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ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025 and EN 15804+A2

Optigrün international AG
Solar green roof



OPTIGRÜN®
DIE DACHBEGRÜNER

Owner of the declaration
Optigrün international AG
Am Birkenstock 15
72505 Krauchenwies
Germany

Product
Solar green roof

Declared product / Functional unit
1 m²

This declaration is based on Product Category Rules
EN 15804:2012 + A2:2019,
NPCR Part A:2021 ,
IBU PCR Part B: Requirements on the EPD for Green Roof Systems

Program operator:
EPD Global
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Declaration number
NEPD-12382-12382-2

Registration number
NEPD-12382-12382-2

Issue date
07.10.2026

Valid to
06.10.2031

EPD Software
Emidat Platform v1.0.0

General Information

Product
Solar green roof

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Declaration Number
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This declaration is based on Product Category Rules
EN 15804:2012 + A2:2019,
NPCR Part A:2021 ,
IBU PCR Part B: Requirements on the EPD for Green Roof Systems

Statements
The owner of the declaration shall be liable for the underlying information and evidence. The Norwegian EPD Foundation shall not be liable with respect to manufacturer, life cycle assessment data and evidences.

Functional unit
1 m^2

General information on verification of EPD from EPD tools
Independent verification of data, other environmental information and the declaration according to ISO 14025:2011-10, § 8.1.3 and § 8.1.4. Verification of each EPD is made according to EPD Global's guidelines for verification and approval requiring that tools are i) integrated into the company's environmental management system, ii) the procedures for use of the EPD tool are approved by EPD Global, and iii) the process is reviewed annually by an independent third-party verifier. See Appendix G of EPD Global's General Programme Instructions for further information on EPD tools.

Verification
Independent third-party verification based on the verification of the EPD tool, background data and test-EPD in accordance with EPD Global's procedures and guidelines for verification and approval of EPD tools.
Third-party verifier: Charlotte Merlin, FORCE Technology

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Place of production
Krauchenwies, Germany

Management system
-

Issue date
07.10.2026

Valid to
06.10.2031

Year of study
2025

Comparability
EPDs of construction products may not be comparable if they do not comply with EN 15804 and are not seen in a building context. EPD data may not be comparable if the datasets used are not developed in accordance with EN 15804 and if the background systems are not based on the same database (including primary and secondary data).

Development and verification of EPD
The declaration was created using the Emidat EPD tool v1.0, developed by Emidat GmbH which is third-party verified and approved as a Reference Flow Tool with internal review under administration and surveillance by EPD Global under provisions stated in general information on verification of EPD from EPD tools.

Developer of EPD: Alexander Klefenz
Reviewer of company-specific input data and EPD: Pascal Keppler

Approved

Håkon Hauan, The Norwegian EPD Foundation

Product

Product description

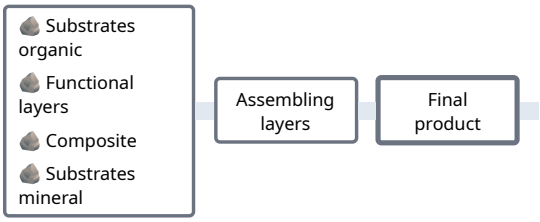
A combined roof system comprising extensive greening and a ballast-supported photovoltaic substructure.

No packaging was included for the modeled product.

Application description

The OPTIGRÜN Solar Green Roof combines extensive roof greening with a ballast-supported substructure for photovoltaic modules. Load distribution, vegetation build-up, drainage and maintenance routes are planned as an integrated system. The green roof protects the waterproofing, retains rainwater and creates a vegetated microclimate, while the photovoltaic system generates renewable electricity.

