Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2012+A2:2019 for:

Extensive Green Roof System: Veg Tech Sedumtak 0-2

From Veg Tech AB

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General information

Programme information

Programme:	The International EPD® System
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CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
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Company information

Owner of the EPD: Veg Tech AB

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Veg Tech AB, Fagerås 1, 342 52 Vislanda, Sweden

Telephone: +46 (0) 472-363 00

Description of the organisation: Veg Tech is the leading supplier of vegetation technology in the Nordic region and is a part of Nordic Waterproofing Group. Veg Tech grow, develop and supply buildings and cities with multifunctional plant systems, that contribute to stormwater management, improve water quality and benefit biodiversity.

Name and location of production site(s): Vislanda, southern Sweden

Product information

Product name: Veg Tech Sedumtak 0-2

Application:
A green roof can be installed for different purposes, it provides many different benefits. For example, green roofs delays and reduces the amount of stormwater, counteract urban heat islands, benefits biodiversity and adds value to residents since greenery has a positive effect on the well-being.

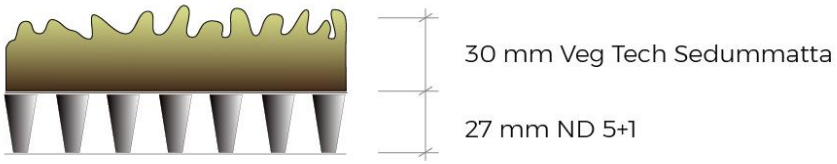
The system Veg Tech Sedumtak 0-2 is designed for roofs with a slope of 0 to 2 degrees and is installed directly on top of the waterproofing membrane that is a part of the underlying roof construction. If properly installed and maintained the sedum roof can last as long as the life of the building.

Product description:
Only a brief product description is included in this EPD. For further information and detailed product documentation, please visit www.vegtech.se.

Veg Tech Sedumtak 0-2 is an extensive green roof system that is light weight, have high water retention capacity and is easy to install. The system includes two main components, Veg Tech pre vegetated sedum mat with biochar (*Veg Tech Sedummatta med biokol*) and a drainage system with a water reservoir (ND5+1).

The sedum mat consists of vegetation, a mineral growing media (substrate) containing biochar and a load-bearing structure (carrier) that reinforces the substrate and protects against erosion. The shrink-free carrier consists of a three-dimensional loop network with a non-woven geotextile thermally bound on the underside and is stable over time. The growing media is optimized for the conditions that prevail on roofs. The use of biochar in the substrate entails soil-improving properties that are especially important for greenery in urban environments. Biochar is also a potential carbon sink. (See further information in section “Additional information”). The vegetation consists of drought-resistant sedum species adapted to the Nordic climate. The sedum mat is cultivated in open fields by Veg Tech in Sweden.

The core of the drainage system ND5+1 is a perforated, vapour permeable dimpled sheet with a high consistent long term compressive strength and drainage capacity. A non-woven geotextile is glued to the back of the dimpled sheet as a filter layer and a vapour permeable geotextile is bonded to each dimple as a protection and separation layer. ND5+1 is CE-marked according to hEN 13252:2016.



Constructional data

Name	Value	Unit
System height	57	mm
System weight unsaturated (dry)	~30	kg/m^2
System weight saturated	~50	kg/m^2
Retention (System maximum water retention capacity)	~20	l/m^2
Runoff coefficient C*	C_s = 0,6	-
Fire resistance class for growing media (EN 13501-5:2016)	B_{ROOF}(t2)	-

* According to the FLL Green Roof Guidelines edition 2018 (roof pitch up to 5°, 4-6 cm substrate)

LCA information

Declared unit:

1 m^2 Veg Tech Sedumtak 0-2, consisting of a 30 mm sedum mat and 27 mm ND5+1 waterholding drainage system.

