Environmental Product

Declaration code EPD-DDW-GB-66.0

Dennert Baustoffwelt GmbH & Co. KG

Products made of concrete and concrete elements

Dennert DX ceiling (DX20) and Dennert wall system

Basis:

DIN EN ISO 14025
EN15804

Company EPD **E**nvironmental **P**roduct **D**eclaration

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Declaration holder	Dennert Baustoffwelt GmbH & Co. KG Veit-Dennert-Straße 7 96132 Schlüsselfeld, Germany www.dennert.de		
Declaration code	EPD-DDW-GB-66.0		
Designation of declared product	Dennert DX ceiling (DX20) and Dennert wall system		
Scope	The Dennert DX ceiling (DX20) product is a precast reinforced concrete hollow core ceiling for residential and commercial construction, the Dennert wall systems are precast reinforced concrete walls for building construction. (Insulation, windows, etc. excluded. Please refer to product description).		
Basis	This EPD was prepared on the basis of EN ISO 14025:2011 and DIN EN 15804:2012+A2:2019. In addition, the "Allgemeiner Leitfaden zur Erstellung von Typ III Umweltproduktdeklarationen" (General guideline for preparation of Type III Environmental Product Declarations) applies. The declaration is based on the PCR documents "PCR Part A" PCR-A-0.3:2018 and "Construction products made of concrete and concrete elements" PCR PB-1.1: 2020.		
Validity	Publication date: 24.05.2023	Last revision: 24.05.2023	Next revision: 24.05.2028
	This verified Company Environmental Product Declaration (company EPD) applies solely to the specified products and is valid for a period of five years from the date of publication in accordance with DIN EN 15804.		
LCA Basis	The LCA was prepared in accordance with DIN EN ISO 14040 and DIN EN ISO 14044. The data are based on both the data compiled from two production sites of Dennert Baustoffwelt GmbH & Co. KG and the generic data derived from the “GaBi 10” database. LCA calculations were carried out for the included “cradle to gate – with options” including all upstream chains (e.g. raw material extraction, etc.).		
Notes	The ift-Guidance Sheet “Conditions and Guidance for the Use of ift Test Documents” applies. The declaration holder assumes full liability for the underlying data, certificates and verifications.		

Christian Kehrer Head of Certification and Surveillance Body	Dr. Torsten Mielecke Chairman of Expert Committee ift-EPD and PCR	Prof. Dr.-Ing. Eric Brehm External verifier

1 General Product Information

Product definition

The EPD belongs to the product group Products made of concrete and concrete elements and applies to

1 m² Dennert DX ceiling (DX20) and Dennert wall system of Dennert Baustoffwelt GmbH & Co. KG

The functional unit is obtained by summing up:

	Assessed product	
	Dennert DX ceiling (DX20)	Dennert wall system
Declared unit	1 m²	1 m²
Weight per unit area	308 kg/m²	300 kg/m²
Material thickness	20 cm	average 14.3 cm
Density	approx. 2,350 kg/m³	approx. 2,100 kg/m³
Cement resistance class	CEM II/ A-S 52.5 N	CEM II/ A-LL 42.5R
Unit weight		
2.00 m * 0.43 m	280 kg	-
5.00 m * 1.06 m	1,700 kg	-
6.00 m * 2.25 m	4,200 kg	-
2.00 m * 2.00 m	-	1,200 kg
4.00 m * 2.50 m	-	3,000 kg
6.00 m * 3.00 m	-	7,900 kg
Load-bearing capacity		
2.00 m span	5,000 kg/m² (bending)	-
5.00 m span	800 kg/m² (bending)	-
6.00 m span	500 kg/m² (bending)	-
2.00 m height	-	400,000 kg/m² (pressure)
2.50 m height	-	350,000 kg/m² (pressure)
3.00 m height	-	300,000 kg/m² (pressure)

Table 1 Product groups

The average unit is declared as follows:
Directly used material flows are determined by means of manufactured areas and allocated to the declared unit. All other inputs and outputs in the manufacture were scaled to the declared unit as a whole, since no direct assignment to the average size is possible. The reference period is the year 2021.

