European Waterproofing Association AISBL

ENVIRONMENTAL PRODUCT DECLARATION

Shingles For Pitched-roof Covering – sector EPD

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

European **W**aterproofing **A**ssociation

BASED ON:
PCR 2019:14 (version 1.11).
2021-02-05
Construction products
UN CPC (5453)

VERSION:
1

REGISTRATION NUMBERS
International EPD® System:
S-P-03375

REGISTRATION DATE:
2021/04/15

VALID UNTIL:
2026/04/14

Geographical scope:
EWA members in: Finland, Lithuania, Italy, Norway, Poland, Russia, Slovakia, Turkey

REFERENCES

EPD owner: European Waterproofing Association AISBL Boulevard du Souverain 68B – 1170 Brussels BELGIUM

Program operator: EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden

INDEPENDENT VERIFICATION

This declaration has been developed referring to the International EPD System, following the General Programme Instructions version 3.01; further information and the document itself are available at: www.environdec.com

CEN standard EN 15804 serves as the core the Product Category Rules PCR (PCR 2019:14 Construction products, Version 1.11, 2021-02-05) PCR review was conducted by the Technical Committee of the International EPD® System. See www.environdec.com/TC for a list of members. Review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact.

Independent third-party verification of the declaration and data, according to EN ISO 14025:2010
☐ EPD process certification (Internal)
☑ EPD verification (External): Ugo Pretato, Accredited as Individual Verifier by the International EPD® System.

Procedure for follow-up during EPD validity involves third party verifier
☐ Yes
☑ No

According to ISO 14025 "EPDs within the same product category but from different programmes may not be comparable".
According to EN 15804 "EPDs of construction products may not be comparable if they do not comply with EN 15804".

CONTACTS

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

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 the bituminous shingles 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 SHINGLES

Bituminous shingles are flexible coloured bituminous waterproofing material for pitched-roof coverage, available in different shapes.

Bituminous shingles are technically defined by EN 544:2011 and European Technical Assessment (ETA). Bituminous shingles are waterproof roofing material used on pitched roofs. They are available in many shapes and colors, simple to install and known worldwide. Bituminous shingles are the ideal roofing material for new buildings and renovation projects. Shingles roofing is an elegant, traditional roofing that gives the roof a nice and exclusive appearance.

The LCA study was developed clustering the different shingles presented by the partners into one single category.

Below, most common shingle shapes are presented.

Hexagonal shingle

Laminated shingle

Rectangular 4-tab shingle

PRODUCT SPECIFICATION

Specific weight (kg/m^2)		7 - 14	
Thickness (mm)		2.6 - 6	
COMPONENT	**WT. %**	**% RECYCLED**	**% RENEWABLE**
Finishing (Granules, slate)	30 – 45	0	0
Bitumen (Bitumen, oxidised bitumen)	20 – 35	0	0
Filler (Limestone, sand)	25 – 40	0	0
Reinforcement (Glass mat)	1 – 5	0	0
Polymer (Polyolefins, SBS)	0 – 15	0 - 100	0
Others (resins)	1 – 10	0	0

Product studied do not contain substances listed in the "Candidate List of Substances of Very High Concern" (SVHC).