Veg Tech Sedumtak 0-2	Value	Unit
Grammage (dry)	31,2	kg/m^2
Conversion factor to 1 kg	0,032	-
Declared unit	1	m^2

Reference service life:

If properly mounted and maintained the vegetation is gradually rejuvenated and Veg Tech green roof systems can have the same service life as the building. Thus, a set reference service life cannot be determined.

Time representativeness:

The year under study for this EPD is 2020.

Database(s) and LCA software used:

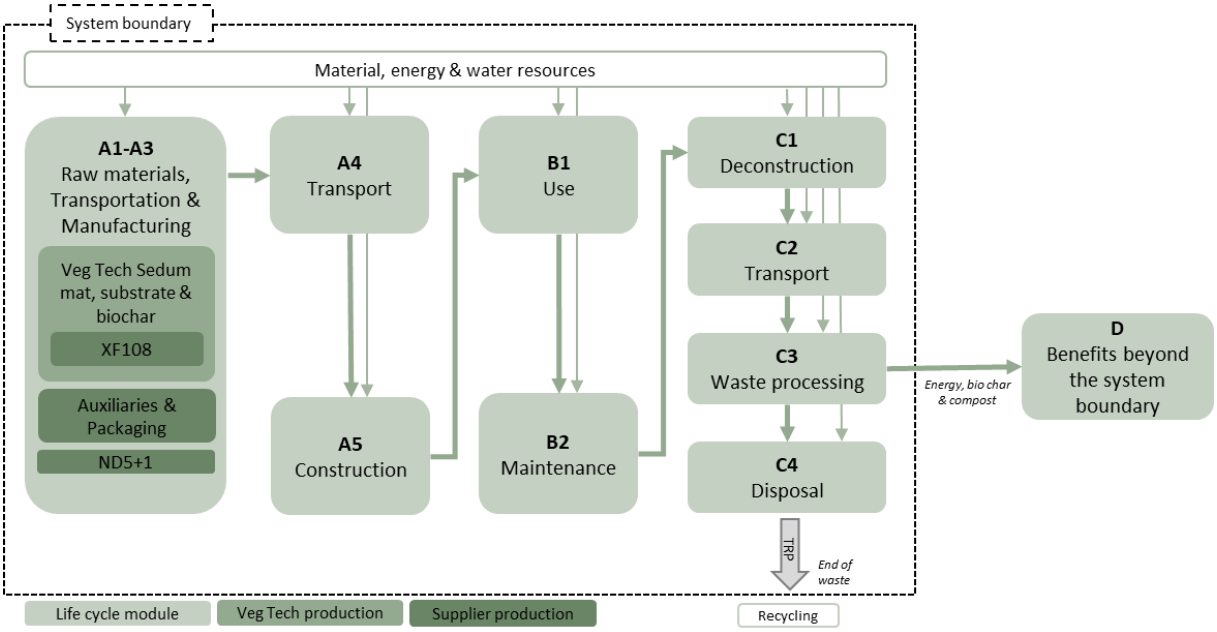
Gabi professional database 2021.2 and Ecoinvent 3.7.1, with LCA software GaBi (version 10.6.0.110).

System boundary:

The system boundary is in line with the EPD type cradle-to-gate with options, modules A1-A5, modules B1-B2, modules C1–C4, and module D.

The cultivation of the vegetation at Veg Tech manufacturing site is included, along with the fertilization and watering in the Use stage. The carbon sequestration and release that the vegetation has during growth and withering in the Use stage, along with its end-of-life management, is however not part of this EPD.

System diagram:



More information:

LCA Practitioner: Agnes Rönnblom, Ramboll

LCA Practitioner: Axel Cullberg, Ramboll

Modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation:

	Product stage			Construc-tion process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	**A1-A3**			**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	X			X	X	X	X	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	EU/ CN	EU	SE	SE	SE	SE	SE	ND	ND	ND	ND	ND	SE	SE	SE	SE	SE
Specific data used	99,3%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	Not relevant			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	Not relevant			-	-	-	-	-	-	-	-	-	-	-	-	-	-

LCA: Scenarios and additional technical information

The following information describe the scenarios of the different modules of the EPD.

