ENVIRONMENTAL PRODUCT DECLARATION

Flexible Bitumen Sheets For Roof Waterproofing – sector EPD

The product declared is an average that is not available for purchase on the market.

European Waterproofing Association



BASED ON:
PCR 2014:12
(version 1.0).
2014/07/10
Flexible sheets for waterproofing – bitumen, plastic or rubber sheets for roof waterproofing.
UN CPC (5453)
EN 15804:2014

VERSION:
1 2015/11/30

CERTIFICATION N°:
S-P-00414

ECO EPD Reg. No:
00000294

VALID UNTIL:
2020/11/30

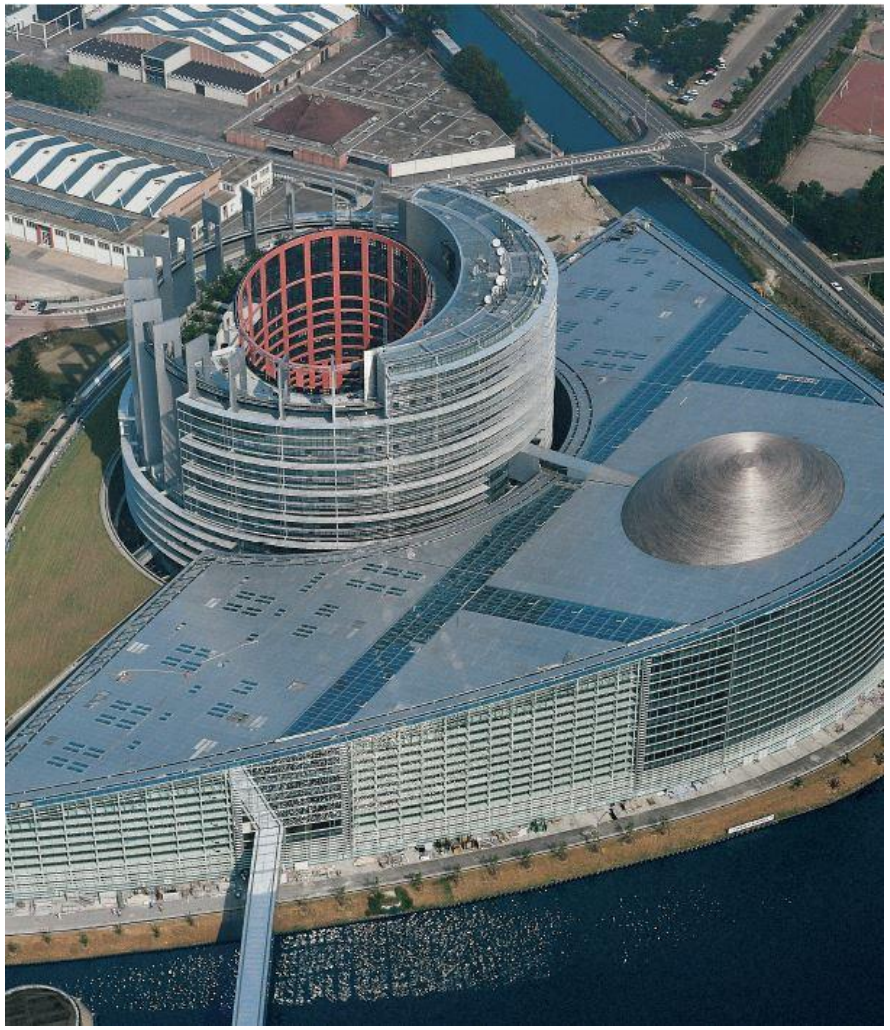
Geographical scope:
EWA members in:
Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Spain and Sweden.

THE EWA

The **E**uropean **W**aterproofing **A**ssociation (**EWA**) was created to provide an authoritative voice for the European Waterproofing industry.
The EWA is Europe's central source of advice and information on all roofing and waterproofing matters, both to the industry and to its user groups.

Sustainable and environmental issues are, quite rightly, matters of great importance to us all in construction. A full understanding of environmental concerns – like 'global warming', 'waste recycling' and 'life-cycle analysis' – is core to maintaining our reputation as a responsible industry. For this reason EWA represents manufacturers who are committed to ensuring their industry is sustainable, which means to be environmentally, economically and socially responsible over time.

EWA decided to develop this **E**nvironmental **P**roduct **D**eclaration (**EPD**) for several bitumen waterproofing systems because it is considered an important tool to support manufacturers on the environmental marketing activities from a scientific and holistic perspective. The product declared is an average that is not available for purchase on the market. This document contains key information to help any expert, involved in construction deal, with the assessment of the environmental impact of the building, building materials and systems used.







Bituminous Membrane

The principal task of bituminous waterproofing is to protect buildings against water in its various forms e.g. rain, humidity, snow and hail. Beyond this, its waterproofing qualities preserve and sustain a building's capital value. Indeed, the membrane provides a good protection from rain water penetration in order to ensure the thermal insulation over time. Bituminous waterproofing can also make the roof accessible to pedestrians, even vehicles, and is the optimal, durable, solution to creating vegetation systems on the roof that can help keep a building healthy and support biodiversity.

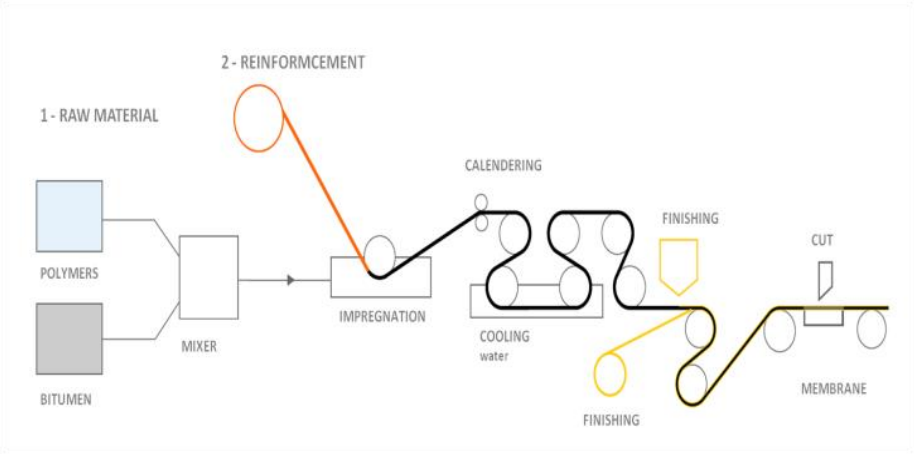
Participants

Since the environmental impact for the same system is comparable from one manufacturer and from one factory, to another, EWA decided to establish a common industry fact sheet that states the average impact generated by systems with bitumen waterproofing sheets produced by EWA members.

A total of 42 plants participated to the EPD data collection phase (further details reported in Appendix). The involved countries were: Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway and Sweden; additionally, individual Austrian, Spanish and Portuguese manufacturing plants took part in the data gathering. The EPD may not be representative for EWA members/production locations from other countries.

Production Process

Bituminous waterproofing membranes are produced by a continuous process as outlined in the figure below.