The validity of the EPD is restricted to the following models:

- Dennert DX ceiling (DX20)
- Dennert wall system

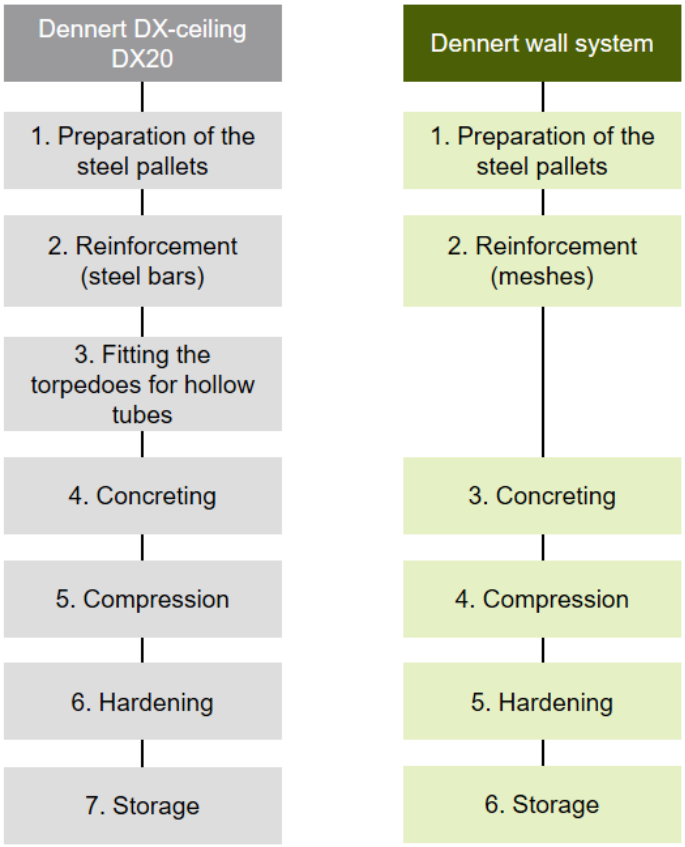
Product description

The Dennert DX ceiling (DX 20) is a slack reinforced hollow board with 20 cm thickness, up to 2.25 m width and up to 7.80 m length of the individual panels. These are lifted onto the existing supports at the construction site by crane, braced with a screw system and the joints concreted out on site. This results in a ceiling pane. No support is needed. The elements are immediately reliable.

Dennert wall systems are manufactured as individual elements in grid widths of 13.2 cm, 17.5 cm, 21.0 cm and 24 cm up to a height of 3.60 m and a length of 7.30 m. The prefabricated wall parts are screw-fastened together on site and temporarily tied back. After placing and casting the floor elements, a stiffening slice effect is ensured.
The values of this EPD apply to all wall versions of the BASE and KX wall system. At the ALFA wall system, all other components of the finishing must also be taken into account, such as insulation materials, built-in components and windows. At the XCON building system, all other building components must also be taken into account, such as ceilings, stairs and chimneys.

For a detailed product description refer to the manufacturer specifications or the product specifications of the respective offer/quotation.

Product manufacture



Application

The Dennert DX ceiling DX20 can be individually planned to match the floor plan of the building and manufactured in the prefabrication plant. Installation parts (e.g. electrical boxes, heating, etc.) can already be installed in the factory.
The Dennert wall systems can be individually planned to match the floor plan and elevation of the building and manufactured in the prefabrication plant. Installation parts (e.g. electrical boxes) can already be installed in the factory.

Test evidence / reports

The following verifications are held:

- Type testing

Product quality for the site in 91637 Wörnitz according to

- DIN EN 206-1:2001-07
- DIN EN 206-1/A1:2004-10
- DIN EN 206-1/A1:2005-09
- DIN 1045-2:2008-08
- DIN 1045-4:2012-02
- DIN V 20000-120:2006-04
- BayTB Annex A 1.2.3/1

Product quality for the site in 96130 Schlüsselfeld according to

- DIN 1045-4:2012-02 as well as Annex C 1.7

For information on further and updated verifications (incl. other national approvals) refer to www.dennert.de.