PACKAGING SPECIFICATION

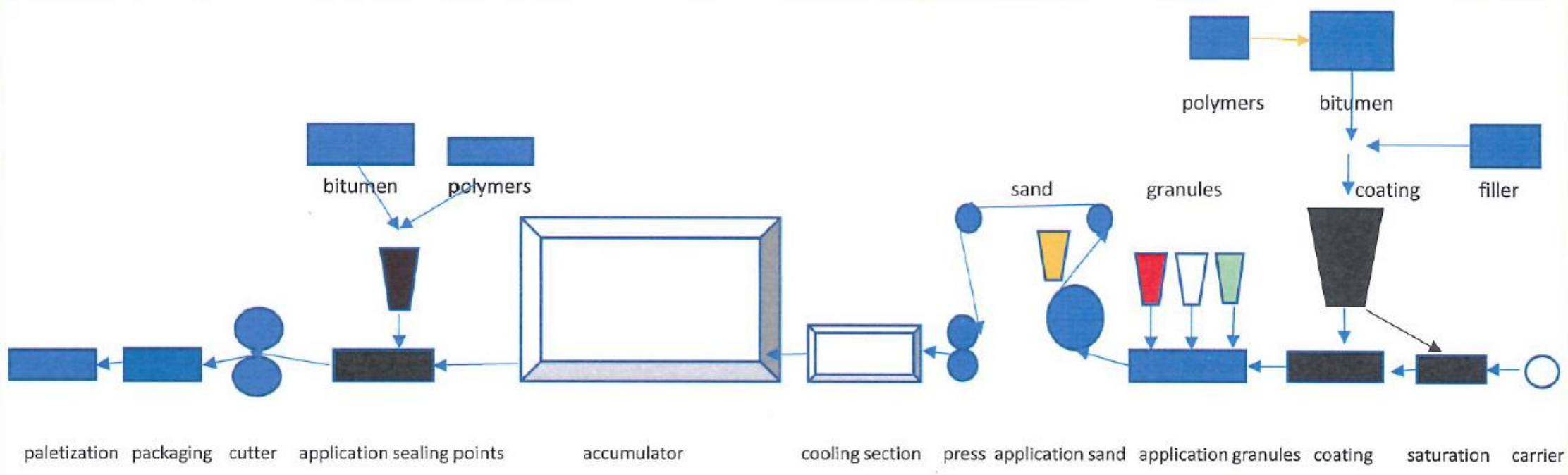
COMPONENT	kg/m²	% RECYCLED	% RENEWABLE
Cardboard	0.1 – 0.3	89 (FEFCO 2019)	100
PE film	0.01- 0.03	0	0
Wooden pallet	0.1 – 0.2	0	100

BIOGENIC CARBON CONTENT	kg C/m²
In product	0
In packaging	0.09 – 0.20

PRODUCTION PROCESS

Bituminous shingle sheets are produced by a continuous process as illustrated below.

The manufacturing process begins with saturation and coating of fiberglass carrier by filled bituminous compounds (oxidised bitumen or polymers modified bitumen). Colored granules or slate are added to the top of surface, an anti-adherent agent in the bottom surface. Bituminous adhesive areas are applied to guarantee bonding of tabs after application. After shingles are cut to obtain the desired shape, packaged and palletized ready for shipment.