Raw materials (bitumen and polymers) are mixed separately at a specific range of temperature and successively reinforced with polyester fleece or glass mat (glass mat, glass grid, glass fabric) by impregnation. After calendering and cooling, the membrane can be finished for practicality and aesthetic reasons by means of different alternative materials, such us polypropylene films, (colored) slates, etc. Membranes are installed on many different type of building roofs as waterproofing, either, as a single or multi-layer, depending on the type of selected product.

The Waterproofing System



Fully torched



Ballasted



Mechanically fastened

Depending on roof typology, design and building structural variables, membranes could be installed in three different modalities:

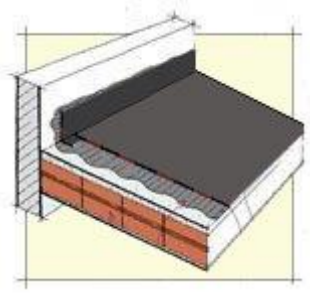
- **Fully Torched**: in which all membranes (single layer, bottom layer and/or top layer) are fully adhered to the substrate of membrane below by heating the bottom surface of the membrane.
- **Ballasted**: in which the membrane (single layer system) or the bottom layer (multi layer system) are loose laid, whereby the joints and top layer, if applicable, are torched. Eventually, the topside of the system is covered by ballast.
- **Mechanically fastened**: in which the membrane (single layer system) or the bottom layer (multi layer system) are loose laid and fixed by metal/plastic fasteners, whereby the joints and top layer, if applicable, are torched.

EWA Online LCA Tool And Data Gathering

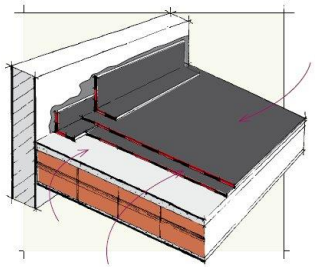
EWA has developed, in close co-operation with Life Cycle Engineering (LCE, Italy), a customized Life Cycle Analysis (LCA) on-line software tool for all EWA members.
This online tool allows EWA to collect specific data among EWA members and to improve the environmental performance of the waterproofing systems.

Product Specifications And Content Of Materials

This EPD reports the environmental performance for six waterproofing systems, which represent those commonly used in the European industry. These systems cover modified plastomeric/elastomeric bitumen sheets with polyester/glass reinforcement; with a thickness between 1,9-5,2 mm; with or without mineral auto-protection and PE film; or sand as a back finishing.



Single layer



Multi layer

Thickness and mass reported in the table are representative for the European average.

Waterproofing systems (data per m²)			Layer	Thickness (mm)	Mass (kg)
Single layer	System1	Fully torched	Single	4.3	**5.3**
	System2	Mechanically fastened	Single	4.4	**5.4**
	System3	With ballast	Single	4.2	**4.8**
Multi layer	System4	Fully torched	Top	3.8	**4.8**
			Bottom	3.1	**3.9**
	System5	Mechanically fastened	Top	3.8	**4.9**
			Bottom	3.0	**3.7**
	System6	With ballast	Top	3.6	4.3
			Bottom	3.0	3.8

Content of Materials And Chemicals Substances

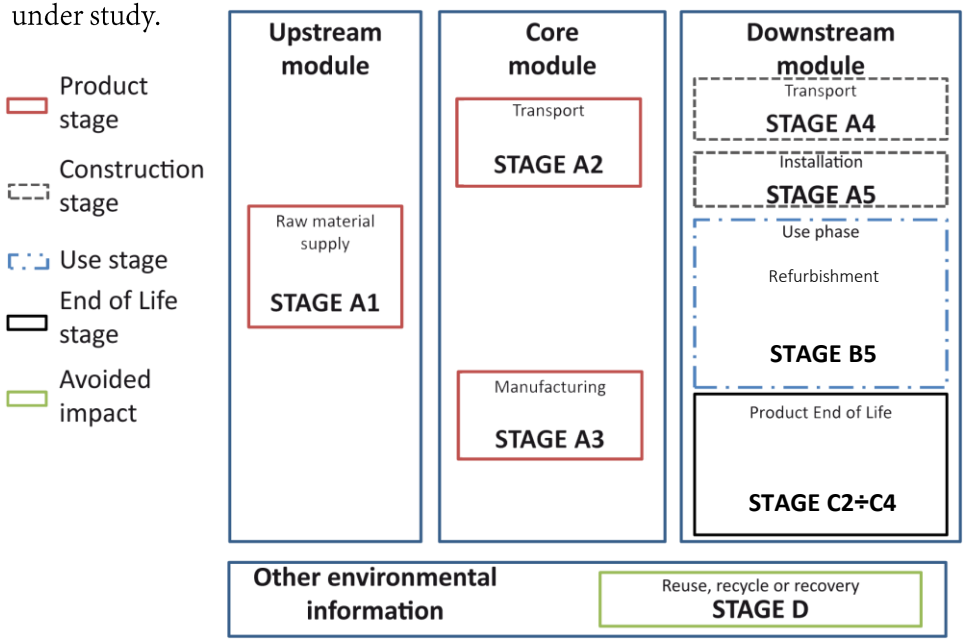
The main materials that are required for the production of the bitumen membranes used in the defined waterproofing systems are bitumen (45-52%), polymers (6-10%), reinforcement (2-4%), minerals as fillers or finishing (30-41%) and other materials (3-5%).

Life Cycle Assessment Calculation

The environmental burden of the six waterproofing systems has been calculated according to the PCR 2014:12, which is in line with EN 15804 "Environmental product declarations – Core rules for the product category of construction products".

A cradle to grave system – from the raw material extraction up to demolition and end of life treatment – is considered to elaborate the set of environmental indicators reported afterwards. Allocation procedures based on the mass criteria are applied here.

Modules from B1 to B4 and C1 were considered as not relevant for the system under study.



Benefits And Loads For The Next Product System Out Of The System Boundaries - Module D

The additional information relative to the burdens and credits beyond the system boundary (Module D), derived from bitumen, gravel and polymers recycling and energy recovery processes, is included.

Incineration with energy recovery allows the avoided production of electricity and heat (natural gas fuel) at European level.

The recycling process for

- bitumen and ballast considers the avoided production of the virgin material in accordance with the current technologies available (100% as substitution factor).
- polymers substitutes the virgin polypropylene, considering 54% as substitution factor.

Functional Unit (FU) And Reference Service Life (RSL)

The study provides the environmental indicators per **1 m² installed roof waterproofing with flexible sheets for roofing, with a reference building service life of 90 years**.

The Reference Service Life (RSL) refers to the declared technical and functional performance of the product within a building. RSL is dependent on the properties of the product and reference in-use conditions. A standard RSL time of 30 years for the initial roof waterproofing system is used, whereby a maximum of 2 renewals are applied (a new top layer fully bonded by torching) both also with a RSL of 30 years.

General Hypothesis Adopted

Upstream Process, A1

For bitumen, which is the main raw material of the membrane, the Eurobitume Life Cycle Inventory (LCI) was used (available on www.eurobitume.eu).

For polymers, the Plastics Europe LCI studies were used as reference data. In some other cases, already published EPDs were used (i.e. polyester fleece).

