by ecoinvent for those processes. It should be noted that the background allocation methods used in ecoinvent, such as mass or economic allocation, may be inconsistent with the approach used to model the foreground system. While this allocation is appropriate for foreground processes, continuation of this methodology into the background datasets would add complexity without substantially improving the quality of the study.

4.5. Life Cycle Impact Assessment - Results

The following tables show the results separately for MM6125®EU for each life cycle stage analyzed. These results are for 1 m² of installed membrane.

Table 4: Environmental Category Indicator Results per m² of Installed Membrane[4]

Impact Category	Stage	MM6125®EU
Global warming potential - kg CO_2 equiv	Product (raw material) (A1)	2.56
	Product (transport/manufact.) (A2-A3)	0.56
	Construction (transport) (A4)	0.57
	Construction (installation) (A5)	1.18
	End of life (end-of-life) (C2-C4)	0.09
	Total	4.96
Acidification potential - kg SO_2 equiv	Product (raw material) (A1)	0.02
	Product (transport/manufact.) (A2-A3)	3.16E-03
	Construction (transport) (A4)	9.79E-03
	Construction (installation) (A5)	2.84E-03
	End of life (end-of-life) (C2-C4)	5.65E-04
	Total	0.04
Eutrophication potential - kg N eq	Product (raw material) (A1)	1.61E-03
	Product (transport/manufact.) (A2-A3)	7.07E-04
	Construction (transport) (A4)	1.04E-03
	Construction (installation) (A5)	4.32E-04
	End of life (end-of-life) (C2-C4)	1.26E-04
	Total	3.92E-03
Smog creation potential - kg O_3 eq	Product (raw material) (A1)	1.35E-03
	Product (transport/manufact.) (A2-A3)	9.94E-05
	Construction (transport) (A4)	3.09E-04
	Construction (installation) (A5)	6.35E-04
	End of life (end-of-life) (C2-C4)	1.79E-05
	Total	2.41E-03
Ozone depletion potential - kg CFC-11 equiv	Product (raw material) (A1)	3.11E-06
	Product (transport/manufact.) (A2-A3)	9.73E-08
	Construction (transport) (A4)	1.09E-07
	Construction (installation) (A5)	1.98E-07
	End of life (end-of-life) (C2-C4)	1.82E-08
	Total	3.53E-06

Table 5: Total Primary Energy Consumption per m² of Installed Membrane[5]

Total Primary Energy Consumption	Stage	MM6125®EU
Non-renewable fossil – MJ (HHV)	Product (raw material) (A1)	246.97
	Product (transport/manufact.) (A2-A3)	8.14
	Construction (transport) (A4)	9.02
	Construction (installation) (A5)	16.45
	End of life (end-of-life) (C2-C4)	1.52
	Total	282.11

[4] Values may not add up due to rounding.
[5] Values may not add up due to rounding.

Total Primary Energy Consumption	Stage	MM6125®EU
Non-renewable nuclear – MJ (HHV)	Product (raw material) (A1)	0.37
	Product (transport/manufact.) (A2-A3)	0.06
	Construction (transport) (A4)	0.04
	Construction (installation) (A5)	0.07
	End of life (end-of-life) (C2-C4)	0.01
	Total	0.55
Renewable (solar, wind, hydroelectric, and geothermal) – MJ (HHV)	Product (raw material) (A1)	1.68
	Product (transport/manufact.) (A2-A3)	0.03
	Construction (transport) (A4)	0.02
	Construction (installation) (A5)	0.03
	End of life (end-of-life) (C2-C4)	0.01
	Total	1.77
Renewable (biomass) – MJ (HHV)	Product (raw material) (A1)	0.32
	Product (transport/manufact.) (A2-A3)	0.02
	Construction (transport) (A4)	0.02
	Construction (installation) (A5)	0.02
	End of life (end-of-life) (C2-C4)	0.00
	Total	0.38

Table 6: Material Resources Consumption per m² of Installed Membrane[6]