Production process



Product specification

Name of ingredient	Share of total weight
Composite	0 - 2 %
Functional layers	2 - 10 %
Substrates mineral	70 - 90 %
Substrates organic	2 - 10 %

Technical data

	Unit	Value
Water storage capacity	Vol.-%	60
System sound absorption	dB	0
System height	mm	110
System weight saturated	kg / m²	115
System weight unsaturated (dry)	kg / m²	73
Water retention capacity	l / m²	100
pH value of the growing media (CaCl2)	-	7.5
Fire resistance class for growing media	-	A2 - s1, d0
Salt content of the growing media	g / l	0.7
Runoff coefficient C	-	0.2

Market

Germany

Recipients

B2B

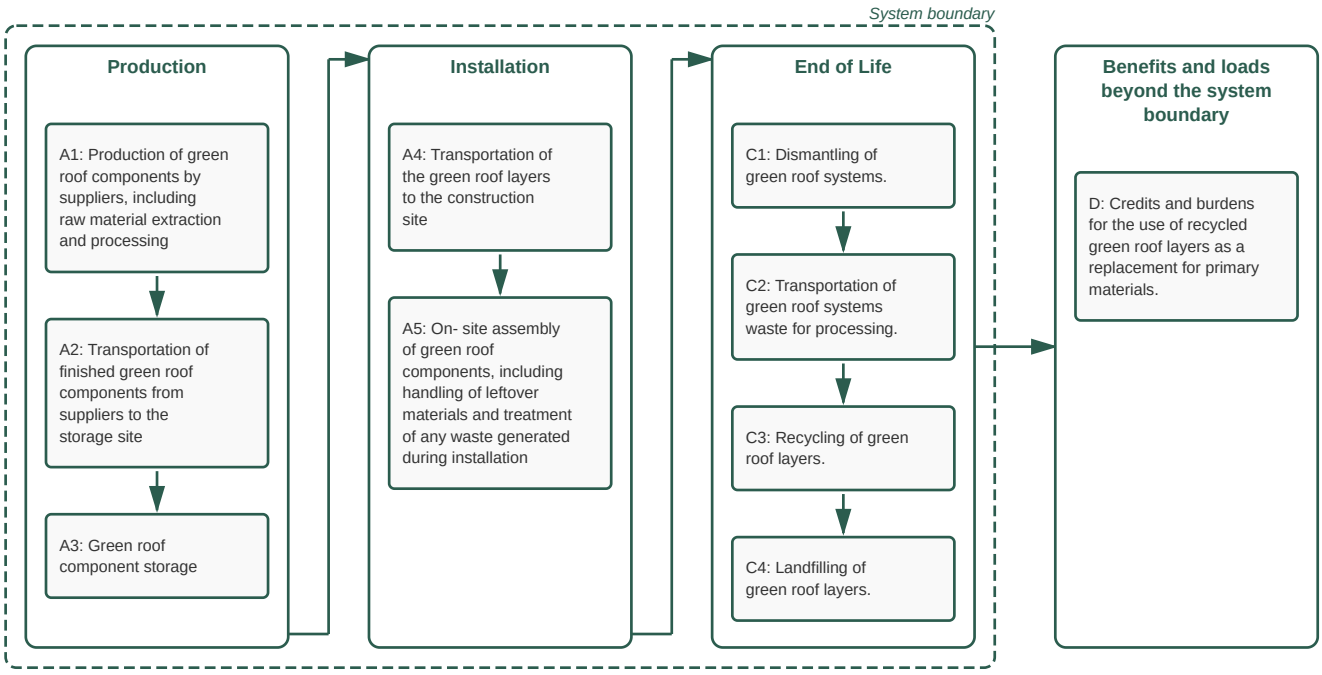
LCA: Calculation rules

Functional unit
1 m²

Product lifetime
Not declared

Reference service life
Not declared

System boundary



Data quality
The foreground data are based on extensive and detailed data collection at the production site of the manufacturer, covering key processes such as raw material sourcing, formulation, and manufacturing. These foreground data are fully linked with corresponding datasets from the background database (ecoinvent 3.10) or with EN15804+A2-compliant EPDs, ensuring consistency, reliability, and maintaining alignment with the latest industry standards.

The overall data representativeness is rated as fair with an overall score of 3.00/5, in accordance with EN 15804+A2 Annex E guidance on data quality assessment, considering geographical, technical, and temporal representativeness.