No primary data was directly collected from the raw material suppliers.

Production And Delivery, A2 + A3 + A4

Primary data was collected from the 42 production plants by means of the EWA on-line tool. Firstly, data was averaged by each cluster and finally delivered to EWA to produce the pan-European average.
The reference year is 2013.
The European electricity mix was used as reference data for each production plant

The average distance for product delivery to the construction site was collected with the aid of EWA on-line tool: 300 km covered by a 32 t truck.

Membrane End Of Life, C2 + C3 + C4

The reference scenario considered for the roof membrane end of life waste management is

- 60 % to landfill.
- 30 % to incineration with energy recovery.
- 10 % to recycling.

Distance covered by an European average EURO 5 lorry 16 t with diesel engine (Module C2):

- 150 km to recycling;
- 100 km to incineration site
- 50 km to disposal

- Waste processing (Module C3) takes into account the electricity consumption of waste sorting facilities.

- Waste treatment includes incineration with energy recovery and/or final disposal; total burden relevant to the incineration with energy recovery was allocated to Module C4.

Installation & Refurbishment, A5 + B5

These stages include the cutting waste production, transport and waste processing and disposal.
The table below reports details regarding to the real membrane consumption and the ancillary materials needed for the installation.

Installation	System 1	System 2	System 3	System 4	System 5	System 6
Type	Single layer	Single layer	Single layer	Multi layer	Multi layer	Multi layer
Gas propane – kg/m²	0.150	0.015	0.015	0.300	0.150	0.150
Fasteners – u/m²	-	5 (only one time)	-	-	5 (only one time)	-
Ballast – kg/m²	-	-	65	-	-	65 (only one time)
Real membrane consumption	+ 10%	+ 14%	+ 10%	+ 8%	+ 9%	+ 8%

The main phase involved in the downstream process is the refurbishment stage, in which all activities for the maintenance of the roof are included. In line with the European common practice two renewals are allowed, whereby a new top layer is fully bonded by torching on the existing waterproofing system.
The transportation of the waste generated at the building site takes into account an European average EURO 5 lorry 16 t with diesel engine (150 km to recycling; 100 km t incineration site; 50 km to disposal)

Refurbishment	Single layer/Multi-layer
Gas propane – kg/m²	0.150
Real membrane consumption	+ 8% (each time)

Environmental Performance

Single layer - System 1 fully torched system			GWP	AP	POCP	EP	ADP elements	ADP fossil fuel	ODP
units per FU			kg CO_2 eq	kg SO_2 eq	kg C_2H_4 eq	kg PO_4^{3-} eq	kg Sb eq	MJ eq	kg CFC11 eq
Product stage	Raw material supply	A1	2.73E-02	1.20E-04	3.11E-05	1.82E-05	4.53E-09	1.91E+00	1.39E-08
	Transport	A2	1.15E-03	5.47E-06	8.31E-07	1.26E-06	7.28E-13	1.64E-02	1.74E-10
	Manufacturing	A3	5.46E-03	8.73E-06	5.36E-06	1.45E-06	3.22E-10	9.60E-02	5.94E-10
	Total (of product stage)	A1 – A3	3.39E-02	1.34E-04	3.73E-05	2.09E-05	4.86E-09	2.02E+00	1.47E-08
Construction process stage	Transport	A4	1.62E-03	6.91E-06	1.07E-06	1.29E-06	1.30E-12	2.31E-02	2.41E-10
	Construction installation	A5	1.26E-02	5.96E-05	6.57E-06	1.27E-05	5.16E-10	2.97E-01	2.29E-09
Use stage	Refurbishment	B5	9.38E-02	3.94E-04	8.83E-05	6.87E-05	1.06E-08	4.60E+00	3.38E-08
End of life	Transport	C2	1.42E-03	7.75E-06	1.12E-06	1.82E-06	1.50E-12	2.01E-02	2.13E-10
	Waste processing	C3	8.74E-04	3.33E-06	2.34E-07	4.45E-07	1.99E-11	1.07E-02	4.09E-11
	Disposal	C4	7.95E-02	1.88E-05	3.38E-06	6.31E-06	2.68E-11	1.68E-02	1.32E-10
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-3.29E-02	-7.91E-05	-1.50E-05	-1.10E-05	-4.86E-10	-1.03E+00	-3.22E-09

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 1 fully torched system			Use of renewable primary energy excluding renewable primary energy resources used as raw materials	Use of renewable primary energy resources used as raw materials	Total use of renewable primary energy resources	Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	Use of non renewable primary energy resources used as raw materials	Total use of non renewable primary energy resources
units per FU			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	4.92E-02	9.01E-06	4.92E-02	5.14E-01	1.53E+00	2.05E+00
	Transport	A2	2.34E-05	-	2.34E-05	1.65E-02	-	1.65E-02
	Manufacturing	A3	3.47E-02	3.09E-03	3.78E-02	8.33E-02	2.06E-02	1.04E-01
	Total (of product stage)	A1 – A3	8.39E-02	3.10E-03	8.70E-02	6.14E-01	1.55E+00	2.17E+00
Construction process stage	Transport	A4	4.91E-05	-	4.91E-05	2.34E-02	-	2.34E-02
	Construction installation	A5	8.71E-03	3.10E-04	9.02E-03	1.58E-01	1.55E-01	3.13E-01
Use stage	Refurbishment	B5	1.82E-01	6.70E-03	1.89E-01	1.56E+00	3.36E+00	4.92E+00
End of life	Transport	C2	2.87E-05	-	2.87E-05	2.03E-02	-	2.03E-02
	Waste processing	C3	1.58E-03	-	1.58E-03	1.76E-02	-	1.76E-02
	Disposal	C4	7.40E-04	-	7.40E-04	2.10E-02	-	2.10E-02
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-2.93E-02	-	-2.93E-02	-1.15E+00	-	-1.15E+00

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 1 fully torched system			Use of secondary material	Use of renewable secondary fuels	Use of non renewable secondary fuels	Use of net fresh water
units per FU			kg	MJ	MJ	m^3
Product stage	Raw material supply	A1	2.11E-03	-	-	2.58E-04
	Transport	A2	-	-	-	1.35E-06
	Manufacturing	A3	1.10E-04	-	-	9.81E-05
	Total (of product stage)	A1 – A3	2.22E-03	-	-	3.57E-04
Construction process stage	Transport	A4	-	-	-	2.00E-06
	Construction installation	A5	2.22E-04	-	-	4.63E-05
Use stage	Refurbishment	B5	4.80E-03	-	-	7.96E-04
End of life	Transport	C2	-	-	-	1.65E-06
	Waste processing	C3	-	-	-	7.71E-06
	Disposal	C4	-	-	-	3.96E-05
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-	-	-	-1.83E-04