Material Resources Consumption	Stage	MM6125®EU
Non-renewable material resources – kg	Product (raw material) (A1)	0
	Product (transport/manufact.) (A2-A3)	6.40
	Construction (transport) (A4)	0
	Construction (installation) (A5)	0
	End of life (end-of-life) (C2-C4)	0
	Total	6.40
Renewable material resources – kg	Product (raw material) (A1)	0
	Product (transport/manufact.) (A2-A3)	0.03
	Construction (transport) (A4)	0
	Construction (installation) (A5)	0
	End of life (end-of-life) (C2-C4)	0
	Total	0.03
Net fresh water – L	Product (raw material) (A1)	31.41
	Product (transport/manufact.) (A2-A3)	1.10
	Construction (transport) (A4)	1.11
	Construction (installation) (A5)	2.00
	End of life (end-of-life) (C2-C4)	0.21
	Total	35.82
Non-hazardous waste generated – kg	Product (raw material) (A1)	0
	Product (transport/manufact.) (A2-A3)	2.67E-03
	Construction (transport) (A4)	0
	Construction (installation) (A5)	0
	End of life (end-of-life) (C2-C4)	0
	Total	2.67E-03

[6] Values may not add up due to rounding.

Material Resources Consumption	Stage	MM6125®EU
Hazardous waste generated – kg	Product (raw material) (A1)	0
	Product (transport/manufact.) (A2-A3)	0.07
	Construction (transport) (A4)	0
	Construction (installation) (A5)	0
	End of life (end-of-life) (C2-C4)	6.39
	Total	6.46

4.6. Life Cycle Impact Assessment - Interpretation

Potential environmental impacts

As observed in Figure 3, **raw materials manufacturing** is the main contributor to the impacts on global warming (52%), acidification of land and water (55%), eutrophication (41%), smog creation (56%) and ozone depletion (88%). **Asphalt** production (52% of the membrane composition) accounts for 28 to 82% of the raw material manufacturing impacts, regardless of the environmental impact category. **Oil** is another major contributor to the total impact on acidification of land and water (11%), eutrophication (11%) and ozone depletion (15%).

The **transport of raw materials** (mainly by truck) and the **transport of membrane to project sites in Europe** (by ship and truck) is also a significant contributor to the impacts on global warming (22%), acidification of land and water (36%), eutrophication (45%) and smog creation (17%). Due to the use of propane and gasoline to melt and agitate the membrane, the **installation stage** is a major contributor to global warming (24%), eutrophication (11%) and smog creation (26%). The membrane manufacturing stage (emissions of energy consumption and waste at Hydrotech's plant) is not a major contributor and represents between 0.1 and 1.2 % of the life cycle impacts, regardless of the environmental impact category.

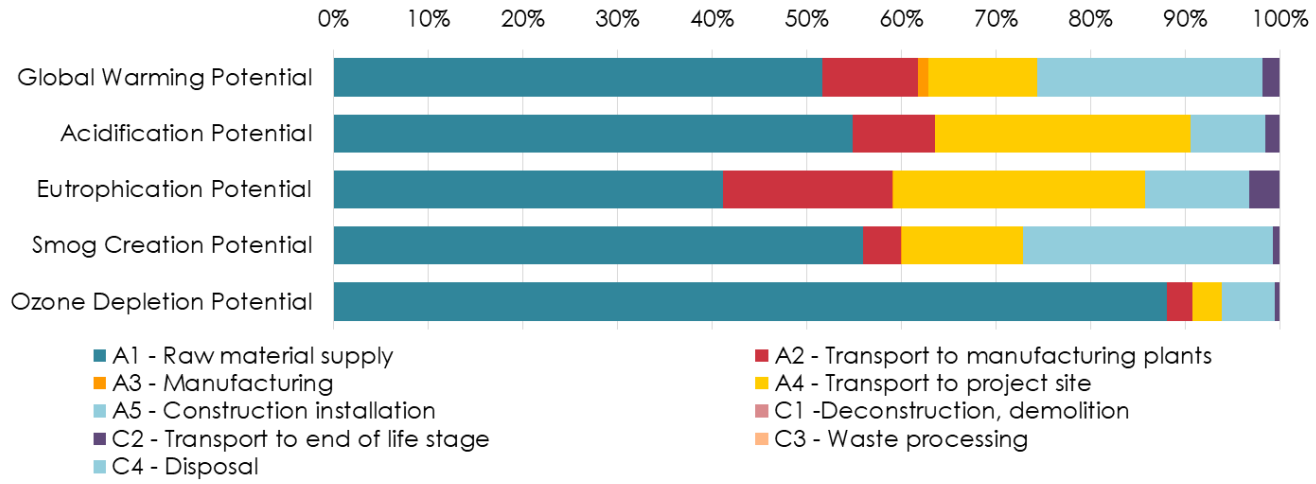


Figure 3: Relative contributions of the main processes in the production of MM6125®EU

Use of resources and generation of waste indicators

Natural gas, coal (in the electricity grid mixes) and petroleum are non-renewable energy resources used to **produce raw materials and to fuel truck, train and ship**. Natural gas is also used during the **membrane manufacturing to heat the plant**. Crude oil is also a raw material **used for the production of** polymer-modified asphalt cement and for the **production of distillates (petroleum) hydrotreated heavy naphthenic**. The use of crude oil as raw material was reported in the Non-renewable fossil indicator.