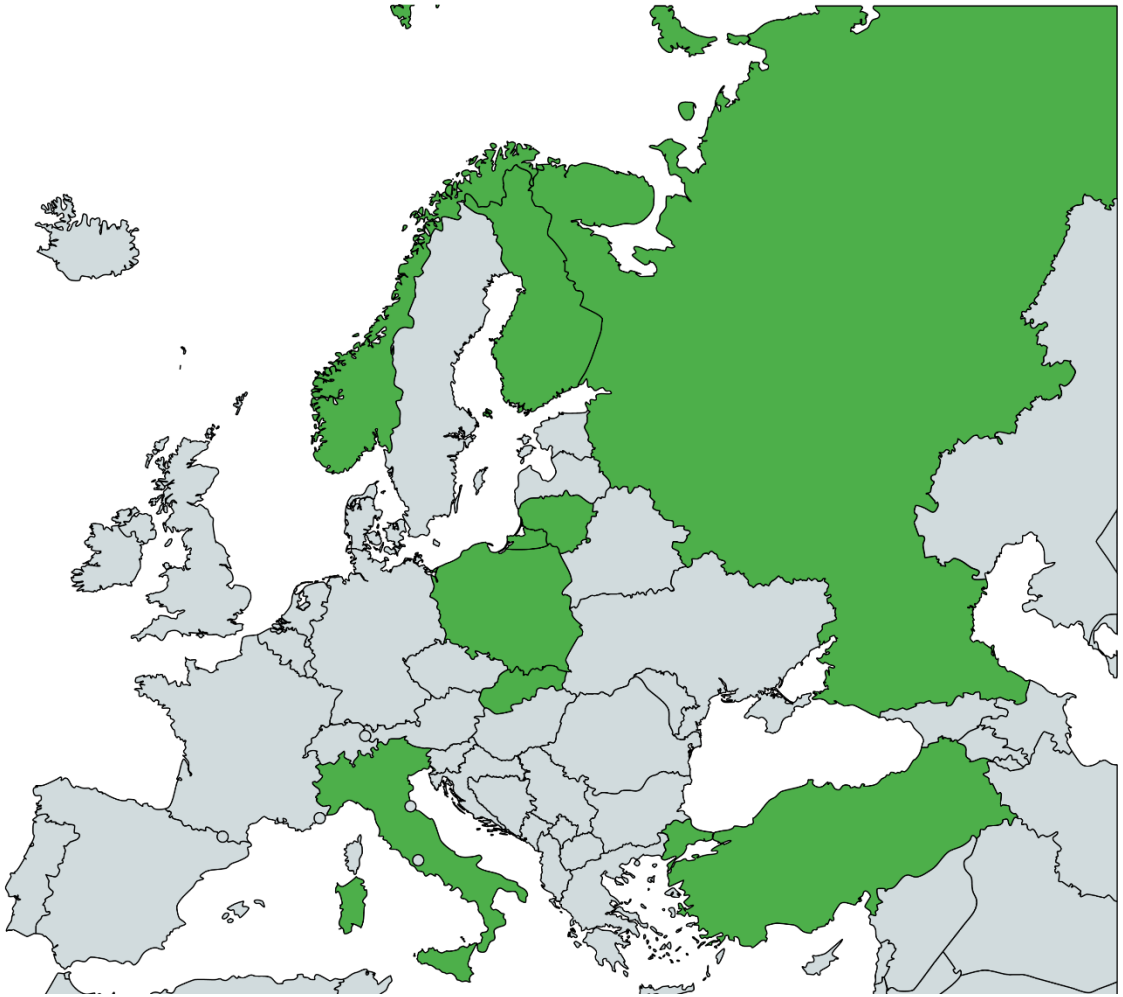


SECTORIAL EPD - PARTICIPANTS

A total of 9 plants participated to the EPD data collection phase (further details reported in Appendix). Manufacturing plants are placed in Norway, Finland, Poland, Slovakia, Italy, Lithuania, Russia and Turkey. Production sites involved in manufacturing of widely-sold products in the EU market were selected by partners for this study.

Seven EWA shingle-producer members out of eight participated in the data collection for the EPD (percentage of representativeness ca. 90%).

The results presented in this EPD are representative exclusively for the members participating in this study.