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 1 fully torched system			Hazardous waste disposed	Non hazardous waste disposed	Radioactive waste disposed
units per FU			kg	kg	kg
Product stage	Raw material supply	A1	3.97E-05	1.76E-03	3.37E-06
	Transport	A2	1.35E-07	1.35E-07	4.63E-09
	Manufacturing	A3	6.01E-04	9.58E-04	1.28E-07
	Total (of product stage)	A1 – A3	6.41E-04	2.72E-03	3.50E-06
Construction process stage	Transport	A4	2.93E-07	2.93E-07	9.99E-09
	Construction installation	A5	6.41E-05	1.62E-03	3.51E-07
Use stage	Refurbishment	B5	1.38E-03	8.32E-03	7.58E-06
End of life	Transport	C2	-	-	-
	Waste processing	C3	-	1.77E-02	-
	Disposal	C4	-	-	-
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-1.08E-07	-6.91E-06	-

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Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 1 fully torched system	Components for re-use	Materials for recycling	Materials for energy recovery	Exported energy
units per FU	kg	kg	kg	MJ
Output flows	-	1.95E-02	5.79E-02	3.55E-01

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 2 Mechanically fastened system			GWP	AP	POCP	EP	ADP elements	ADP fossil fuel	ODP
units per FU			kg CO_2 eq	kg SO_2 eq	kg C_2H_4 eq	kg PO_4^{3-} eq	kg Sb eq	MJ eq	kg CFC11 eq
Product stage	Raw material supply	A1	2.73E-02	1.22E-04	2.99E-05	1.78E-05	4.82E-09	1.91E+00	1.45E-08
	Transport	A2	1.19E-03	5.63E-06	8.55E-07	1.30E-06	7.49E-13	1.69E-02	1.79E-10
	Manufacturing	A3	5.80E-03	9.11E-06	5.55E-06	3.28E-06	3.27E-10	1.02E-01	6.46E-10
	Total (of product stage)	A1 – A3	3.42E-02	1.37E-04	3.63E-05	2.24E-05	5.15E-09	2.03E+00	1.53E-08
Construction process stage	Transport	A4	1.74E-03	7.76E-06	1.17E-06	1.45E-06	1.41E-12	2.47E-02	2.58E-10
	Construction installation	A5	1.24E-02	3.41E-05	7.39E-06	6.16E-06	1.85E-08	3.42E-01	2.51E-09
Use stage	Refurbishment	B5	9.48E-02	4.03E-04	8.63E-05	7.24E-05	1.12E-08	4.61E+00	3.52E-08
End of life	Transport	C2	1.44E-03	7.89E-06	1.14E-06	1.85E-06	1.53E-12	2.05E-02	2.17E-10
	Waste processing	C3	8.91E-04	3.39E-06	2.39E-07	4.53E-07	2.03E-11	1.09E-02	4.17E-11
	Disposal	C4	8.10E-02	1.92E-05	3.44E-06	6.43E-06	2.73E-11	1.72E-02	1.34E-10
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-3.40E-02	-8.16E-05	-1.55E-05	-1.13E-05	-5.02E-10	-1.06E+00	-3.32E-09

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Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 2 Mechanically fastened system			Use of renewable primary energy excluding renewable primary energy resources used as raw materials	Use of renewable primary energy resources used as raw materials	Total use of renewable primary energy resources	Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	Use of non renewable primary energy resources used as raw materials	Total use of non renewable primary energy resources
units per FU			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	4.90E-02	1.05E-05	4.90E-02	5.13E-01	1.54E+00	2.05E+00
	Transport	A2	2.41E-05	-	2.41E-05	1.70E-02	-	1.70E-02
	Manufacturing	A3	3.55E-02	3.72E-03	3.92E-02	8.87E-02	2.09E-02	1.10E-01
	Total (of product stage)	A1 – A3	8.45E-02	3.73E-03	8.83E-02	6.19E-01	1.56E+00	2.18E+00
Construction process stage	Transport	A4	5.40E-05	-	5.40E-05	2.50E-02	-	2.50E-02
	Construction installation	A5	1.39E-02	5.22E-04	1.44E-02	1.51E-01	2.18E-01	3.69E-01
Use stage	Refurbishment	B5	1.83E-01	8.05E-03	1.91E-01	1.58E+00	3.37E+00	4.94E+00
End of life	Transport	C2	2.92E-05	-	2.92E-05	2.07E-02	-	2.07E-02
	Waste processing	C3	1.61E-03	-	1.61E-03	1.80E-02	-	1.80E-02
	Disposal	C4	7.54E-04	-	7.54E-04	2.14E-02	-	2.14E-02
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-3.05E-02	-	-3.05E-02	-1.18E+00	-	-1.18E+00

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 2 Mechanically fastened system			Use of secondary material	Use of renewable secondary fuels	Use of non renewable secondary fuels	Use of net fresh water
units per FU			kg	MJ	MJ	m^3
Product stage	Raw material supply	A1	2.11E-03	-	-	2.41E-04
	Transport	A2	-	-	-	1.39E-06
	Manufacturing	A3	1.34E-04	-	-	8.92E-05
	Total (of product stage)	A1 – A3	2.24E-03	-	-	3.31E-04
Construction process stage	Transport	A4	-	-	-	2.15E-06
	Construction installation	A5	3.14E-04	-	-	7.39E-05
Use stage	Refurbishment	B5	4.84E-03	-	-	7.40E-04
End of life	Transport	C2	-	-	-	1.68E-06
	Waste processing	C3	-	-	-	7.86E-06
	Disposal	C4	-	-	-	4.03E-05
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-	-	-	-1.89E-04

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 2 Mechanically fastened system			Hazardous waste disposed	Non hazardous waste disposed	Radioactive waste disposed
units per FU			kg	kg	kg
Product stage	Raw material supply	A1	4.10E-05	1.73E-03	3.50E-06
	Transport	A2	1.39E-07	1.39E-07	4.76E-09
	Manufacturing	A3	1.05E-05	3.62E-04	1.34E-07
	Total (of product stage)	A1 – A3	5.17E-05	2.09E-03	3.64E-06
Construction process stage	Transport	A4	3.27E-07	3.27E-07	1.10E-08
	Construction installation	A5	7.28E-06	1.96E-03	5.11E-07
Use stage	Refurbishment	B5	1.12E-04	1.28E-02	7.89E-06
End of life	Transport	C2	-	-	-
	Waste processing	C3	-	1.80E-02	-
	Disposal	C4	-	-	-
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-1.12E-07	-7.16E-06	-

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 2 Mechanically fastened system	Components for re-use	Materials for recycling	Materials for energy recovery	Exported energy
units per FU	kg	kg	kg	MJ
Output flows	-	2.01E-02	5.97E-02	3.66E-01