The following table discloses all processes or activities assessed with very poor or poor data representativeness according to EN 15804+A2, as well as those assessed as fair that contribute more than 30 % to any core impact indicator in A1–A3:

Element	Minimal Representativeness	Source	Year
Composite	Poor	ecoinvent 3.10	2023
Packaging	Poor	ecoinvent 3.10	2023
Substrates mineral	Poor	ecoinvent 3.10	2023
Substrates organic	Poor	ecoinvent 3.10	2023
Functional layers	Fair	ecoinvent 3.10	2023
Packaging	Fair	ecoinvent 3.10	2023

System boundaries (X=included, MND=module not declared)

	Production			Installation		Use stage							End-of-Life				Next product system
	Raw material supply	Transport	Manufacturing	Transport	Installation Process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Demolition	Transport	Waste Processing	Disposal	Benefits and loads beyond the system boundary
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	x	x	x	x	x	MND	MND	MND	MND	MND	MND	MND	x	x	x	x	x
Geography			DE	DE	DE	MND	MND	MND	MND	MND	MND	MND	DE	DE	DE	DE	DE

For the geographies modeled in A1 and A2, refer to *Product specification*.

Type of EPD: Cradle to gate with options, modules A4, A5, C1-C4 + D

Stage of Material Production and Construction

Module A1: Production of green roof components by suppliers, including raw material extraction and processing

Module A2: Transportation of finished green roof components from suppliers to the storage site

Module A3: Green roof component storage

Module A4: Transportation of the green roof layers to the construction site

Module A5: On-site assembly of green roof components, including handling of leftover materials and treatment of any waste generated during installation

Disposal Stage

Module C1: Dismantling of green roof systems.

Module C2: Transportation of green roof systems waste for processing.

Module C3: Recycling of green roof layers.

Module C4: Landfilling of green roof layers.

Credits and burdens outside the system boundaries

Module D: Credits and burdens for the use of recycled green roof layers as a replacement for primary materials.

Cut-off criteria

All inputs and outputs related to the declared modules of Green roof, including raw materials, packaging, transportation, energy usage and ancillary materials, were comprehensively considered in line with EN 15804+A2 and if applicable the product-specific PCR. Furthermore, all known hazardous substances (within the REACH list and the Norwegian Priority List), regulated materials, and significant emissions were declared and are not excluded under the cut-off rules.

The following processes are considered below the EN 15804+A2 cut-off threshold and were excluded:

- Impacts related to the manufacturer's infrastructure and assets
- Manufacturing of means of production, buildings or other capital goods
- Transportation of personnel to the plant
- Transportation of personnel within the plant
- Research and development activities
- Long-term emissions

Allocation

Foreground inventory data (energy and fuels, ancillary materials, emissions and waste) was collected at the production process level. Allocation based on Area was applied to allocate the total output of the production process in 2025 to the reference product.

Key assumptions and estimates

Production process flows are allocated to the reference product, as described under allocation. The Area-based allocation assumes a uniform distribution of production impacts across co-products. Foreground inventory data is checked for consistency of production process, to ensure the validity of the allocated results.

LCA: Scenarios and additional technical information

The following information describe the scenarios in the different modules of the EPD. Mass and energy flows are reported per 1 m^2 of product.

Transport to the building site (A4)	Value	Unit
Location of the production site	Germany	
Location of the installation site	Germany	
Transported mass	73.00	kg
Transport modality: Truck	transport, freight, lorry >32 metric ton, EURO6	-
Distance	100.00	km
Litres of fuel	36.48	l / 100km
Energy demand	1.58	MJ / t*km
Energy demand (km)	0.12	MJ / km
Capacity utilization	53.30	%

Transport of the product and its packaging from the production site to the installation site. Transport distances are based on external sources such as reported market averages, standards or PCRs. Vehicle type, fuel consumption and capacity utilization assumptions stem from the underlying background transport datasets and are stated below.

