ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	KNAUF INSULATION
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
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URBANSCAPE Extensive Green Roof System

KNAUF INSULATION

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD EN 15804 VERIFIED

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General Information

Name of the manufacturer	KNAUF INSULATION
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the Declaration** KNAUF INSULATION Rue de Maestricht 95 4600 Visé Belgium
Declaration number EPD-KNI-20160071-CBA1-EN	**Declared product / Declared unit** 1 m² of URBANSCAPE Extensive Green Roof
This Declaration is based on the Product Category Rules: Pre-vegetated green roof systems for extensive use, 03.2016 (PCR tested and approved by the SVR)	**Scope:** URBANSCAPE Extensive Green Roof is an innovative instant green roof product. The product is made of three basic components: sedum blanket, Green roll and drainage layer. The Green roll is the growing media and is made of Mineral Wool without any binder. The manufacturing plant for the Mineral Wool is KNAUF INSULATION plant of Skofja Loka in Slovenia. The sedum blankets are cultivated in Netherlands. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Issue date 5/30/2016	**Verification** The CEN Norm /EN 15804/ serves as the core PCR Independent verification of the declaration according to /ISO 14025/ ☐ internally ☒ externally
Valid to 5/29/2021	
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	
Dr. Burkhart Lehmann (Managing Director IBU)	Matthias Schulz (Independent verifier appointed by SVR)

Product

Product description
This pre-vegetated green roof system for extensive use consists of a mix of three layers. Starting from the top, the pre-vegetated layer with up to 12 different species of sedums, the mineral wool growing media and the drainage. If needed, depending on the roof quality, an additional root barrier membrane can be added underneath the system. This kind of green roof is defined as instant green roof as vegetation is covering at least 95% of substrate media directly at installation.

The sedum-mix blanket is extensively cultivated in open fields in order to allow further same extensive use on the roofs. The sebaceous sedum plants are adept at storing water in their leaves and are therefore extremely suitable for varying weather conditions. The mix of different species provides a diverse leaves and flowers dense cover throughout the year. Local micro-fauna is enhanced and people feel more comfortable with this kind of green view.

The Green roll multi-functional growing media made of mineral wool stable felt is an open structure of substrate promoting extensive roots distribution and plant growth. The mineral wool is binder-free in order to avoid any toxicity effects to the vegetation roots and made of virgin rock fibers. It is up to ten times lighter than other regular green roof substrates. The Green roll can be of different thicknesses but the most common is the 40 mm thickness which has been selected for this life cycle assessment calculation.

The drainage layer is a high performance CE-marked drainage system with a dimple design made out of 100% recycled high impact polystyrene (HIPS). Protection fleece attached to the drainage can be used as waterproofing protection layer when facing down or as a separation layer when facing up.

Application
URBANSCAPE Extensive Green Roof System is an innovative, lightweight and easy to install system with high water retention capacity designed specifically for green roofs on residential, non-residential and industrial buildings in urban areas.

Technical Data
URBANSCAPE Extensive Green Roof System meets a number of technical requirements. The most important ones are summarized in the table here below which also includes references to testing methods.

Constructional data

Name	Value	Unit
water storage capacity	65	Vol.-%
System sound absorption (/EN ISO 10140-1 // EN ISO 10140-2)/	57	dB
System height	93	mm
System weight saturated	60.2	kg/m²
System weigth unsaturated (dry)	20.5	kg/m²
Retention (System maximum water retention capacity)	39.6	l/m²
pH value of the growing media (CaCl2)	7.5	-
Fire resistance class for growing media (EN 13501-1)	A1	-
salt content of the growing media (KCl)	0.3	g/l

Base materials / Ancillary materials
URBANSCAPE Extensive Green Roof System is made of three different layers. The sedum-blanket is composed up to 12 different species of sedums, of a bio-degradable net and of lightweight substrate with organic and inorganic components.
The growing media is made of mineral wool . Raw materials used in the production of Mineral Wool are diabaze (a rock that is similar to volcanic rock bazalt), dolomite and briquettes. Additionally, coke is also added in the cupola as an energy carrier. The drainage system is made out of 100% recycled high impact polystyrene and a Protection fleece non-woven geotextile.

Reference service life
The Reference Service Life (RSL) or durability of URBANSCAPE Extensive Green Roof can be with proper maintenance as long as the lifetime of the roof on which it is installed.

LCA: Calculation rules

Declared Unit
The declared unit is 1 m² of URBANSCAPE Extensive Green Roof System including the 3 components sedum-blanket, Green roll and drainage layer. Potential root barrier, protection layer or waterproof membrane are not considered into this specific EPD as those additional layers depends on the existing roof quality. However, the quality of the roof should be most of the time sufficient to avoid adding any additional layers to the proposed 3 components of the Urbanscape System. Green roll production plant data are for complete year 2013. Background databases are GaBi datasets with last update 2016.

Declared unit

Name	Value	Unit
Grammage (as balanced)	23.34	kg/m²
Conversion factor to 1 kg	0.0428	-
Declared unit	1	m²

System boundary
The system boundary of the EPD follows the modular approach defined by /EN 15804/.
The type of EPD is cradle-to-gate-with options.