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 3 Loose laid with ballast system			GWP	AP	POCP	EP	ADP elements	ADP fossil fuel	ODP
units per FU			kg CO_2 eq	kg SO_2 eq	kg C_2H_4 eq	kg PO_4^{3-} eq	kg Sb eq	MJ eq	kg CFC11 eq
Product stage	Raw material supply	A1	2.45E-02	9.97E-05	2.70E-05	1.46E-05	4.41E-09	1.89E+00	1.36E-08
	Transport	A2	1.05E-03	5.00E-06	7.59E-07	1.15E-06	6.65E-13	1.50E-02	1.59E-10
	Manufacturing	A3	5.53E-03	8.26E-06	5.09E-06	3.46E-06	2.91E-10	9.79E-02	6.31E-10
	Total (of product stage)	A1 – A3	3.11E-02	1.13E-04	3.28E-05	1.92E-05	4.71E-09	2.01E+00	1.44E-08
Construction process stage	Transport	A4	1.55E-03	6.68E-06	1.03E-06	1.25E-06	1.35E-12	2.20E-02	2.30E-10
	Construction installation	A5	8.97E-03	2.87E-05	6.08E-06	5.50E-06	1.54E-09	2.44E-01	1.85E-09
Use stage	Refurbishment	B5	8.72E-02	3.49E-04	7.85E-05	6.49E-05	1.02E-08	4.56E+00	3.33E-08
End of life	Transport	C2	7.08E-03	3.87E-05	5.57E-06	9.08E-06	7.50E-12	1.00E-01	1.07E-09
	Waste processing	C3	7.92E-04	3.01E-06	2.12E-07	4.03E-07	1.80E-11	9.72E-03	3.70E-11
	Disposal	C4	7.36E-02	2.87E-05	5.95E-06	8.32E-06	2.66E-11	3.87E-02	3.24E-10
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-2.97E-02	-7.03E-05	-1.31E-05	-9.68E-06	-4.03E-10	-9.08E-01	-2.91E-09

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 3 Loose laid with ballast system			Use of renewable primary energy excluding renewable primary energy resources used as raw materials	Use of renewable primary energy resources used as raw materials	Total use of renewable primary energy resources	Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	Use of non renewable primary energy resources used as raw materials	Total use of non renewable primary energy resources
units per FU			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	4.14E-02	1.08E-05	4.15E-02	4.19E-01	1.60E+00	2.01E+00
	Transport	A2	2.13E-05	-	2.13E-05	1.51E-02	-	1.51E-02
	Manufacturing	A3	2.87E-02	2.37E-03	3.11E-02	8.49E-02	1.74E-02	1.02E-01
	Total (of product stage)	A1 – A3	7.02E-02	2.38E-03	7.25E-02	5.19E-01	1.61E+00	2.13E+00
Construction process stage	Transport	A4	5.34E-05	-	5.34E-05	2.23E-02	-	2.23E-02
	Construction installation	A5	1.61E-02	2.38E-04	1.63E-02	1.42E-01	1.61E-01	3.03E-01
Use stage	Refurbishment	B5	1.52E-01	5.15E-03	1.57E-01	1.36E+00	3.48E+00	4.84E+00
End of life	Transport	C2	1.43E-04	-	1.43E-04	1.01E-01	-	1.01E-01
	Waste processing	C3	1.43E-03	-	1.43E-03	1.60E-02	-	1.60E-02
	Disposal	C4	7.18E-04	-	7.18E-04	4.27E-02	-	4.27E-02
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-2.71E-02	-	-2.71E-02	-1.02E+00	-	-1.02E+00

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 3 Loose laid with ballast system			Use of secondary material	Use of renewable secondary fuels	Use of non renewable secondary fuels	Use of net fresh water
units per FU			kg	MJ	MJ	m^3
Product stage	Raw material supply	A1	2.64E-03	-	-	1.66E-04
	Transport	A2	-	-	-	1.23E-06
	Manufacturing	A3	1.16E-05	-	-	9.42E-05
	Total (of product stage)	A1 – A3	2.66E-03	-	-	2.62E-04
Construction process stage	Transport	A4	-	-	-	1.95E-06
	Construction installation	A5	2.66E-04	-	-	1.05E-03
Use stage	Refurbishment	B5	5.74E-03	-	-	5.89E-04
End of life	Transport	C2	-	-	-	8.26E-06
	Waste processing	C3	-	-	-	6.99E-06
	Disposal	C4	-	-	-	3.79E-05
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-	-	-	-2.67E-04

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 3 Loose laid with ballast system			Hazardous waste disposed	Non hazardous waste disposed	Radioactive waste disposed
units per FU			kg	kg	kg
Product stage	Raw material supply	A1	3.19E-05	1.82E-03	1.98E-06
	Transport	A2	1.23E-07	1.23E-07	4.22E-09
	Manufacturing	A3	7.73E-06	1.24E-04	1.00E-07
	Total (of product stage)	A1 – A3	3.97E-05	1.94E-03	2.08E-06
Construction process stage	Transport	A4	2.80E-07	2.80E-07	1.10E-08
	Construction installation	A5	4.00E-06	1.42E-03	2.09E-07
Use stage	Refurbishment	B5	8.64E-05	6.42E-03	4.52E-06
End of life	Transport	C2	-	-	-
	Waste processing	C3	-	8.82E-02	-
	Disposal	C4	-	-	-
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-9.79E-08	-6.27E-06	-

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Single layer - System 3 Loose laid with ballast system	Components for re-use	Materials for recycling	Materials for energy recovery	Exported energy
units per FU	kg	kg	kg	MJ
Output flows	-	1.75E-02	5.24E-02	3.23E-01

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 4 fully torched system			GWP	AP	POCP	EP	ADP elements	ADP fossil fuel	ODP
units per FU			kg CO_2 eq	kg SO_2 eq	kg C_2H_4 eq	kg PO_4^{3-} eq	kg Sb eq	MJ eq	kg CFC11 eq
Product stage	Raw material supply	A1	3.79E-02	1.67E-04	3.99E-05	2.34E-05	7.34E-09	2.94E+00	1.66E-08
	Transport	A2	1.86E-03	8.85E-06	1.34E-06	2.04E-06	1.18E-12	2.65E-02	2.81E-10
	Manufacturing	A3	1.02E-02	1.56E-05	1.02E-05	2.92E-06	5.10E-10	1.63E-01	1.04E-09
	Total (of product stage)	A1 – A3	4.99E-02	1.92E-04	5.15E-05	2.84E-05	7.85E-09	3.13E+00	1.79E-08
Construction process stage	Transport	A4	2.48E-03	1.11E-05	1.66E-06	2.05E-06	2.12E-12	3.51E-02	3.67E-10
	Construction installation	A5	2.01E-02	1.06E-04	9.58E-06	2.30E-05	6.87E-10	4.36E-01	3.04E-09
Use stage	Refurbishment	B5	8.26E-02	3.48E-04	7.37E-05	6.11E-05	9.53E-09	3.91E+00	2.56E-08
End of life	Transport	C2	1.63E-03	8.92E-06	1.28E-06	2.09E-06	1.73E-12	2.31E-02	2.46E-10
	Waste processing	C3	1.01E-03	3.83E-06	2.70E-07	5.12E-07	2.29E-11	1.24E-02	4.71E-11
	Disposal	C4	9.15E-02	2.16E-05	3.89E-06	7.27E-06	3.09E-11	1.94E-02	1.52E-10
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-3.80E-02	-9.07E-05	-1.70E-05	-1.26E-05	-5.60E-10	-1.15E+00	-3.71E-09