Installation into the building (A5)	Value	Unit
Ancillary materials for installation	0	kg
Water use during installation	0	m^3
Use of other resources during installation	0	kg
Energy consumption during installation		
Diesel consumption	1.77	l
Material waste on the construction site before waste processing		
Installation loss	6.00	%
Installation loss	4.38	kg
Direct emissions to ambient air, soil and water	0	kg
Treatment of installation loss waste		
Landfill	100.00	%

Installation losses are accounted for by scaling up the quantity of product required at the construction site by the loss percentage. The production, transportation and treatment of the lost material is assigned to A5. Substrate is transported on top of the roof with vacuum. The installation of a green roof system involves preparing the roof surface with protective and waterproofing layers, then adding components that enable drainage, support plant growth, and sustain vegetation. The use of mechanized construction equipment during product installation is included as energy use under module A5.

End-of-life scenario (C1-C4)	Value	Unit
Diesel consumption	1.77	l
Collection process specified by type		
Collected individually	0	kg

End-of-life scenario (C1-C4)	Value	Unit
Collected with mixed construction and demolition waste	73.00	kg
Recovery system specified by type		
Destined for reuse	0	kg
Destined for recycling	0	kg
Destined for energy recovery	1.90	kg
Disposal specified by type		
Product or material destined for final disposal	71.10	kg
Transport		
Distance to incineration	50.00	km
Distance to landfill	50.00	km
Transport modality: Truck	transport, freight, lorry >32 metric ton, EURO6	-
Energy demand	1.58	MJ / t*km
Energy demand (km)	0.12	MJ / km
Capacity utilization	53.30	%

Substrate layer is assumed to be vacuumed off the roof (Diesel consumption). All other system components are deconstructed manually (no loads). Module C2 includes the impact of transportation of material after deconstruction, during the End-of-Life stage.

Reuse, recovery and/or recycling potentials (D)	Value	Unit
Amount of secondary material that the system takes in	3.50	kg
Installation (packaging): Net flow of secondary material	0	kg
End-of-life (product): Net flow of secondary material	0	kg
Installation (packaging): Material eligible for incineration credits	0	kg
Installation (packaging): Exported energy eligible for credits	0	MJ
Installation (production loss): Material eligible for incineration credits	0	kg
Installation (production loss): Exported energy eligible for credits	0	MJ
End-of-life (product): Material eligible for incineration credits	1.81	kg
End-of-life (product): Exported energy eligible for credits	0.29	MJ
Substitution of electricity production, grid mix	0.08	MJ
Substitution of heat production from natural gas	0.21	MJ

Calculation of loads and benefits per EN 15804+A2. Exported energy is credited only where it originates from the incineration of primary material; landfilled fractions receive no exported-energy credit and therefore no avoided primary energy consumption. Recycling or reuse benefits are credited for the net flow of secondary material.

LCA: Results

Core environmental impact indicators

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-total	kg CO_2-eq.	1.02e+01	7.57e-01	7.38e+00	6.43e+00	3.78e-01	4.61e+00	4.35e+00	-2.71e-02
GWP-fossil	kg CO_2-eq.	1.21e+01	7.56e-01	7.27e+00	6.43e+00	3.78e-01	4.52e+00	7.12e-01	-2.60e-02
GWP-biogenic	kg CO_2-eq.	-1.95e+00	3.79e-04	1.08e-01	6.42e-04	1.90e-04	9.71e-02	3.64e+00	-1.08e-03
GWP-luluc	kg CO_2-eq.	2.26e-02	2.68e-04	1.95e-03	5.59e-04	1.34e-04	2.93e-05	1.73e-04	-2.12e-05
ODP	kg CFC-11-Eq	6.91e-06	1.58e-08	5.16e-07	9.84e-08	7.88e-09	1.67e-09	2.23e-08	-8.02e-10
AP	mol H+-Eq	5.50e-02	1.79e-03	6.20e-02	5.80e-02	8.93e-04	1.03e-03	7.85e-03	-3.11e-05
EP-freshwater	kg P-Eq	3.25e-03	5.32e-05	4.61e-04	1.87e-04	2.66e-05	1.42e-05	1.19e-03	-1.35e-05
EP-marine	kg N-Eq	1.14e-02	4.68e-04	2.78e-02	2.69e-02	2.34e-04	5.86e-04	1.96e-03	-1.08e-05
EP-terrestrial	mol N-Eq	1.20e-01	5.06e-03	3.04e-01	2.95e-01	2.53e-03	4.99e-03	2.10e-02	-8.89e-05
POCP	kg NMVOC-Eq	5.53e-02	3.10e-03	9.20e-02	8.79e-02	1.55e-03	1.25e-03	7.70e-03	-4.36e-05
ADPE	kg Sb-Eq	1.02e-04	2.16e-06	8.69e-06	2.31e-06	1.08e-06	3.24e-07	1.40e-06	-2.43e-08
ADPF	MJ, net calorific value	2.45e+02	1.13e+01	1.01e+02	8.41e+01	5.67e+00	8.82e-01	1.66e+01	-4.12e-01
WDP	m^3 world Eq deprived	4.36e+00	5.70e-02	4.79e-01	2.06e-01	2.85e-02	2.97e-01	9.92e-02	-2.32e-03