Quality assurance

The following quality assurance system are in place:
Product quality for the sites in 91637 Wörnitz and 96130 Schlüsselfeld according to

- EN 1168:2005+A3:2011
- EN 13225:2013
- EN 13747:2005+A2:2010
- EN 14843:2007
- EN 14992:2007+A1:2012
- EN 15258:2008

Additional information

For additional verifications of applicability or conformity refer to the CE marking and the documents accompanying the product, if applicable.

The Dennert DX ceiling (DX20) meets the following building-physical performance characteristics:

- Concrete resistance class C50/60 according to EC2

The Dennert wall systems meet the following building-physical performance characteristics:

- C20/25 according to EC2

2 Materials used

Primary materials

The primary materials used are listed in the LCA (see Section 7).

Declarable substances

The product contains no substances from the REACH candidate list (declaration dated 08.08.2022).

All relevant safety data sheets can be obtained from company Dennert Baustoffwelt GmbH & Co. KG.

3 Construction process stage

Processing recommendations, installation

Observe the instructions for assembly/installation, operation, maintenance and disassembly, provided by the manufacturer. For this, see https://www.dennert.de/downloads/technische-infos.html#c534

4 Use stage

Emissions to the environment

No emissions to indoor air, water and soil are known. There may be VOC emissions.

Reference service life (RSL)

The RSL information was provided by the manufacturer. The RSL must be established under specified reference conditions of use and relate to the declared technical and functional performance of the product within the building. It must be determined according to all specific rules given in European product standards or, if none are available, according to a c-PCR. It must also take into account ISO 15686-1, -2, -7 and -8. If there is guidance on deriving RSLs from European Product Standards or a c-PCR, then such guidance must take precedence.
If it is not possible to determine the service life as the RSL in accordance with ISO 15686, the BBSR table “Nutzungsdauer von Bauteilen zur Lebenszyklusanalyse nach BNB” (service life of building components for life cycle assessment in accordance with the sustainable construction evaluation system) can be used. For further information and explanations refer to www.nachhaltigesbauen.de.

For this EPD the following applies:
For an EPD "cradle to factory gate with options", with modules C1-C4 and module D (A1-A3 + C + D and one or more additional modules from A4 to B7), the specification of a reference service life (RSL) is only possible if the reference service life conditions are specified.
According to the BBSR table, the reference service life (RSL) of the Dennert DX ceiling (DX20) and Dennert wall system of company Dennert Baustoffwelt GmbH & Co. KG is optionally specified with ≥ 50 years.

The service life is dependent on the characteristics of the product and in-use conditions. The conditions and characteristics described in the EPD are applicable, in particular the characteristics listed below:

- Outdoor environment: Climatic influences may have a negative impact on the service life.

- Indoor environment: No impacts (e.g. humidity, temperature) known that have a negative effect on the service life.

The service life solely applies to the characteristics specified in this EPD or the corresponding references.
The RSL does not reflect the actual life time, which is usually determined by the service life and the redevelopment of a building. It does not give any information on the useful life, warranty referring to performance characteristics or guarantees.

5 End-of-life stage

Possible end-of-life stages

The products Dennert DX ceiling (DX20) and Dennert wall system are shipped to central collection points. There the products are usually shredded and sorted into their constituents. The end-of-life stage depends on the site where the products are used and is therefore subject to the local regulations. Observe the locally applicable regulatory requirements.

In this EPD, the modules of after-use are presented according to the market situation.
Concrete/construction debris is recycled to certain parts. Residual fractions are sent to landfill.

Disposal routes

The LCA includes the average disposal routes.

All life cycle scenarios are detailed in the Annex.

6 Life Cycle Assessment (LCA)

Environmental product declarations are based on life cycle assessments (LCAs) which use material and energy flows for the calculation and subsequent representation of environmental impacts.