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

ENVIRONMENTAL PERFORMANCE

Multi layer - System 4 fully torched system			Use of renewable primary energy excluding renewable primary energy resources used as raw materials	Use of renewable primary energy resources used as raw materials	Total use of renewable primary energy resources	Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	Use of non renewable primary energy resources used as raw materials	Total use of non renewable primary energy resources
units per FU			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	5.70E-02	2.64E-05	5.71E-02	6.82E-01	2.46E+00	3.14E+00
	Transport	A2	3.78E-05	-	3.78E-05	2.67E-02	-	2.67E-02
	Manufacturing	A3	6.48E-02	5.83E-03	7.07E-02	1.46E-01	4.07E-02	1.87E-01
	Total (of product stage)	A1 – A3	1.22E-01	5.86E-03	1.28E-01	8.54E-01	2.50E+00	3.35E+00
Construction process stage	Transport	A4	8.30E-05	-	8.30E-05	3.56E-02	-	3.56E-02
	Construction installation	A5	1.03E-02	4.69E-04	1.07E-02	2.57E-01	2.00E-01	4.57E-01
Use stage	Refurbishment	B5	1.53E-01	5.90E-03	1.58E-01	1.35E+00	2.88E+00	4.23E+00
End of life	Transport	C2	3.30E-05	-	3.30E-05	2.33E-02	-	2.33E-02
	Waste processing	C3	1.82E-03	-	1.82E-03	2.03E-02	-	2.03E-02
	Disposal	C4	8.51E-04	-	8.51E-04	2.42E-02	-	2.42E-02
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-3.32E-02	-	-3.32E-02	-1.29E+00	-	-1.29E+00

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 4 fully torched system			Use of secondary material	Use of renewable secondary fuels	Use of non renewable secondary fuels	Use of net fresh water
units per FU			kg	MJ	MJ	m^3
Product stage	Raw material supply	A1	3.38E-03	-	-	2.99E-04
	Transport	A2	-	-	-	2.18E-06
	Manufacturing	A3	5.36E-04	-	-	7.68E-05
	Total (of product stage)	A1 – A3	3.92E-03	-	-	3.78E-04
Construction process stage	Transport	A4	-	-	-	3.10E-06
	Construction installation	A5	3.14E-04	-	-	4.96E-05
Use stage	Refurbishment	B5	4.63E-03	-	-	6.20E-04
End of life	Transport	C2	-	-	-	1.90E-06
	Waste processing	C3	-	-	-	8.88E-06
	Disposal	C4	-	-	-	4.55E-05
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-	-	-	-2.11E-04

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 4 fully torched system			Hazardous waste disposed	Non hazardous waste disposed	Radioactive waste disposed
units per FU			kg	kg	kg
Product stage	Raw material supply	A1	5.03E-05	2.31E-03	3.89E-06
	Transport	A2	2.18E-07	2.18E-07	7.48E-09
	Manufacturing	A3	1.43E-05	3.82E-04	2.85E-07
	Total (of product stage)	A1 – A3	6.48E-05	2.70E-03	4.18E-06
Construction process stage	Transport	A4	4.69E-07	4.69E-07	1.70E-08
	Construction installation	A5	5.22E-06	2.19E-03	3.36E-07
Use stage	Refurbishment	B5	8.80E-05	5.55E-03	6.51E-06
End of life	Transport	C2	-	-	-
	Waste processing	C3	-	2.03E-02	-
	Disposal	C4	-	-	-
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-1.24E-07	-7.92E-06	-

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 4 fully torched system	Components for re-use	Materials for recycling	Materials for energy recovery	Exported energy
units per FU	kg	kg	kg	MJ
Output flows	-	2.31E-02	6.95E-02	4.10E-01

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 5 Mechanically fastened system			GWP	AP	POCP	EP	ADP elements	ADP fossil fuel	ODP
units per FU			kg CO_2 eq	kg SO_2 eq	kg C_2H_4 eq	kg PO_4^{3-} eq	kg Sb eq	MJ eq	kg CFC11 eq
Product stage	Raw material supply	A1	4.02E-02	1.75E-04	4.52E-05	2.50E-05	7.52E-09	3.03E+00	2.00E-08
	Transport	A2	1.84E-03	8.73E-06	1.33E-06	2.01E-06	1.16E-12	2.61E-02	2.77E-10
	Manufacturing	A3	1.14E-02	1.38E-05	9.13E-06	2.22E-06	4.78E-10	1.62E-01	1.11E-09
	Total (of product stage)	A1 – A3	5.34E-02	1.97E-04	5.56E-05	2.92E-05	8.00E-09	3.22E+00	2.14E-08
Construction process stage	Transport	A4	2.37E-03	1.00E-05	1.57E-06	1.87E-06	1.97E-12	3.36E-02	3.51E-10
	Construction installation	A5	1.80E-02	7.25E-05	9.58E-06	1.47E-05	1.85E-08	4.29E-01	2.99E-09
Use stage	Refurbishment	B5	8.36E-02	3.55E-04	7.74E-05	6.12E-05	9.53E-09	4.14E+00	2.54E-08
End of life	Transport	C2	1.64E-03	8.97E-06	1.29E-06	2.10E-06	1.74E-12	2.33E-02	2.47E-10
	Waste processing	C3	1.01E-03	3.85E-06	2.71E-07	5.15E-07	2.31E-11	1.24E-02	4.73E-11
	Disposal	C4	9.20E-02	2.18E-05	3.91E-06	7.31E-06	3.11E-11	1.95E-02	1.53E-10
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-3.89E-02	-9.30E-05	-1.74E-05	-1.29E-05	-5.70E-10	-1.19E+00	-3.80E-09

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 5 Mechanically fastened system			Use of renewable primary energy excluding renewable primary energy resources used as raw materials	Use of renewable primary energy resources used as raw materials	Total use of renewable primary energy resources	Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	Use of non renewable primary energy resources used as raw materials	Total use of non renewable primary energy resources
units per FU			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	7.01E-02	2.44E-05	7.01E-02	7.30E-01	2.53E+00	3.26E+00
	Transport	A2	3.73E-05	-	3.73E-05	2.64E-02	-	2.64E-02
	Manufacturing	A3	5.29E-02	4.71E-03	5.76E-02	1.50E-01	2.06E-02	1.70E-01
	Total (of product stage)	A1 – A3	1.23E-01	4.73E-03	1.28E-01	9.06E-01	2.55E+00	3.46E+00
Construction process stage	Transport	A4	7.61E-05	-	7.61E-05	3.41E-02	-	3.41E-02
	Construction installation	A5	1.33E-02	4.26E-04	1.37E-02	2.28E-01	2.29E-01	4.57E-01
Use stage	Refurbishment	B5	1.44E-01	4.91E-03	1.49E-01	1.39E+00	3.07E+00	4.47E+00
End of life	Transport	C2	3.32E-05	-	3.32E-05	2.35E-02	-	2.35E-02
	Waste processing	C3	1.83E-03	-	1.83E-03	2.04E-02	-	2.04E-02
	Disposal	C4	8.56E-04	-	8.56E-04	2.43E-02	-	2.43E-02
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-3.39E-02	-	-3.39E-02	-1.33E+00	-	-1.33E+00