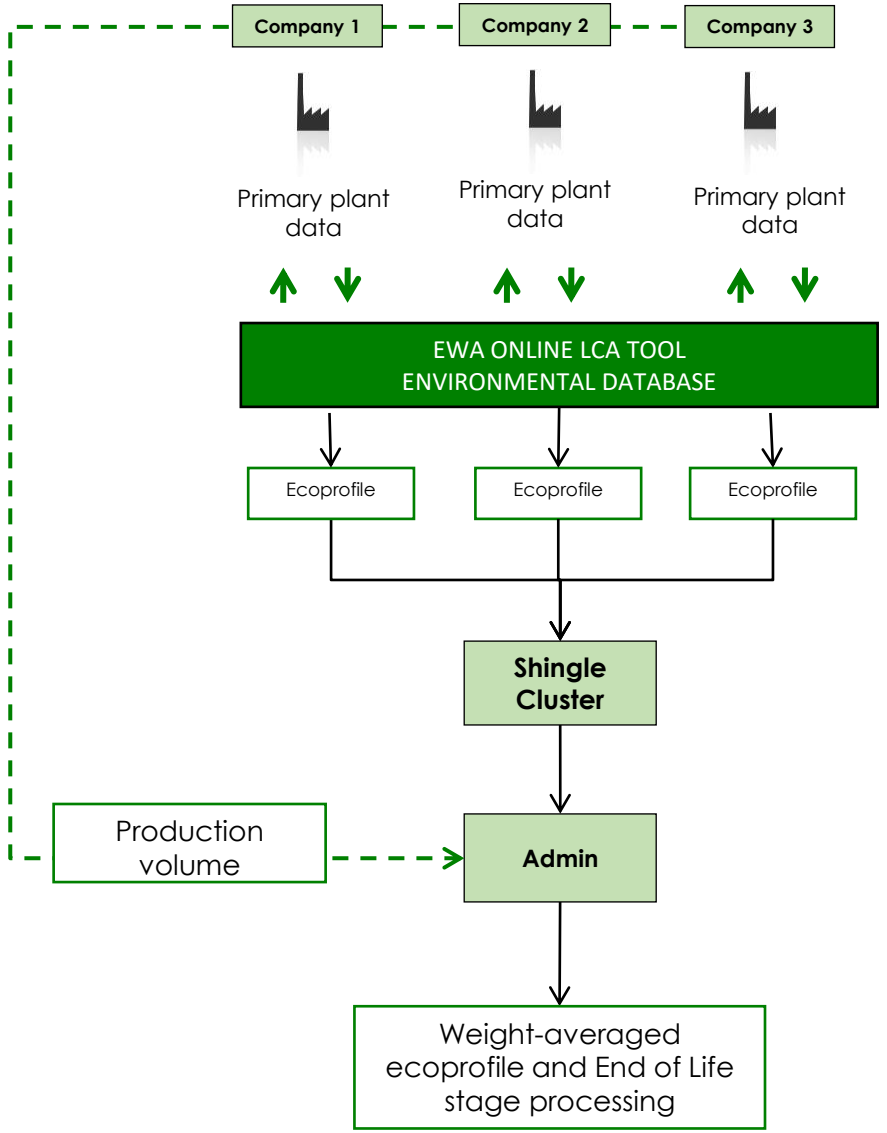
EWA ONLINE LCA TOOL AND DATA COLLECTION

EWA has developed, in close co-operation with **L**ife **C**ycle **E**ngineering (**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.

Primary data were collected from the 9 production plants by means of the EWA on-line tool. Only one set of environmental results is presented in the EPD, as a weighted average based on each company production volume of shingles ready to be installed. Picture besides explains the structure of the tool and the averaging method

The allocation procedure follows the rules established by PCR 2019:14 v1.11 (ch. 4.5).

The reference year is **2019**.



TECHNICAL SPECIFICATIONS OF THE EPD®

GEOGRAPHICAL SCOPE: Europe
DECLARED UNIT (DU): 1 square metre (m^2) of roof covered by shingles
TYPE OF EPD: Cradle-to-gate with module C1-C4 and module D. The list of life-cycle stages is indicated in the table below, according to EN 15804

Information regarding results variations between production sites and products composition – compared with the average product declared – are presented in page 16.

	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE						END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Decostruction, demolition	Transport	Waste processing	Disposal	Reuse-recovery-recycling potential
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	✓	✓	✓	ND	ND	ND	ND	ND	ND	ND	ND	ND	✓ *	✓	✓	✓	✓
Geography	EU	EU	EU	-	-	-	-	-	-	-	-	-	-	EU	EU	EU	EU
Specific data used	>90%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

✓ = Module assessed; ND = Module not declared

REPRESENTATIVE YEAR FOR MANUFACTURING DATA: 2019
SOFTWARE: SimaPro version 9
DATABASE: Ecoinvent 3,6, Plastics Europe

* Module however not declared, due to the cut-off. See page 13 for further information

LIST OF CORE AND ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS

The following table shows the core and additional environmental impact indicators evaluated per each product studied, along with the disclaimers to be considered for part of them

ILCD CLASSIFICATION	INDICATOR	DISCLAIMER
ILCD Type 1	Global warming potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
ILCD Type 2	Acidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD Type 3	Abiotic depletion potential for non-fossil resources (ADP-m&m)	2
	Abiotic depletion potential for fossil resources (ADP-f)	2
	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans (HTP-c)	2
	Potential Comparative Toxic Unit for humans (HTP-nc)	2
	Potential Soil quality index (SQP)	2

Disclaimer 1 This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health
of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to
radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some
construction materials is also not measured by this indicator.

Disclaimer 2 The results of this environmental impact indicator shall be used with care as the uncertainties on these
results are high or as there is limited experienced with the indicator.