As a basis for this, life cycle assessments were prepared for Dennert DX ceiling (DX20) and Dennert wall system. These LCAs are in conformity with the requirements set out in DIN EN 15804 and the international standards DIN EN ISO 14040, DIN EN ISO 14044, ISO 21930 and EN ISO 14025.

The LCA is representative of the products presented in the Declaration and the specified reference period.

6.1 Definition of goal and scope

Aim

The goal of the LCA is to demonstrate the environmental impacts of the products. In accordance with DIN EN 15804, the environmental impacts covered by this Environmental Product Declaration are presented for the entire product life cycle in the form of basic information. No other additional environmental impacts are specified.

Data quality, data availability and geographical and time-related system boundaries

The specific data originate exclusively from the 2021 fiscal year. They were collected on-site at the plant located in Wörnitz (Dennert DX ceiling (DX20)) or in Schlüsselfeld (Dennert wall system) and originate in parts from company records and partly from values directly obtained by measurement. The data represent the specific concrete formulation of Dennert Baustoffwelt GmbH & Co. KG.

The generic data originate from the “GaBi 10” professional and building materials databases. The last update of both databases was in 2022. Data from before this date originate also from these databases and are not more than four years old. No other generic data were used for the calculation.

Data gaps were either filled with comparable data or conservative assumptions, or the data were cut off in compliance with the 1% rule.

The life cycle was modelled using the sustainability software tool “GaBi” for the development of life cycle assessments.

Scope / system boundaries

The system boundaries refer to the procurement of raw materials and purchased parts, the production and the after-use of Dennert DX ceiling (DX20) and Dennert wall system.
No additional data from pre-suppliers/subcontractors or other sites were taken into consideration.

Cut-off criteria

All company data collected, i.e. all commodities/input and raw materials used, the thermal energy and electricity consumption, were taken into consideration.

The boundaries cover only the product-relevant data. Building sections/parts of facilities that are not relevant to the manufacture of the products, were excluded.

The transport distances of the pre-products used were taken into consideration site-specifically as a function of 100% of the mass of the products.
The following assumption was made for the means of transport:

- Truck, more than 32 t gross weight / 24.7 t payload, Euro 6, freight, 85 % capacity utilization.

The criteria for the exclusion of inputs and outputs as set out in DIN EN 15804 are fulfilled. From the data analysis it can be assumed that the total of negligible processes per life cycle stage does not exceed 1% of the mass/primary energy. This way the total of negligible processes does not exceed 5% of the energy and mass input. The life cycle calculation also includes material and energy flows that account for less than 1%.

6.2 Inventory analysis

Aim

All material and energy flows are described below. The processes covered are presented as input and output parameters and refer to the declared/functional units.

Life cycle stages

The complete life cycle of Dennert DX ceiling (DX20) and Dennert wall system is shown in the annex. The product stage "A1 – A3", end-of-life stage "C1 – C4" and the benefits and loads beyond the system boundaries "D" are considered.

Benefits

The below benefits have been defined as per DIN EN 15804:

- Benefits from recycling
- Benefits (thermal and electrical) from incineration

Allocation of co-products

No allocations occur during production.

Allocations for re-use, recycling and recovery

If the products are reused/recycled and recovered during the product stage (rejects), the elements are shredded, if necessary and then sorted into their constituents. This is done by various process plants, e.g. magnetic separators.
The system boundaries were set following their disposal, reaching the end-of-waste status.

Allocations beyond life cycle boundaries

The use of recycled materials in the manufacturing process was based on the current market-specific situation. In parallel to this, a recycling potential was taken into consideration that reflects the economic value of the product after recycling (recyclate).
Secondary material designated as inputs to Dennert DX ceiling (DX20) and Dennert wall system is calculated as input without loads. No benefits are assigned to Module D, but consumption to Module C3 (worst case consideration).
The system boundary set for the recycled material refers to collection.

Secondary material

The use of secondary material by Dennert Baustoffwelt GmbH & Co. KG was considered in Module A3. Secondary material is used.