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 5 Mechanically fastened system			Use of secondary material	Use of renewable secondary fuels	Use of non renewable secondary fuels	Use of net fresh water
units per FU			kg	MJ	MJ	m^3
Product stage	Raw material supply	A1	4.41E-03	-	-	3.01E-04
	Transport	A2	-	-	-	2.15E-06
	Manufacturing	A3	9.22E-05	-	-	9.80E-05
	Total (of product stage)	A1 – A3	4.51E-03	-	-	4.01E-04
Construction process stage	Transport	A4	-	-	-	2.95E-06
	Construction installation	A5	4.05E-04	-	-	7.10E-05
Use stage	Refurbishment	B5	4.93E-03	-	-	6.13E-04
End of life	Transport	C2	-	-	-	1.91E-06
	Waste processing	C3	-	-	-	8.93E-06
	Disposal	C4	-	-	-	4.58E-05
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-	-	-	-2.15E-04

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 5 Mechanically fastened system			Hazardous waste disposed	Non hazardous waste disposed	Radioactive waste disposed
units per FU			kg	kg	kg
Product stage	Raw material supply	A1	5.45E-05	2.75E-03	4.10E-06
	Transport	A2	2.16E-07	2.16E-07	7.38E-09
	Manufacturing	A3	1.30E-05	3.78E-04	1.56E-07
	Total (of product stage)	A1 – A3	6.78E-05	3.12E-03	4.27E-06
Construction process stage	Transport	A4	4.29E-07	4.29E-07	1.56E-08
	Construction installation	A5	6.14E-06	2.34E-03	3.85E-07
Use stage	Refurbishment	B5	8.86E-05	5.64E-03	6.55E-06
End of life	Transport	C2	-	-	-
	Waste processing	C3	-	2.04E-02	-
	Disposal	C4	-	-	-
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-1.25E-07	-7.97E-06	-

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 5 Mechanically fastened system	Components for re-use	Materials for recycling	Materials for energy recovery	Exported energy
units per FU	kg	kg	kg	MJ
Output flows	-	2.38E-02	7.18E-02	4.20E-01

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 6 Loose laid with ballast system			GWP	AP	POCP	EP	ADP elements	ADP fossil fuel	ODP
units per FU			kg CO_2 eq	kg SO_2 eq	kg C_2H_4 eq	kg PO_4^{3-} eq	kg Sb eq	MJ eq	kg CFC11 eq
Product stage	Raw material supply	A1	3.70E-02	1.54E-04	3.86E-05	2.16E-05	7.61E-09	2.90E+00	1.82E-08
	Transport	A2	1.76E-03	8.35E-06	1.27E-06	1.93E-06	1.11E-12	2.50E-02	2.65E-10
	Manufacturing	A3	9.71E-03	1.33E-05	9.38E-06	2.25E-06	4.56E-10	1.61E-01	1.15E-09
	Total (of product stage)	A1 – A3	4.85E-02	1.76E-04	4.92E-05	2.57E-05	8.07E-09	3.09E+00	1.97E-08
Construction process stage	Transport	A4	2.38E-03	1.10E-05	1.62E-06	2.02E-06	2.15E-12	3.37E-02	3.51E-10
	Construction installation	A5	1.62E-02	7.18E-05	9.10E-06	1.49E-05	1.74E-09	3.72E-01	2.69E-09
Use stage	Refurbishment	B5	7.78E-02	3.14E-04	6.88E-05	5.54E-05	9.22E-09	3.93E+00	2.55E-08
End of life	Transport	C2	7.28E-03	3.98E-05	5.73E-06	9.34E-06	7.72E-12	1.03E-01	1.10E-09
	Waste processing	C3	9.18E-04	3.50E-06	2.46E-07	4.67E-07	2.09E-11	1.13E-02	4.30E-11
	Disposal	C4	8.51E-02	3.14E-05	6.44E-06	9.23E-06	3.05E-11	4.11E-02	3.43E-10
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-3.45E-02	-8.17E-05	-1.52E-05	-1.13E-05	-4.73E-10	-1.05E+00	-3.38E-09

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 6 Loose laid with ballast system			Use of renewable primary energy excluding renewable primary energy resources used as raw materials	Use of renewable primary energy resources used as raw materials	Total use of renewable primary energy resources	Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	Use of non renewable primary energy resources used as raw materials	Total use of non renewable primary energy resources
units per FU			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	5.83E-02	2.97E-05	5.83E-02	6.27E-01	2.49E+00	3.12E+00
	Transport	A2	3.56E-05	-	3.56E-05	2.52E-02	-	2.52E-02
	Manufacturing	A3	5.00E-02	4.56E-03	5.46E-02	1.46E-01	2.23E-02	1.68E-01
	Total (of product stage)	A1 – A3	1.08E-01	4.59E-03	1.13E-01	7.99E-01	2.51E+00	3.31E+00
Construction process stage	Transport	A4	8.65E-05	-	8.65E-05	3.42E-02	-	3.42E-02
	Construction installation	A5	1.79E-02	3.67E-04	1.83E-02	2.37E-01	2.01E-01	4.38E-01
Use stage	Refurbishment	B5	1.34E-01	5.00E-03	1.39E-01	1.20E+00	3.02E+00	4.22E+00
End of life	Transport	C2	1.47E-04	-	1.47E-04	1.04E-01	-	1.04E-01
	Waste processing	C3	1.66E-03	-	1.66E-03	1.85E-02	-	1.85E-02
	Disposal	C4	8.25E-04	-	8.25E-04	4.58E-02	-	4.58E-02
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-3.16E-02	-	-3.16E-02	-1.18E+00	-	-1.18E+00

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 6 Loose laid with ballast system			Use of secondary material	Use of renewable secondary fuels	Use of non renewable secondary fuels	Use of net fresh water
units per FU			kg	MJ	MJ	m^3
Product stage	Raw material supply	A1	4.54E-03	-	-	2.34E-04
	Transport	A2	-	-	-	2.05E-06
	Manufacturing	A3	7.28E-05	-	-	1.02E-04
	Total (of product stage)	A1 – A3	4.61E-03	-	-	3.37E-04
Construction process stage	Transport	A4	-	-	-	3.02E-06
	Construction installation	A5	3.69E-04	-	-	1.06E-03
Use stage	Refurbishment	B5	5.99E-03	-	-	4.81E-04
End of life	Transport	C2	-	-	-	8.50E-06
	Waste processing	C3	-	-	-	8.10E-06
	Disposal	C4	-	-	-	4.36E-05
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-	-	-	-2.94E-04

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 6 Loose laid with ballast system			Hazardous waste disposed	Non hazardous waste disposed	Radioactive waste disposed
units per FU			kg	kg	kg
Product stage	Raw material supply	A1	4.77E-05	2.67E-03	2.98E-06
	Transport	A2	2.06E-07	2.06E-07	7.05E-09
	Manufacturing	A3	1.48E-05	1.98E-04	1.67E-07
	Total (of product stage)	A1 – A3	6.27E-05	2.87E-03	3.16E-06
Construction process stage	Transport	A4	4.63E-07	4.63E-07	1.78E-08
	Construction installation	A5	5.05E-06	2.85E-03	2.54E-07
Use stage	Refurbishment	B5	7.87E-05	7.01E-03	4.21E-06
End of life	Transport	C2	-	-	-
	Waste processing	C3	-	9.08E-02	-
	Disposal	C4	-	-	-
Benefits and loads beyond the system boundaries	Reuse, recovery or recycling and/or recovery potentials	D	-1.13E-07	-7.25E-06	-

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

Environmental Performance

Multi layer - System 6 Loose laid with ballast system	Components for re-use	Materials for recycling	Materials for energy recovery	Exported energy
units per FU	kg	kg	kg	MJ
Output flows	-	2.07E-02	6.24E-02	3.74E-01

Functional **U**nit (**FU**): 1 m^2 installed roof waterproofing system with flexible sheets for roofing, with a reference building service life of 90 years
Modules from B1 to B4 and C1 were considered as not relevant for the system under study.