Production stage (A1-A3)

ND5+1 contains polystyrene that is post-industrial recycled. Since information on the full supply chain's production processes could not be provided, a dataset for virgin production has been applied for conservative measures.

Transport to user (A4)

The transport scenario is based on an average distance between Veg Tech's manufacturing facility in Vislanda to customers in Malmö, Gothenburg, and Stockholm.

Vehicle	Capacity utilisation [%]	Vehicle specifications	Distance [km]	Fuel consumption
Truck	61	Truck, Euro 6, 28 - 32t gw	280	0,025 l/tkm

Installation (A5)

Module A5 covers the installation of the product at a construction site. The product is lifted to installation altitude using either a crane-truck or an electrical tower crane depending on the installation site. A scenario where half of each installation method is applied. The A5 module also includes waste from packaging and installation, which is assumed to be incinerated.

Resource	Amount	Unit/m²
Diesel	0,025	l
Electricity	0,156	kWh
Water	5	l
Incinerable waste	0,211	kg

Use (B1)/Maintenance (B2)

The results presented for modules B1-B2 refer to one year of usage. This due to the full B module not being declared and that no reference service life has been determined. For calculating the full life cycle impact, the results in B1-B2 hence need to be multiplied with the assessed time period of interest.

There are no impacts from module B1 for the product. The maintenance module B2 is calculated for one year. Veg Tech sedum mat with biochar only needs to be fertilized every second year, the amount of fertilizer in the table below is the yearly average.

Resource	Amount per year	Unit/m²
Fertilizer	0,015	kg
Water	2,5	l

End of life (C1-C4)
Deconstruction of the green roof system is done manually, where crane can be used to bring the waste to ground level if the altitude is high. Materials are separated and sent to composting for compostable material and the rest is assumed to be sent for incineration, with an assumed transport distance of 100km.

Resource	Amount	Unit/m²
Diesel	11,5	ml
Waste for composting	12,3	kg
Inert waste for composting	18,1	kg
Waste for incineration	1,6	kg

Benefits beyond the system boundary (D)
Module D includes recovery and recycling potential, expressed as net impact and benefits. At the end of life, most of the product is composted. The net benefit consists of the compost output replacing alternative material production. For the waste that is incinerated, heat and electricity is recovered and is assumed to replace energy that would have been produced from other sources.

Resource	Amount	Unit/m²
Material replacing compost production	5	kg
Heat replacing Swedish district heating	18	MJ
Electricity replacing Swedish electricity grid mix	10	MJ

Biogenic carbon in biochar
In accordance with EN 15804:2012+A2:2019 the biogenic carbon balance must be zero from module A to C. For calculation purposes, the biogenic carbon is booked as an emission in module C, and a corresponding uptake in module D. In reality the biogenic carbon remains stored in the biochar during the service life of the roof, and in ensuing product life cycles. The total amount of biochar carbon in the sedum mat is 0,31 kg C/m², corresponding to -1,14 kg CO_2/m².

Content information

System components	Weight, kg	Weight-% (versus the product)
Substrate	26,90	86%
Plastics	1,63	5%
Others	2,67	9%
TOTAL	31,2	100%
Packaging materials	**Weight, kg**	**Weight-% (versus the product)**
Pallet	0,13	0,40%
Plastic film	0,01	0,03%
TOTAL	0,13	0,42%

Dangerous substances from the Candidate List of SVHC for authorization are not present in the product, including all other associated materials covered by this EPD.