GWP-total: Global Warming Potential - total , **GWP-fossil**: Global warming potential - fossil , **GWP-biogenic**: Global Warming Potential - biogenic , **GWP-luluc**: Global Warming Potential - luluc , **ODP**: Depletion potential of the stratospheric ozone layer , **AP**: Acidification potential, Accumulated Exceedance , **EP-freshwater**: Eutrophication potential - freshwater , **EP-marine**: Eutrophication potential - marine , **EP-terrestrial**: Eutrophication potential - terrestrial , **POCP**: Photochemical Ozone Creation Potential , **ADPE**: Abiotic depletion potential - non-fossil resources , **ADPF**: Abiotic depletion potential - fossil resources , **WDP**: Water (user) deprivation potential

Additional indicators

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PM	disease incidence	7.63e-07	7.36e-08	1.71e-06	1.65e-06	3.68e-08	5.31e-09	1.19e-07	-1.69e-10
IRP	kBq U235-Eq	1.08e+00	1.38e-02	1.05e-01	3.76e-02	6.89e-03	1.61e-03	2.22e-02	-2.47e-03
ETP-fw	CTUe	5.18e+01	2.69e+00	1.60e+01	1.19e+01	1.34e+00	9.08e+00	1.22e+01	-4.70e-02
HTP-c	CTUh	4.44e-08	4.84e-09	2.85e-08	2.51e-08	2.42e-09	1.04e-09	4.04e-09	-4.19e-11
HTP-nc	CTUh	1.03e-07	7.48e-09	1.95e-08	1.14e-08	3.74e-09	1.35e-08	1.99e-08	-8.96e-11
SQP	dimensionless	2.12e+02	1.14e+01	2.21e+01	5.89e+00	5.71e+00	2.48e-01	4.06e+01	-2.89e-02

PM: Potential incidence of disease due to PM emissions , **IRP**: Potential Human exposure efficiency relative to U235 , **ETP-fw**: Potential Comparative Toxic Unit for ecosystems , **HTP-c**: Potential Comparative Toxic Unit for humans - cancer effects , **HTP-nc**: Potential Comparative Toxic Unit for humans - non-cancer effects , **SQP**: Potential Soil quality index . **IRP**: 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. **ETP-fw, HTP-c, HTP-nc, SQP**: The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experienced with these indicators.

Use of resources

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	MJ	2.73e+01	1.80e-01	2.19e+00	5.15e-01	9.00e-02	3.51e-02	3.44e-01	-3.86e-02
PERM	MJ	1.01e+01	0.00e+00	6.08e-01	0.00e+00	0.00e+00	-2.64e-01	0.00e+00	0.00e+00