List and explanation of the modules declared in the EPD.

The product stage (A1-A3) includes:
- A1 - raw material extraction and processing, processing of secondary material input (e.g. recycling processes),
- A2 - transport to the manufacturer,
- A3 - manufacturing.

This includes provision of all materials, products and energy, packaging processing and its transport, as well as waste processing up to the end-of waste state or disposal of final residues during the product stage. The LCA results are given in an aggregated form for the product stage, meaning that the modules A1, A2 and A3 are considered as a **unique module A1-A3**.

The construction process stage includes:
- A4 - transport to the construction site and
- A5 - installation into the building.

The transport to the building site (A4) is included in the LCA calculation. For the considered product, the average transport distance is assumed to be 600 km with a truck capacity utilization of 70%.
Module A5 has been included and declared in this EPD. The treatment of the products losses and the packaging waste after the installation of the product have been considered.

The use stage:
The sequestration of CO_2 by the sedum species has been considered for the 50 years of product's considered life. This sequestrated carbon will be released during composting. Because they are specific to the building, its use and location, none of the modules related to the building fabric (B2-B5) nor the operation of the building (B6 and B7) have been taken into account in this EPD.

The end-of-life stage includes:
- C1 - de-construction, demolition,
- C2 - transport to waste processing,
- C3 - waste processing for reuse, recovery and/or recycling including composting and
- C4 - disposal.

This includes provision of all transports, materials, products and related energy and water use. Only modules C2, C3 and C4 are reported, as they are considered the most relevant scenarios.
At the end-of-life, it is assumed that the sedum-blanket and the Green roll are composted, the drainage polystyrene is recycled and the fleece is incinerated.

Module D includes reuse, recovery and/or recycling potentials. According to /EN 15804/, any declared benefits and loads from net flows leaving the product system not allocated as co-products and having passed the end-of-waste state shall be included in module D. Module D is included in the background model for benefits and loads from packaging from installation and fleece from end-of-life. Incineration is giving benefits for energy recovery (steam and electricity generation).

Comparability
Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.

The model has been set-up with help of software GaBi version 7.2. and relevant datasets with last update beginning 2016.

LCA: Scenarios and additional technical information

The following technical information can be used for the development of specific scenarios in the context of a building assessment.

Transport to the building site (A4)

Name	Value	Unit
Litres of fuel (per kg transported)	0.0025	l/100km
Transport distance	600	km
Capacity utilisation (including empty runs)	70	%
Gross density of products transported	NA	kg/m^3
Capacity utilisation volume factor in %	90	-

Installation into the building (A5)

Name	Value	Unit
Auxiliary	0	kg
Water consumption	0	m^3
Other resources	0	kg
Electricity consumption	0	kWh
Other energy carriers	0	MJ
Material loss product	0.466	kg
Output substances following waste treatment on site packaging	1.02	kg
Dust in the air	0	kg
VOC in the air	0	kg

Use or application of the installed product (B1)
see section 2.12 "Use"

Name	Value	Unit
CO2 sequestration	15	kg CO2

Reference service life

Name	Value	Unit
Reference service life	50	a

End of life (C1-C4)

Name	Value	Unit
Collected separately	0	kg
Collected as mixed construction waste	0	kg
Reuse	0	kg
Recycling	0.484	kg
Energy recovery	0.156	kg
Landfilling	0	kg
Composting	22.53	Kg

LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction 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
X	X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² URBANSCAPE Extensive Green Roof System

Parameter	Unit	A1-A3	A4	A5	B1	C2	C3	C4	D
GWP	[kg CO_2-Eq.]	3.97E+0	6.68E-1	2.02E+0	-1.50E+1	5.33E-2	1.96E+1	5.03E-1	-1.78E+0
ODP	[kg CFC11-Eq.]	3.74E-10	3.07E-12	1.41E-10	0.00E+0	2.45E-13	1.01E-11	4.32E-10	-3.20E-10
AP	[kg SO_2-Eq.]	2.44E-2	1.65E-3	6.64E-4	0.00E+0	1.31E-4	1.94E-3	4.29E-5	-2.63E-3
EP	[kg $(PO_4)^{3-}$-Eq.]	3.86E-3	3.81E-4	1.14E-4	0.00E+0	3.04E-5	5.12E-4	7.62E-6	-3.17E-4
POCP	[kg ethene-Eq.]	1.51E-3	-4.62E-4	5.30E-5	0.00E+0	-3.69E-5	2.88E-4	4.34E-6	-2.67E-4
ADPE	[kg Sb-Eq.]	1.35E-6	4.45E-8	4.46E-8	0.00E+0	3.55E-9	2.97E-7	2.36E-9	-4.32E-7
ADPF	[MJ]	7.80E+1	9.20E+0	1.78E+0	0.00E+0	7.34E-1	5.73E+0	7.65E-2	-2.23E+1