Inputs

The following manufacturing-related inputs were included in the LCA per 1 m² Dennert DX ceiling (DX20) and Dennert wall system:

Energy
For the input material gas, "Thermal energy from natural gas Germany" was assumed. For the electricity mix, the "Electricity Mix 2020 Germany" and "Electricity from Photovoltaics Germany" (only for the declared product: Dennert DX ceiling DX 20) were assumed.

Water
The water consumed by the individual process steps for the manufacture amounts to a total of 12.74 l per 1 m² of Dennert DX ceiling (DX20) and 21.92 l per 1 m² of Dennert wall system.
The consumption of fresh water specified in Section 6.3 originates (among others) from the process chain of the pre-products.

Raw material/Pre-products

The charts below show the share of raw materials/pre-products in percent.

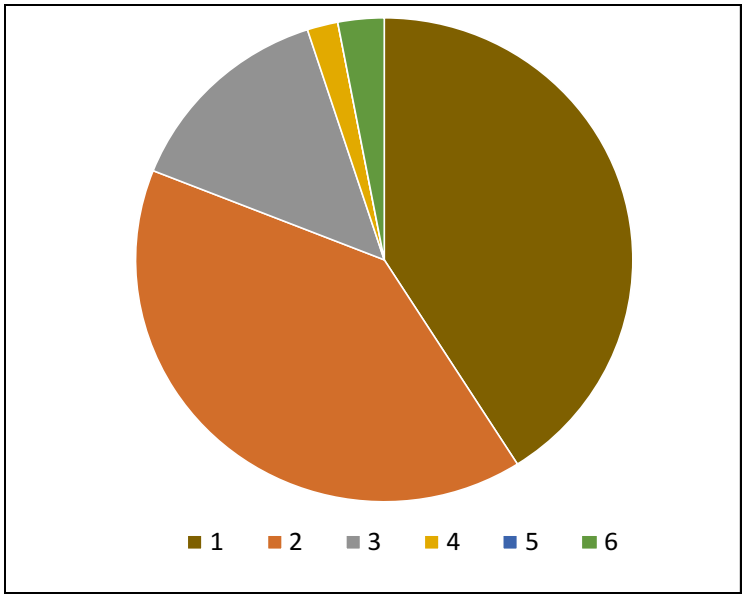


Illustration 1 Percentage of individual materials per declared unit Dennert DX ceiling (DX20)

No.	Material	Mass in %
1	Sand	41
2	Grit	40
3	Cement	14
4	Limestone meal	2
5	Superplasticizer	< 1
6	Reinforcement	3

Table 2 Percentage of individual materials per declared unit Dennert DX ceiling (DX20)

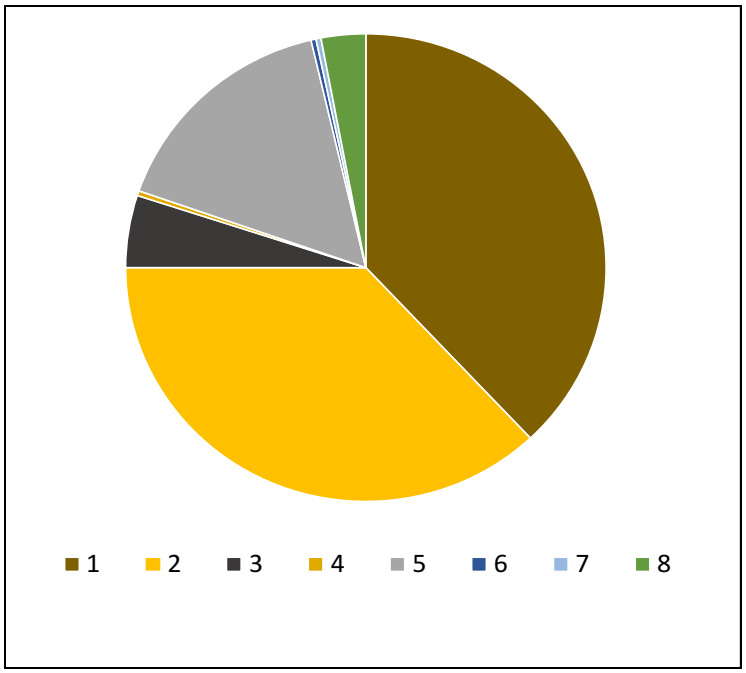


Illustration 2 Percentage of individual materials per declared unit Dennert wall system

No.	Material	Mass in %
1	Sand	38
2	Gravel	37
3	Expanded shale	5
4	Pumice	< 1
5	Cement	16
6	Superplasticizer	< 1
7	Hardening accelerator	< 1
8	Reinforcement	3

Table 3 Percentage of individual materials per declared unit Dennert wall system

Ancillary materials and consumables
There are no ancillary materials and consumables used.