Hazardous wastes are mainly composed of **oil and asphalt residues**, **laboratory tests** and **membranes that did not meet the standards**. Non-hazardous wastes mainly include **plastic** and **cardboard wastes which are recycled.**

5. Additional environmental information

Product Improvement

Hydrotech's commitment to environmental sustainability has led the company to take action towards the reduction of its product's environmental footprint. The company had therefore gradually replaced primary kaolin with post-consumer inert filler. Today, kaolin has been completely replaced by this post-consumer inert filler. In addition to achieving the same mechanical properties as kaolin, post-consumer inert filler has lower environmental impacts. Since there is no industry benchmark, a third-party reviewed LCA which includes a comparison between the environmental impacts of the same product but with slightly different formulations can be used as a reference for the Multi-Attribute Optimization option in the LEED® credit for Building disclosure and Optimization – Environmental Product Declarations. In order to contribute to LEED®'s points, the newer formulation must be better than the older one on at least three of the six impact categories defined by LEED®.

It was demonstrated in the LCA report that the environmental profile of the current MM6125®EU's formulation is better (i.e. lower impacts) than the old formulation for at least 3 environmental impact categories.

Recycled Content

MM6125®EU is made of post-consumer inert filler and recycled tires. Through the manufacture of its products, Hydrotech thus contributes to the diversion of materials from landfills. The post-consumer recycled content[7] can help projects integrating MM6125®EU to earn up to **1 potential point towards LEED®v4 rating systems.** MM6125®'s Recycled Content Claim was validated by Underwriter Laboratories (UL)[8].

[7] Recycled content, recycled content is the sum of postconsumer recycled content plus one-half the pre-consumer recycled content, based on cost. Products meeting recycled content criteria are valued at 100% of their cost for the purposes of credit achievement calculation [LEED v.4 MR Credit, Building product disclosure and optimization - sourcing of raw materials, Option 2. leadership extraction practices (1 point), https://www.usgbc.org/node/2616388?return=/credits/new-construction/v4/material-%26amp%3B-resources].

[8] Report Number : 98149-4210, project number : 47880881606, validation period : 10/24/2017 – 10/24/2018.

Contribution to Green Building Certification Schemes

The publication of this Product-specific Type III EPD[9,10] can help projects integrating MM6125®EU to earn up to **2 potential points towards LEED®v4 rating systems.**

This third-party verified EPD can be also used **under the BREEAM® certification program.** BREEAM's Green Guide Rating is a metric used to assess the performance of individual components in a construction project. The BREEAM® score for the membrane could be improved by an additional 0.125-0.25 point[11] by completing an EPD verified by a third party.

Content of Regulated Hazardous Substances

According to the REACH regulation[12], because the MM6125®EU membrane is a mixture of REACH-compliant ingredients, the membrane itself can be considered to be **REACH-compliant**. REACH registration numbers for each ingredient can be found in the MM6125®EU SDS (Safety Data Sheet).

[9] Product-specific Type III EPD, products with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator are valued as one whole product for purposes of credit achievement calculation [LEED v.4 MR Credit, Building product disclosure and optimization - environmental product declarations, Option 1. environmental product declaration (EPD) (1 point), https://www.usgbc.org/node/2616376?return=/credits/new-construction/v4/material-%26amp%3B-resources].

[10] Refer to product improvement paragraph in section 5 [LEED v.4 MR Credit, Building product disclosure and optimization - environmental product declarations, Option 2. multi-attribute optimization – point 2: USGBC approved program (1 point), https://www.usgbc.org/sites/default/files/pcr_committee_process_and_resources__part_b.pdf].

[11] For more information, see table 21 from: http://www.breeam.com/BREEAM2011SchemeDocument/content/09_material/mat01_general.htm

[12] According to regulation (EC) No. 1907/2006 (REACH) with its amendment Regulation (EU) 2015/830.