Use of resources

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERT	MJ	3.75e+01	1.80e-01	2.80e+00	5.15e-01	9.00e-02	-2.29e-01	3.44e-01	-3.86e-02
PENRE	MJ	7.94e+01	1.13e+01	9.09e+01	8.41e+01	5.67e+00	8.82e-01	1.66e+01	-4.12e-01
PENRM	MJ	1.66e+02	0.00e+00	9.99e+00	0.00e+00	0.00e+00	-4.33e+00	0.00e+00	0.00e+00
PENRT	MJ	2.46e+02	1.13e+01	1.01e+02	8.41e+01	5.67e+00	-3.45e+00	1.66e+01	-4.12e-01
SM	kg	3.50e+00	0.00e+00	2.10e-01	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	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	0.00e+00
FW	m^3	1.22e-01	1.65e-03	5.83e-04	5.46e-03	8.25e-04	5.09e-03	-2.00e-01	-7.69e-05

PERE: Primary energy resources - renewable: use as energy carrier , **PERM**: Primary energy resources - renewable: used as raw materials , **PERT**: Primary energy resources - renewable: total , **PENRE**: Primary energy resources - non-renewable: use as energy carrier , **PENRM**: Primary energy resources - non-renewable: used as raw materials , **PENRT**: Primary energy resources - non-renewable: total , **SM**: Use of secondary material , **RSF**: Renewable secondary fuels , **NRSF**: Non-renewable secondary fuels , **FW**: Net use of fresh water

Waste flows

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HWD	kg	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
NHWD	kg	0.00e+00	0.00e+00	4.38e+00	0.00e+00	0.00e+00	1.90e+00	7.11e+01	0.00e+00
RWD	kg	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

HWD: Hazardous waste disposed , **NHWD**: Non hazardous waste disposed , **RWD**: Radioactive waste disposed

Output flows

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
CRU	kg	0.00e+00	0.00e+00	0.00e+00	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	0.00e+00	0.00e+00	0.00e+00
MER	kg	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
EEE	MJ	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	5.33e-01	0.00e+00	0.00e+00
EET	MJ	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.35e+00	0.00e+00	0.00e+00

CRU: Components for re-use , **MFR**: Materials for recycling , **MER**: Materials for energy recovery , **EEE**: Exported electrical energy , **EET**: Exported thermal energy

Name	Value	Unit
Biogenic carbon content in product	1.02e+00	kg C
Biogenic carbon content in accompanying packaging	0.00e+00	kg C

Additional requirements

Greenhouse gas emissions from the use of electricity in the manufacturing phase

None.

Dangerous substances

The product contains no hazardous substances given by the REACH Candidate List or the Norwegian Priority List.

Additional environmental information

Secondary content

The product contains 4.78 % secondary material. Secondary material includes recycled, recovered and by-product content.

Additional environmental impact indicators required in NPCR Part A for construction products

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-IOBC	kg CO_2-eq.	1.22e+01	7.56e-01	7.28e+00	6.43e+00	3.78e-01	4.52e+00	7.14e-01	-2.60e-02

GWP-IOBC: Global Warming Potential - Instantaneous oxidation of biogenic carbon

Bibliography

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EN 15804:2012+A2:2019	Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
EN 15942:2022-04	Sustainability of construction works - Environmental product declarations - Communication format business-to-business
ISO 14025:2011-10	Environmental labels and declarations - Type III environmental declarations - Principles and procedures
ISO 14040:2021-02	Environmental management - Life cycle assessment - Principles and framework
ISO 14044:2021-02	Environmental management - Life cycle assessment - Requirements and guidelines
EF 3.1	Environmental Footprint (EF) Life Cycle Impact Assessment method - Characterisation Factors version 3.1, European Commission, Joint Research Centre (JRC)
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NPCR Part A:2021	Construction products and services, Version 2.0. Issue date: 24.03.2021; validity extended to 31.12.2026.
IBU PCR Part B	Requirements on the EPD for Green roof systems, 2024, Version 7. Issue date: 01.08.2024.
RICS, 2023	RICS Whole Life Carbon Assessment for the Built Environment
Bundesministerium für Wohnen, Stadtentwicklung und Bauwesen, 2017	Nutzungsdauern von Bauteilen für Lebenszyklusanalysen nach Bewertungssystem Nachhaltiges Bauen (BNB); URL: https://www.nachhaltigesbauen.de/austausch/nutzungsdauern-von-bauteilen/

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