Product packaging
There is no product packaging.

Biogenic carbon content
The biogenic carbon content is neglected and not reported, as the total mass of biogenic carbon-containing materials is less than 5% of the total mass of the product and associated packaging and the mass of biogenic carbon-containing materials in the packaging is less than 5 % of the total mass of the packaging.

Outputs

The following manufacturing-related outputs were included in the LCA per 1 m² Dennert DX ceiling (DX20) and Dennert wall system:

Waste
Secondary raw materials were included in the benefits.
See Section 6.3 Impact assessment.

Waste water
No waste water is produced during the manufacturing process.

6.3 Impact assessment

Aim

The impact assessment covers both inputs and outputs. The impact categories applied are stated below:

Impact categories

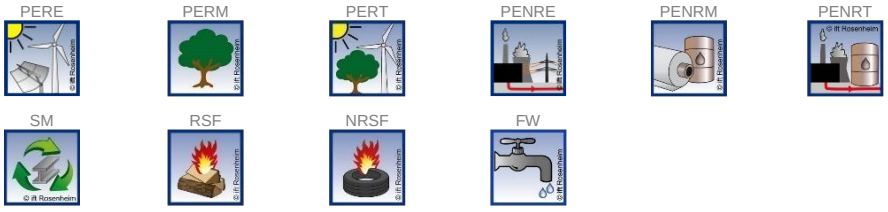
The models for impact assessment were applied as described in DIN EN 15804-A2.
The impact categories presented in the EPD are as follows:

- Depletion of abiotic resources - minerals and metals,
- Depletion of abiotic resources - fossil fuels,
- Acidification;
- Ozone depletion;
- Climate change - total,
- Climate change - fossil;
- Climate change - biogenic;
- Climate change - land use and land use change,
- Eutrophication freshwater;
- Eutrophication salt water;
- Eutrophication land;
- Photochemical ozone creation;
- Water use.

Resource management

The models for impact assessment were applied as described in DIN EN 15804-A2.
The following resource use indicators are presented in the EPD:

- Renewable primary energy as energy source;
- Renewable primary energy for material use;
- Total use of renewable primary energy;
- Non-renewable primary energy as energy source;
- Renewable primary energy for material use;
- Total use of non-renewable primary energy;
- Use of secondary materials;
- Use of renewable secondary fuels;
- Use of non-renewable secondary fuels;
- Net use of freshwater resources.

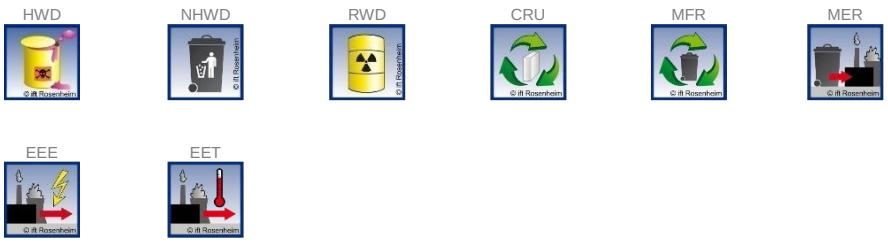


Waste

The waste generated during the production of 1 m² of Dennert DX ceiling (DX20) and Dennert wall system is evaluated and shown separately for the fractions trade wastes, special wastes and radioactive wastes. Since waste handling is modelled within the system boundaries, the amounts shown refer to the deposited wastes. A portion of the waste indicated is generated during the manufacture of the pre-products.