REFERENCE

This declaration has been developed referring to the International EPD® System, following the General Program Instruction and Supporting Annexes (ver. 2.5 -2015/05/11) and in accordance with ISO 14025 and EN 15804.

EPD of construction products may not be comparable if they do not comply with EN 15804.

Further information and the document itself are available at:
www.environdec.com.

Software: SimaPro ver. 8.0.5 (www.pre.nl)

Main database: Ecoinvent 2.2, Eurobitume, Plastics Europe.

Reference year: 2013

CONTACTS

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Technical support to EWA was provided by Life Cycle Engineering, Italy.
(info@studiolce.it, www.lcengineering.eu).

INDEPENDENT VERIFICATION	
CEN standard EN 15804 that serves as core PCR	PCR 2014:12 (version 1.0). Flexible sheets for waterproofing – bitumen, plastic or rubber sheets for roof waterproofing. UN CPC (5453) in accordance with EN 13707.
Product category rules (PCR) review conducted by	The Technical Committee of the International EPD® System Chair: Massimo Marino Contact via info@environdec.com
Product category rules (PCR) prepared by	PCR Moderator: Lodewijk Niemöller niemoller@ewa-europe.com
Independent verification of the declaration and data, according to EN ISO 14025 : 2006	☐ EPD® process certification (internal) ☒ EPD® External verification
Third party verifier	Maurizio FIESCHI (Dr.), fieschi@studiofieschi.it www.studiofieschi.it Accredited as Individual Verifier by the International EPD® System.
EPD® programme	The International EPD® System Vasagatan 15-17 se-111 20 Stockholm Sweden.
LCA report	LCA report of European flexible bitumen sheets for roof waterproofing for EPD purposes
EPD® valid within the following geographical area	Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Spain and Sweden
EPD® Type	Cradle-to-grave

GLOSSARY

GWP – Global Warming Potential: measure of potential contribution to climate change due to the amount of greenhouse gases (GHG) released by production chain processes. This contribution is measured in terms of mass of CO_2 equivalent (kg CO_2eq) and is calculated by multiplying the specific GHG emissions (mainly CO_2, N_2O, CH_4) by the specific conversion factors defined by the IPCC (www.ipcc.ch). Many protocols are available for its calculation.

AP – Acidification Potential: phenomenon by which atmospheric rainfall has a pH value below the normal average. It can provoke damage to forests and agriculture, as well as to aquatic ecosystems and manmade structures. It is the result of SO_2, of NOx, and NH_3, that are included in the Acidification Potential indicator (AP) expressed as kg SO_2eq.

EP - Eutrophication potential: nutrient enrichment of flowing water bodies, which determines unbalance in aquatic ecosystems due to excessive flourishing caused by lack of nutrient limitation. The Eutrophication potential (EP) especially includes phosphate and nitrogen salts, and is expressed as kg PO_4^{3-} eq.

ODP – Ozone Depletion Potential: degradation of the stratospheric layer of the ozone involved in blocking the UV component of sunrays. Depletion is due to particularly reactive components that originate from chlorofluorocarbon (CFC) or chlorofluoromethanes (CFM). The substance employed as benchmark measure for OPD is trichlorofluoromethane, or CFC-11 (kg CFC11 eq).

POCP - Photochemical Ozone Creation Potential: production of compounds that foster oxidation due to interaction with light, resulting in ozone formation in the troposphere. The POCP indicator mostly encompasses VOC (volatile organic compounds) and is expressed as grams of ethylene equivalent (kg C_2H_4).

ADP elements – Abiotic Depletion Potential elements: natural resources, such as iron ore, which are regarded as non-living. ADP is derived for each extraction of elements and is a relative measure with the depletion of the element "antinomy" as a reference.

ADP fossil fuel– Abiotic Depletion Potential fossil fuel: The sum of the overall fossil resources extracted for both, material and energy purposes. It is measured in MJ. Uranium energy is not taken into account.

List Of Participants

Cluster	Plant	Location
Benelux	Atab N.V.	Antwerp-Belgium
	De Boer N.V.	Schoten-Belgium
	Iko Sales International B.V.	Ham-Belgium
	Imperbel SA, Perwez	Perwez-Belgium
	Soprema N.V	Grobbendonk-Belgium
	Icopal B.V	Groningen-Netherlands
	Troelstra & De Vries B.V.	IJlst-Netherlands
EWA	Imperalum	Montijo-Portugal
	Bitbau Dörr Gmbh	Innsbruck - Austra
	Danosa, Derivados Asfálticos Normalizados S.A.	Fontanar-Spain
France	Axter	Courchelettes-France
	Meple	Tourville la Riviere-France
	Icopal-Loriol plant	Loriol-France
	Icopal-Cormenon plant	Cormenon-France
	Soprema STG	Strasbourg-France
	Soprema VDR	Val de Reuil-France
	Soprema SOR	Sorgues-France

List Of Participants

Cluster	Plant	Location
Germany	Binné & Sohn GmbH & Co. KG	Pinneberg-Germany
	Georg Börner Chemisches Werk für Dach- und Bautenschutz GmbH & Co. KG	Bad Hersfeld-Germany
	Dapa GmbH	Magdeburg-Germany
	Emder Dachpappenfabrik Arthur Hille GmbH & Co. KG	Emden-Germany
	C. Hasse & Sohn Inh. E. Rädecke GmbH & Co. KG	Uelzen-Germany
	Icopal GmbH	Saarwellingen-Germany
	Mogat-Werke Adolf Böving GmbH	Mainz-Germany
	Paul Bauder GmbH & Co. KG	Stuttgart-Germany
	W. Quandt GmbH & Co. KG	Berlin-Germany
	Soprema-KLEWA GmbH	Burbach-Wahlbach-Germany
	Vedag GmbH	Bamberg-Germany
Italy	Polyglass S.p.A.	Negrisia di Ponte di Piave - Italy
	Novaglass S.p.A	Salgareda- Italy
	Copernit S.p.A.	Pegognaga - Italy
	Index Construction Systems and Products S.p.A	Castel D'Azzano -Italy
	Pluvitec S.p.A.	Ronco all' Adige-Italy
	General Membrane S.p.A.	Ceggia - Italy
	Valli Zabban S.p.A.	Tre Castelli - Italy
Nordic	Icopal AB	Malmö-Sweden
	Icopal Danmark a/s	Ikast-Denmark
	Katepal Oy	Lempäälä-Finland
	Nordic waterproofing AB	Höganäs-Sweden
	Nordic waterproofing A/S	Vejen-Denmark
	Nordic Waterproofing Oy	Lohja - Finland
	Icopal Oy	Espoo-Finland