LIFE CYCLE IMPACT ASSESSMENT

Potential environmental impacts *

POTENTIAL ENVIRONMENTAL IMPACTS	UNITS PER DU	A1	A2	A3	C2	C3	C4	D
GWP-total	kg CO2 eq	5.11E+00	1.37E-01	2.75E-01	1.13E-01	0.00E+00	6.13E-01	0.00E+00
GWP-fossil	kg CO2 eq	5.06E+00	1.37E-01	7.17E-01	1.13E-01	0.00E+00	6.12E-01	0.00E+00
GWP-biogenic	kg CO2 eq	3.67E-02	5.59E-05	-4.42E-01†	5.59E-05	0.00E+00	9.31E-04	0.00E+00
GWP-luluc	kg CO2 eq	1.03E-02	1.08E-06	3.41E-04	4.86E-05	0.00E+00	4.77E-05	0.00E+00
GWP-GHG	kg CO2 eq	5.08E+00	1.37E-01	7.20E-01	1.13E-01	0.00E+00	6.13E-01	0.00E+00
ODP	kg CFC11 eq	2.28E-06	3.16E-08	9.10E-08	2.49E-08	0.00E+00	3.39E-08	0.00E+00
AP	mol H+ eq	3.69E-02	8.98E-04	1.69E-03	4.53E-04	0.00E+00	1.12E-03	0.00E+00
EP-freshwater[1]	kg P eq	1.86E-04	8.10E-08	7.08E-06	1.03E-06	0.00E+00	1.83E-06	0.00E+00
EP-marine	kg N eq	6.74E-03	3.75E-04	4.92E-04	1.29E-04	0.00E+00	7.14E-04	0.00E+00
EP-terrestrial	mol N eq	7.46E-02	4.11E-03	5.22E-03	1.43E-03	0.00E+00	3.47E-03	0.00E+00
POCP	kg NMVOC eq	2.65E-02	1.06E-03	2.07E-03	4.41E-04	0.00E+00	1.13E-03	0.00E+00
ADP-minerals&metals	kg Sb eq	4.97E-04	8.03E-09	1.35E-07	4.05E-06	0.00E+00	1.13E-06	0.00E+00
ADP-fossil	MJ	1.79E+02	1.93E+00	1.23E+01	1.68E+00	0.00E+00	2.57E+00	0.00E+00
WDP	m3 world eq. deprived	9.47E+00	-4.25E-04 ‡	1.11E-01	5.16E-03	0.00E+00	9.93E-02	0.00E+00

DU: 1 square metre (m2) of roof covered by shingles

[1] Due to a typographical error in EN 15804:2021+A2:2019, PCR 2019:14 indicates that results shall be given in both kg $PO4_{eq}$ and kg P_{eq}. Results are here presented only as kg P_{eq}. To obtain the value in kg $PO4_{eq}$ multiply by 3.07 (as indicated in PCR 2019:14)

† Negative value due to carbon uptake from vegetal feedstocks growing for packaging production (cardboard/pallet). According to EN 15804:2019 , emissions of the same amount of carbon must be accounted in module A5 "installation", when packaging end-of-life is assessed. That module was however not considered within the system boundaries of this study.

‡ negative value due water flows accounting of the AWARE method used to calculate water depletion potential. An input of marine salt water is used in the transport process inventory of A2 module, along with an output of freshwater. However, the former is not considered from the AWARE method, hence highlighting a credit for returning freshwater to nature, but not the impact of withdrawing it in the first place.

* See Annex A for information on the indicators abbreviations

LIFE CYCLE IMPACT ASSESSMENT

Potential additional environmental impacts *

POTENTIAL ENVIRONMENTAL IMPACTS	UNITS PER DU	A1	A2	A3	C2	C3	C4	D
PM	Disease incidence (No.)	6.85E-06	1.62E-08	1.59E-08	6.87E-09	0.00E+00	1.78E-08	0.00E+00
IRP	kBq U235 eq	7.74E-01	8.49E-03	1.20E-02	7.35E-03	0.00E+00	1.04E-02	0.00E+00
ETP-fw	CTUe	9.22E+01	8.38E-01	2.81E+00	1.42E+00	0.00E+00	2.65E+00	0.00E+00
HTP-c	CTUh	1.74E-09	4.38E-11	1.10E-09	4.41E-11	0.00E+00	6.81E-11	0.00E+00
HTP-nc	CTUh	7.77E-08	2.01E-09	6.12E-09	1.50E-09	0.00E+00	1.49E-09	0.00E+00
SQP	(-)	6.80E+00	4.79E-03	3.79E+01	9.99E-01	0.00E+00	6.13E+00	0.00E+00