The models for impact assessment were applied as described in DIN EN 15804-A2.
The following waste categories and indicators for output closures are presented in the EPD:

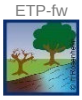
- Disposed hazardous waste;
- Disposed non-hazardous waste;
- Radioactive waste disposed;
- Components for re-use;
- Materials for recycling;
- Materials for energy recovery;
- Exported electrical energy;
- Exported thermal energy.



Additional environmental impact indicators

The models for impact assessment were applied as described in DIN EN 15804-A2.
The additional impact categories presented in the EPD are as follows:

- Fine dust missions,
- Ionizing radiation, human health,
- Ecotoxicity (freshwater),
- Human toxicity, carcinogenic effects,
- Human toxicity, non-carcinogenic effects,
- Impacts associated with land use/soil quality.

Product Manager 
IRP 
ETP-fw 
HTP-c 
HTP-nc 
SQP 

Results per 1 m² Dennert DX ceiling (DX20)																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Core indicators																
GWP-t	kg CO_2 equivalent	48.25	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.20	0.51	0.77	0.28	-1.50
GWP-f	kg CO_2 equivalent	48.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.19	0.50	0.76	0.27	-0.67
GWP-b	kg CO_2 equivalent	0.21	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.33E-03	2.07E-04	1.87E-03	8.34E-03	-0.83
GWP-l	kg CO_2 equivalent	1.11E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.03E-04	1.88E-03	2.33E-03	5.20E-04	-1.54E-03
ODP	kg CFC-11-eq.	4.97E-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.69E-14	7.19E-14	2.07E-12	6.70E-13	-5.34E-12
AP	mol H^+-eq.	4.80E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.20E-04	4.50E-04	3.76E-03	2.00E-03	-2.24E-03
EP-fw	kg P-eq.	4.51E-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.90E-07	1.04E-06	1.75E-06	4.79E-07	-1.90E-06
EP-m	kg N-eq.	1.54E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.37E-04	1.45E-04	1.75E-03	5.11E-04	-8.74E-04
EP-t	mol N-eq.	0.15	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.84E-03	1.75E-03	1.93E-02	5.61E-03	-9.63E-03
POCP	kg NMVOC-eq.	4.28E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.23E-03	3.89E-04	4.72E-03	1.55E-03	-2.06E-03
ADPF*²	MJ	247.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.51	6.70	14.50	3.69	-8.86
ADPE*²	kg Sb equivalent	4.91E-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.95E-08	5.21E-08	8.66E-07	2.90E-08	-1.52E-07
WDP*²	m^3 world-eq. deprived	0.99	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.39E-04	1.98E-03	0.13	3.07E-02	-1.68E-02
Resource management																
PERE	MJ	112.82	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.15	0.40	1.42	0.57	-2.81
PERM	MJ	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
PERT	MJ	112.82	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.15	0.40	1.42	0.57	-2.81
PENRE	MJ	247.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.51	6.71	14.50	3.70	-8.87
PENRM	MJ	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
PENRT	MJ	247.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.51	6.71	14.50	3.70	-8.87
SM	kg	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
RSF	MJ	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
NRSF	MJ	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
FW	m^3	7.99E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.3E-04	3.47E-04	3.75E-03	9.34E-04	-1.48E-03
Categories of waste																
HWD	kg	2.20E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.16E-11	3.10E-11	1.95E-10	1.90E-10	-3.92E-10
NHWD	kg	2.98	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.97E-04	1.10E-03	4.32E-03	18.90	-6.03
RWD	kg	9.39E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.52E-06	6.74E-06	1.11E-04	4.05E-05	-2.78E-04
Output material flows																
CRU	kg	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
MFR	kg	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	289.21	0.00	0.00
MER	kg	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
EEE	MJ	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
EET	MJ	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00