Environmental Information

Potential environmental impact – mandatory indicators according to EN 15804

Results per m² Veg Tech Sedumtak 0-2												
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2****	**B3-B7**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-total	kg CO_2 eq.	1,02E+01	7,96E-01	3,58E-01	0	1,12E-02	ND	3,44E-02	2,48E-01	1,27E+01	0	-2,02E+00
GWP-fossil	kg CO_2 eq.	9,88E+00	7,81E-01	2,46E-01	0	1,11E-02	ND	3,37E-02	2,43E-01	5,97E+00	0	-9,88E-01
GWP-biogenic	kg CO_2 eq.	3,17E-01	8,44E-03	1,10E-01	0	5,75E-05	ND	3,68E-04	2,63E-03	6,70E+00	0	-1,03E+00
GWP-luluc	kg CO_2 eq.	1,10E-02	6,47E-03	1,27E-03	0	7,18E-06	ND	2,83E-04	2,02E-03	1,59E-04	0	-1,68E-03
ODP	kg CFC 11 eq.	5,95E-07	1,56E-16	2,82E-16	0	3,16E-17	ND	4,41E-18	4,87E-17	1,47E-15	0	-1,62E-09
AP	mol H^+ eq.	2,11E-02	8,57E-04	9,89E-04	0	2,72E-05	ND	1,96E-04	2,67E-04	2,86E-03	0	-2,52E-03
EP-freshwater	kg PO_4^{3-} eq.	3,19E-04	7,21E-06	2,03E-06	0	8,66E-07	ND	3,13E-07	2,25E-06	2,32E-05	0	-4,45E-05
EP-freshwater	[kg P eq.]	1,04E-04	2,35E-06	6,60E-07	0	2,82E-07	ND	1,02E-07	7,33E-07	7,56E-06	0	-1,45E-05
EP-marine	kg N eq.	6,83E-03	2,77E-04	4,71E-04	0	9,53E-06	ND	9,59E-05	8,64E-05	1,66E-04	0	-9,60E-04
EP-terrestrial	mol N eq.	7,38E-02	3,28E-03	5,26E-03	0	1,19E-04	ND	1,06E-03	1,02E-03	1,40E-02	0	-9,39E-03
POCP	kg NMVOC eq.	2,38E-02	7,48E-04	9,38E-04	0	1,05E-05	ND	1,85E-04	2,33E-04	1,24E-03	0	-2,21E-03
ADP-minerals &metals*	kg Sb eq.	3,02E-06	7,02E-08	1,96E-08	0	7,95E-10	ND	2,63E-09	2,19E-08	1,58E-08	0	-2,01E-07
ADP-fossil*	MJ	2,06E+02	1,05E+01	2,77E+00	0	1,62E-01	ND	4,60E-01	3,28E+00	2,26E+00	0	-1,33E+01
WDP	m^3	2,15E+00	7,35E-03	6,20E-02	0	1,13E-02	ND	3,00E-04	2,29E-03	5,75E-01	0	-4,42E-01
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption											

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

** *Refers to one year of usage as the full B module is not declared and no reference service life is determined.*

Potential environmental impact – additional mandatory and voluntary indicators

Results per m^2 Veg Tech Sedumtak 0-2												
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2***	**B3-B7**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-GHG[1]	kg CO_2 eq.	1,03E+01	7,75E-01	2,44E-01	0	1,09E-02	ND	3,34E-02	2,41E-01	5,88E+00	0	-9,78E-01

* *Refers to one year of usage as the full B module is not declared and no reference service life is determined.*

Use of resources

Results per m^2 Veg Tech Sedumtak 0-2												
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2***	**B3-B7**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	4,34E+01	6,07E-01	6,96E-01	0	1,15E-02	ND	2,56E-02	1,89E-01	5,92E+00	0	-1,79E+01
PERM	MJ	1,71E+02	0	0	0	0	ND	0	0	0	0	0
PERT	MJ	2,14E+02	6,07E-01	6,96E-01	0	1,15E-02	ND	2,56E-02	1,89E-01	5,92E+00	0	-1,79E+01
PENRE	MJ	2,06E+02	1,06E+01	2,78E+00	0	1,62E-01	ND	4,60E-01	3,30E+00	2,26E+00	0	-1,33E+01
PENRM	MJ.	6,04E+01	0	0	0	0	ND	0	0	0	0	0
PENRT	MJ	2,66E+02	1,06E+01	2,78E+00	0	1,62E-01	ND	4,60E-01	3,30E+00	2,26E+00	0	-1,33E+01
SM	kg	0	0	0	0	0	ND	0	0	0	0	0
RSF	MJ	0	0	0	0	0	ND	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	ND	0	0	0	0	0
FW	m^3	3,29E-01	6,95E-04	6,87E-03	0	2,52E-03	ND	2,94E-05	2,16E-04	1,35E-02	0	-2,58E-02
Acronyms	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											