DU: 1 square metre (m2) of roof covered by shingles

* See Annex A for information on the indicators abbreviations

LIFE CYCLE IMPACT ASSESSMENT

Use of resources *

USE OF RESOURCES	UNITS PER DU	A1	A2	A3	C2	C3	C4	D
PERE	MJ	5.01E+00	2.70E-03	2.02E+00	2.86E-02	0.00E+00	5.28E-02	0.00E+00
PERM	MJ	0.00E+00	0.00E+00	3.63E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	5.01E+00	2.70E-03	5.65E+00	2.86E-02	0.00E+00	5.28E-02	0.00E+00
PENRE	MJ	8.57E+01	1.93E+00	1.20E+01	1.70E+00	0.00E+00	2.64E+00	0.00E+00
PENRM	MJ	1.03E+02	0.00E+00	1.50E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.88E+02	1.93E+00	1.36E+01	1.70E+00	0.00E+00	2.64E+00	0.00E+00
SM	kg	6.21E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.38E-01	3.82E-05	2.98E-03	2.26E-04	0.00E+00	0.002764	0.00E+00

DU: 1 square metre (m2) of roof covered by shingles

* See Annex B for information on the indicators abbreviations

LIFE CYCLE IMPACT ASSESSMENT

Other indicators describing waste categories *

OUTPUT FLOWS	UNITS PER DU	A1	A2	A3	C2	C4
HWD	kg	6.77E-06	0.00E+00	1.58E-03	0.00E+00	0.00E+00
NHWD	kg	9.15E-04	0.00E+00	2.17E-01	0.00E+00	1.05E+01
RWD	kg	4.51E-03	5.61E-05	4.95E-05	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	3.01E-02	0.00E+00	0.00E+00
EE	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

DU: 1 square metre (m2) of roof covered by shingles

* See Annex B for information on the indicators abbreviations

CALCULATION RULES AND HYPOTHESES

DATABASE
The database used to model the various raw materials and processes is EcoInvent 3.6, the most updated version of the data bank. No primary data from raw materials suppliers were collected.

CUT-OFF RULES
LCA model has been processed considering all main input/output associated with core process in accordance with the threshold valued stated in EN 15804 (§ 6.3.6), namely the sum of the excluded material flows to the core module shall not exceed 1% of mass and energy.

Hence, the following aspects were considered negligible:
- Production of packaging for the raw materials input transport process
- Machinery production
- Deconstruction, demolition (C1) life cycle stage

ALLOCATION
Allocation occurs anytime a system is producing more than a single output. In this case it is necessary to choose a technique to proper split the environmental burdens among the output flows; international standards ISO 14044 and PCR 2019:14 v 1.11 provide guidelines about how to deal with this issue, that have been implemented in this project as well. EWA members produce several product types that are not object of the study. Therefore, it is important to establish an allocation method based on physical variables to split input and output flows to the multi-products: allocation by square metres of plant products was chosen as most representative tool for the system understudy.

TRANSPORTATION
Impacts calculations related to transports in SimaPro are performed according to the EcoInvent model. For module A2, average transportation distances are considered, performed only by truck.

ELECTRIC ENERGY MODEL
Electricity mix model combines the already-existing Ecoinvent 3.6 European mix, the Russian Federation mix and the Turkey mix. The different mixes are combined on the basis of the electricity production volumes. As a result, 1 kWh of electricity by EWA Electricity mix is produced 65% by fossil fuels and 35% by renewables. The contribution of the electricity energy mix on the overall impact of stages A1 to A3 is less than 10%, so the documentation is not necessary here.