6. GLOSSARY

6.1. Acronyms

CFC-11	Trichlorofluoromethane
CH_4	Methane
CO_2	Carbon dioxide
CSA	Canadian Standards Association
EPD	Environmental Product Declaration
eq.	Equivalent
ft^2	Square foot
GHG	Greenhouse gas
ISO	International Organization for Standardization
kg	kilogram
CFC 11	Trichlorofluoromethane
CO_2	Carbon dioxide
EOL	End of life
HHV	Higher heating value
km	Kilometer
lb	Pound
LCA	Life cycle assessment
LCI	Life cycle inventory
LEED	Leadership in Energy and Environmental Design
MJ	Megajoule
Mm	Millimeter
m^2	Square meter
m^3	Cubic meter
N	Nitrogen
NO_x	Nitrogen oxide
NSF	NSF International – program operator
PCR	Product Category Rules
O_3	Ozone
Sb	Antimony
SO_2	Sulfur dioxide
VOC	Volatile organic compound

6.2. Environmental Impact Categories and Parameters Assessed

The **acidification potential** refers to the change in acidity (i.e. reduction in pH) in soil and water due to human activity. The increase in CO_2 emissions and other air pollutants (e.g. NO_x and SO_2) generated by the transportation and manufacturing sectors are the main causes of this impact category. The acidification of land and water has multiple consequences: degradation of aquatic and terrestrial ecosystems, endangering numerous species and food security. The concentration of the gases responsible for the acidification is expressed in sulphur dioxide equivalents **(kg SO_2 equivalent).**

The **eutrophication potential** measures the enrichment of an aquatic or terrestrial ecosystem due to the release of nutrients (e.g. nitrates, phosphates) resulting from natural or human activity (e.g. the discharge of wastewater into watercourses). In an aquatic environment, this activity results in the growth of algae which consume dissolved oxygen present in water when they degrade and thus affect species sensitive to the concentration of dissolved oxygen. Also, the increase of nutrients in the soils makes it difficult for the terrestrial environment to manage the excess of biomass produced. The concentration of nutrients causing this impact is expressed in nitrogen equivalents **(kg N equivalent)**.

Net fresh water consumption accounts for the imbalance in the natural water cycle created by the water evaporated, consumed by a system or released to a different watershed (i.e. not its original source). This imbalance can cause water scarcity and affect biodiversity. This indicator refers to the waste of the resource rather than its pollution. Also, it does not refer to water that is used but returned to the original source (e.g. water for hydroelectric turbines, cooling or river transportation) or lost from a natural system (e.g. due to evaporation of rainwater). The quantity of freshwater consumed is expressed as a volume of water in meter cube **(L of water consumed)**.

The **global warming potential** refers to the impact of a temperature increase on the global climate patterns (e.g. severe flooding and drought events, accelerated melting of glaciers) due to the release of greenhouse gases (GHG) (e.g. carbon dioxide and methane from fossil fuel combustion). GHG emissions contribute to the increase in the absorption of radiation from the sun at the earth's surface. These emissions are expressed in units of kg of carbon dioxide equivalents **(kg CO_2 equivalent)**.

The **ozone depletion potential** indicator measures the potential of stratospheric ozone level reduction due to the release of some molecules such as refrigerants used in cooling systems (e.g. chlorofluorocarbons). When they react with ozone (O_3), the ozone concentration in the stratosphere diminishes and is no longer sufficient to absorb ultraviolet (UV) radiation which can cause high risks to human health (e.g. skin cancers and cataracts) and the terrestrial environment. The concentration of molecules that are responsible of ozone depletion is expressed in kilograms of trichlorofluoromethane equivalents **(kg CFC 11 equivalent).**

The **smog creation potential** indicator covers the emissions of pollutants such as nitrogen oxides and volatile organic compounds (VOCs) into the atmosphere. They are mainly generated by motor vehicles, power plants and industrial facilities. When reacting with the sunlight, these pollutants create smog which can affect human health and cause various respiratory problems. The concentration of pollutants causing smog are expressed in kg of ozone equivalents **(kg O_3 equivalent)**.

The **renewable/non-renewable primary energy consumption** parameters refer to the use of energy from renewable resources (e.g., wind, solar, hydro) and non-renewable resources (e.g., natural gas, coal, petroleum). The quantity of primary energy used is expressed in megajoules, on the basis of the net calorific value of the resources **(MJ, net calorific value).**

The **renewable/non-renewable material resources consumption** parameters represent the quantity of material made from renewable resources or nonrenewable resources used to manufacture a product, excluding recovered or recycled materials. The quantity of these resources are reported in kilograms **(kg)**.

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