* *Refers to one year of usage as the full B module is not declared and no reference service life is determined.*

[1] The indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. This indicator is thus almost equal to the GWP indicator originally defined in EN 15804:2012+A1:2013.

Waste production and output flows

Waste production

Results per m² Veg Tech Sedumtak 0-2												
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2***	**B3-B7**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	2,66E-08	5,58E-10	3,07E-10	0	2,94E-11	ND	2,32E-11	1,74E-10	8,98E-09	0	-1,97E-08
Non-hazardous waste disposed	kg	8,28E-01	1,66E-03	2,70E-02	0	7,51E-04	ND	6,84E-05	5,17E-04	2,72E-02	0	-1,14E-01
Radioactive waste disposed	kg	1,36E-03	1,92E-05	2,55E-04	0	3,48E-06	ND	5,57E-07	5,98E-06	6,76E-05	0	-4,48E-03

* *Refers to one year of usage as the full B module is not declared and no reference service life is determined.*

Output flows

Results per m² Veg Tech Sedumtak 0-2												
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2***	**B3-B7**	**C1**	**C2**	**C3**	**C4**	**D**
Components for re-use	kg	0	0	0	0	0	ND	0	0	0	0	0
Material for recycling	kg	1,24E-01	0	0	0	0	ND	0	0	2,49E+00	0	0
Materials for energy recovery	kg	0	0	0	0	0	ND	0	0	0	0	0
Exported energy, electricity	MJ	4,60E-02	0	2,60E-01	0	0	ND	0	0	9,90E+00	0	0
Exported energy, thermal	MJ	1,05E-01	0	5,92E-01	0	0	ND	0	0	1,76E+01	0	0

* *Refers to one year of usage as the full B module is not declared and no reference service life is determined.*

Information on biogenic carbon content

Results per m² Veg Tech Sedumtak 0-2		
BIOGENIC CARBON CONTENT	**Unit**	**QUANTITY**
Biogenic carbon content in product	kg C	1,08E+00
Biogenic carbon content in packaging	kg C	6,60E-02

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO_2.

Additional information

General information about biochar

Biochar is a porous, carbonaceous material produced by pyrolysis of plant biomass. If applied in such a way that the contained carbon remains stored long-term it is a carbon sink. Since 2018 IPCC has recognized biochar as a CDR-method (Carbon Dioxide Removal) that can achieve negative emissions (Schmidt H.-P., 2018).

Biochar entails many benefits when used in a plant bed; it enhances the water and nutrient retention ability, improves soil structure, increases microbial activity and counteracts compaction.

For further information, please visit www.biokol.org and www.european-biochar.org/en.

Biochar in Veg Tech Sedum mat

The main part of the biochar in the sedum mat is produced by Veg Tech in Vislanda. Analysis performed in accordance with the EBC Guidelines for sustainable production of biochar shows that Veg Tech's biochar is very clean, high in carbon content and stable (Eurofins Umwelt Ost GmbH, 2020).

Biochar contributes to a more efficient use of fertilizers (Hao Xia et. al., 2022). The nutrients can be captured and retained in the growing medium until the plants have had time to absorb them. This minimizes the risk of nutrient leakage. Since Veg Tech introduced biochar in the sedum mat, fertilization is recommended only every two years after establishment.

For information about how biogenic carbon in the biochar has been handled in the LCA see the earlier section with information about LCA scenarios.

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