LIFE-CYCLE STAGES CONSIDERED

A1 (Upstream process)
- Raw materials supply
- Generation of electricity as European mix (0.48 kg $CO_{2,eq}$/kWh)
- NG supply for internal heat generators
- Diesel supply for internal transportations

A2 + A3 (Core process)
- Raw materials transport to plants by truck (A2)
- Manufacturing process
- Heat production from internal generators
- Water usage; emissions to air
- Manufacturing process waste treatment

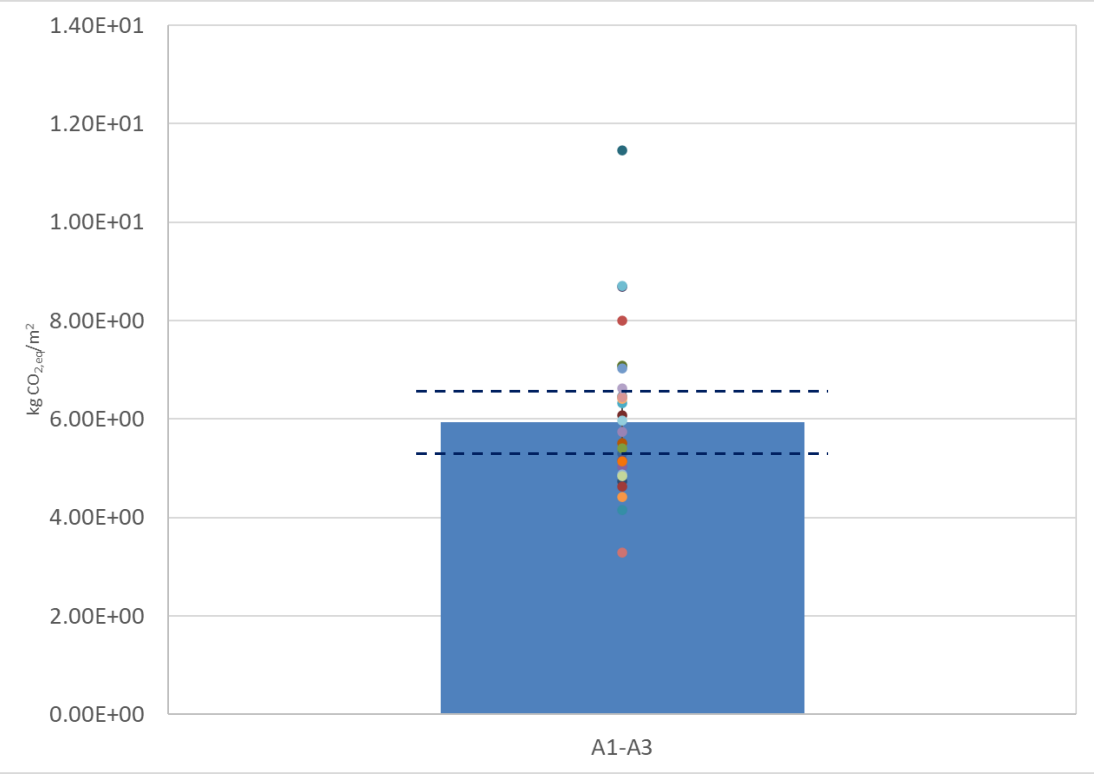
PRODUCT STAGE

C2
- Out-of-service shingles transportation to treatment sites by truck (50 km hypothesys)

C4
- Sanitary landfilling operations (100% of the product)

END OF LIFE STAGE

GWP-GHG VARIATION FROM AVERAGE ECOPROFILE (A1-A3 MODULES)



19 products' GWP-GHG indicator out of 29 differ more than ± 10% from the A1-A3 average product value. As indicated in PCR 2019:14 § 4.6.3, these variation and its origin are to be reported in the EPD.

The products' GWP-GHG vary from - 45% to + 93% (namely, from half to twice the average value). The reason behind this variation is the wide difference in specific raw materials consumption between products, that is much likely to occur because of the different specific weight of the analysed shingles. As indicated in page 4 the products specific weight may range from 7 – 14 kg/m².

REFERENCE

- ISO 14025: 2010 "Environmental labels and declarations – Type III environmental declarations"
- ISO 14040:2006 "Environmental Management, Life Cycle Assessment – Principle and framework"
- ISO 14044:2017 "Environmental Management, Life Cycle Assessment – Requirements and guidelines"
- General Programme Instructions for the International EPD® System 3.01 (2019-09-18)
- EN 15804: 2012+A2:2019 "Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products"
- EN 544:2011 "Bitumen shingle with mineral and/or synthetic reinforcement"
- PCR "Construction products" – 2019: 14 version 1.11 (date 2021-02-05)
- G.L. Baldo, M. Marino, S. Rossi "Analisi del ciclo di vita LCA – nuova edizione aggiornata" Edizioni Ambiente, 2008
- EWA bituminous shingles LCA report 2021