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources

RESULTS OF THE LCA - RESOURCE USE: 1 m² URBANSCAPE Extensive Green Roof System

Parameter	Unit	A1-A3	A4	A5	B1	C2	C3	C4	D
PERE	[MJ]	17.70	-	-	0.00	-	-	-	-
PERM	[MJ]	4.98	-	-	0.00	-	-	-	-
PERT	[MJ]	2.27E+1	5.23E-1	2.69E-1	0.00E+0	4.17E-2	5.66E+0	2.45E-3	-7.39E+0
PENRE	[MJ]	49.60	-	-	0.00	-	-	-	-
PENRM	[MJ]	35.80	-	-	0.00	-	-	-	-
PENRT	[MJ]	8.54E+1	9.23E+0	1.99E+0	0.00E+0	7.37E-1	6.75E+0	9.44E-2	-2.61E+1
SM	[kg]	5.61E-1	0.00E+0	1.12E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF	[MJ]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW	[m^3]	1.53E-1	1.31E-3	7.46E-3	0.00E+0	1.05E-4	7.26E-3	4.01E-4	-7.72E-3

Caption	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 material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² URBANSCAPE Extensive Green Roof System

Parameter	Unit	A1-A3	A4	A5	B1	C2	C3	C4	D
HWD	[kg]	3.59E-4	6.98E-7	1.20E-6	0.00E+0	5.57E-8	6.89E-8	0.00E+0	-1.79E-8
NHWD	[kg]	6.54E-1	7.76E-4	4.83E-1	0.00E+0	6.19E-5	9.66E-3	0.00E+0	-1.48E-2
RWD	[kg]	2.92E-3	1.32E-5	8.22E-5	0.00E+0	1.05E-6	3.98E-4	5.43E-6	-1.52E-3
CRU	[kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	[kg]	0.00	0.00	0.00	0.00	0.00	23.20	0.00	0.00
MER	[kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	[MJ]	0.00	0.00	2.45	0.00	0.00	0.00	0.82	0.00
EET	[MJ]	0.00	0.00	5.94	0.00	0.00	0.00	2.70	0.00

Caption	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; EEE = Exported electrical energy; EEE = Exported thermal energy

INTERPRETATION

USE OF ENERGY RESOURCES

The primary energy demand from non-renewable resources is dominated by the production of the green roll made of mineral wool
(especially due to the energy carrier, coke). The renewable energy demand is dominated by the production, mostly due to electricity consumption, and packaging.

ENVIRONMENTAL IMPACT

Every impact category is dominated by the production of the mineral wool due mainly to the consumption of energy (electricity and coke) during the production. The sedum-blanket made of renewable materials and the drainage layer made of recycled polystyrene have smaller impacts.

The **Abiotic Depletion Potential elements (ADPe)** main impacts are coming from production of the mineral wool (>50% of total impact due to the use of cement in briquettes). The drainage material is impacting only for the geotextile as at the polystyrene which is 100% recycled material origin has no impact.
The **Global Warming Potential (GWP)** main negative impacts are coming from production of mineral wool by the use of coke which has a quite high CO_2 emission factor. The end of life has a relevant impact as this is assumed in order to close the CO_2 loop, that the 15 kg of CO_2 sequestrated during the use phase (50 years) will be released during the composting. The sedums are also installed on the roof with already a part of CO_2 sequestrated. Installation has some impact by the incineration of the packaging's (wooden pallet and plastic foils), then module D is taking the benefits.
For the **Ozone Depletion Potential (ODP)**, at the end of life stage, the waste incineration of plastics packaging has the biggest impact even if it helps for energy recovery in module D. For the remaining ODP impacts this is driven by the use of electricity and the cooling systems needed which still utilized ODP refrigerants.
For the **Acidification Potential (AP)** main impacts are coming from emissions from Cupola during mineral wool manufacturing (Mostly, the impact refers to coke emissions to air: 75% from sulphur dioxide and 20% from nitrogen oxides.). Transport has relevant effect with acid emissions in the fumes.
The **Eutrophication Potential (EP)** is significantly influenced by the production due to emissions from the cupola furnace and other unit processes.
The **Potential Ozone Photochemical Oxidants (POCP)** is particularly dominated by the production (emissions in the cupola furnace and other unit processes). The results from the transport are negative due to the NO emissions; NO counteracts the POCP.

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Publisher
Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Tel +49 (0)30 3087748- 0
Fax +49 (0)30 3087748- 29
Mail info@bau-umwelt.com
Web **www.bau-umwelt.com**

Programme holder
Institut Bauen und Umwelt e.V.
Panoramastr 1
10178 Berlin
Germany

Tel +49 (0)30 - 3087748- 0
Fax +49 (0)30 – 3087748 - 29
Mail info@bau-umwelt.com
Web **www.bau-umwelt.com**

Author of the Life Cycle Assessment
Thinkstep
Hauptstrasse 111
70771 Leinfelden-Echterdingen
Germany

Tel 49(0)7113418170
Fax 49(0)71134181725
Mail info@thinkstep.com
Web **www.thinkstep.com**

Owner of the Declaration
Knauf Insulation
rue de Maestricht 95
4600 Visé
Belgium

Tel 03210488462
Fax 003210488474
Mail jean-pierre.pigeolet@knaufinsulation.com
Web **www.knaufinsulation.com**