LIST OF PARTICIPANTS

COMPANY	PLANT
BMI Group	BMI Icopal roofing plant and warehouse Läntinen Teollisuuskatu 13, 02920 Espoo tel. 020 7436 282
	BMI Icopal SP Z O O Ul. Łaska 169/197 Zduńska Wola, ŁÓDZKIE, 98-220 Poland
BTM	Kemalpaşa Organize Sanayi Bölgesi Mah. Gazi Bulvarı. No:183, 35170, Kemalpaşa, İzmir ,Turkey
IKO	IKO Sales International NV, Kaplinské Pole 16, 905 01 Senica, Slovakia
Isola	Isola AS, Prestemoen 9, 3946 Porsgrunn, Norway
Katepal	Katepal Oy, Lempäälä, Finland
Technonicol	Mida LT UAB, Gamyklos 19, LT-96155 Gargzdai, Lithuania
	Zavod Shinglas LLC, Vostochniy Promuzel 21, bldg. 58, Ryazan, 390000, Russia
Tegola Canadese	Via dell'industria 21, Vittorio Veneto, 31029, Italy

ANNEX A

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ENVIRONMENTAL IMPACT CATEGORIES AND INDICATORS

CORE ENVIRONMENTAL IMPACT INDICATORS

Abbreviation	Impact category	Indicator
GWP-total	Climate change - total	Global Warming Potential total
GWP-fossil	Climate change - fossil	Global Warming Potential fossil fuels
GWP-biogenic	Climate change - biogenic	Global Warming Potential biogenic
GWP-luluc	Climate change – land use and land use change	Global Warming Potential land use and land use change
ODP	Ozone Depletion	Depletion potential of the stratospheric ozone layer
AP	Acidification	Acidification potential, Accumulated Exceedance
EP-freshwater	Eutrophication aquatic freshwater	Eutrophication potential, fraction of nutrients reaching freshwater end compartment
EP-marine	Eutrophication aquatic marine	Eutrophication potential, fraction of nutrients reaching marine end compartment
EP-terrestrials	Eutrophication terrestrial	Eutrophication potential, Accumulated Exceedance
POCP	Photochemical ozone formation	Formation potential of tropospheric ozone
ADP-minerals&metals	Depletion of abiotic resources – minerals and metals	Abiotic depletion potential for non-fossil resources
ADP-fossil	Depletion of abiotic resources – fossil fuels	Abiotic depletion potential for fossil resources
WDP	Water use	Water (user) deprivation potential, deprivation-weighted water consumption

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS

Abbreviation	Impact category	Indicator
PM	Particulate matter emissions	Potential incidence of disease due to PM emissions
IRP	Ionising radiation, human health	Potential Human exposure efficiency relative to U235
ETP-fw	Ecotoxicity (freshwater)	Potential Comparative Toxic Unit for ecosystems
HTP-c	Human toxicity, cancer effects	Potential Comparative Toxic Unit for humans
HTP-nc	Human toxicity, non-cancer effects	Potential Comparative Toxic Unit for humans
SQP	Land use related impacts / soil quality	Potential Soil quality index

ANNEX B

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INDICATORS DESCRIBING RESOURCE USE AND OUTPUT FLOWS BASED ON LIFE CYCLE INVENTORY

USE OF RESOURCES INDICATORS

Abbreviation	Indicator
PERE	Use of renewable primary energy excluding renewable primary energy resources used as raw materials
PERM	Use of renewable primary energy resources used as raw materials
PERT	Total use of renewable primary energy resources
PENRE	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials
PENRM	Use of non-renewable primary energy resources used as raw materials
PENRT	Total use of non-renewable primary energy resources
SM	Use of secondary raw materials
RSF	Use of renewable secondary fuels
NRSF	Use of non-renewable secondary fuels
FW	Use of net fresh water

OUTPUT FLOWS INDICATORS

Abbreviation	Indicator
HWD	Hazardous waste disposed
NHWD	Non-hazardous waste disposed
RWD	Radioactive waste disposed
CRU	Components for re-use
MFR	Materials for recycling
MER	Materials for energy recovery
EE	Exported energy