Key:
GWP-t – global warming potential - total **GWP-f** – global warming potential fossil fuels **GWP-b** – global warming potential - biogenic **GWP-l** – global warming potential - land use and land use change **ODP** – ozone depletion potential **AP** - acidification potential **EP-fw** - eutrophication potential - aquatic freshwater **EP-m** - eutrophication potential - aquatic marine **EP-t** - feutrophication potential - terrestrial **POCP** - photochemical ozone formation potential **ADPF*²** - abiotic depletion potential – fossil resources **ADPE*²** - abiotic depletion potential –minerals&metals **WDP*²** – Water (user) deprivation potential **PERE** - Use of renewable primary energy **PERM** - use of renewable primary energy resources **PERT** - total use of renewable primary energy resources **PENRE** - use of non-renewable primary energy **PENRM** - use of non-renewable primary energy resources **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** - net use of fresh water **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 **EET** - exported thermal energy

Results per 1 m² Dennert DX ceiling (DX20)																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Additional environmental impact indicators																
PM	Disease incidence	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IRP*[1]	kBq U235-eq.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw*[2]	CTUe	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-c*[2]	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-nc*[2]	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SQP*[2]	dimensionless	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Key:
PM – particulate matter emissions potential **IRP*[1]** – ionizing radiation potential – human health **ETP-fw*[2]** - Eco-toxicity potential – freshwater **HTP-c*[2]** - Human toxicity potential – cancer effects **HTP-nc*[2]** - Human toxicity potential – non-cancer effects **SQP*[2]** – soil quality potential

Disclaimers:

*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.

*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 experience with the indicator.

Results per 1 m² Dennert wall system																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Core indicators																
GWP-t	kg CO_2 equivalent	52.36	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.19	0.49	0.75	0.26	-2.60
GWP-f	kg CO_2 equivalent	52.31	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.18	0.49	0.74	0.25	-0.63
GWP-b	kg CO_2 equivalent	3.29E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.11E-03	2.01E-04	1.82E-03	8.09E-04	-1.93
GWP-l	kg CO_2 equivalent	1.68E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.85E-04	1.83E-03	2.27E-03	5.04E-04	-1.46E-03
ODP	kg CFC-11-eq.	3.27E-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.62E-14	6.99E-14	2.01E-12	6.49E-13	-5.05E-12
AP	mol H^+-eq.	9.46E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.96E-04	4.30E-04	3.66E-03	1.94E-03	-2.12E-03
EP-fw	kg P-eq.	6.17E-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.80E-07	1.01E-06	1.71E-06	4.64E-07	-1.80E-06
EP-m	kg N-eq.	1.90-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.26E-04	1.27E-04	1.75E-03	4.95E-04	-8.27E-04
EP-t	mol N-eq.	0.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.71E-03	1.51E-03	1.88E-02	5.44E-03	-9.10E-03
POCP	kg NMVOC-eq.	5.65E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.19E-03	3.45E-04	4.60E-03	1.50E-03	-1.95E-03
ADPF*²	MJ	277.50	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.44	6.51	14.1	3.58	-8.37
ADPE*²	kg Sb equivalent	4.78E-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.90E-08	5.06E-08	8.44E-07	2.82E-08	-1.44E-07
WDP*²	m^3 world-eq. deprived	1.18	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.20E-04	1.92E-03	0.13	2.98E-02	-1.59E-02
Resource management																
PERE	MJ	93.82	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.14	0.38	1.38	0.54	-2.65
PERM	MJ	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
PERT	MJ	93.82	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.14	0.38	1.38	0.54	-2.65
PENRE	MJ	277.50	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.44	6.51	14.10	3.58	-8.38
PENRM	MJ	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
PENRT	MJ	277.50	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.44	6.51	14.10	3.58	-8.38
SM	kg	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
RSF	MJ	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
NRSF	MJ	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
FW	m^3	9.89E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.26E-04	3.37E-04	3.65E-03	9.05E-04	-1.40E-03
Categories of waste																
HWD	kg	1.51E-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.13E-11	3.01E-11	1.90E-10	1.84E-10	-3.71E-10
NHWD	kg	7.67	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.87E-04	1.03E-03	4.21E-03	18.30	-5.70
RWD	kg	1.07E-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.55E-06	6.74E-06	1.09E-04	3.92E-05	-2.63E-04
Output material flows																
CRU	kg	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
MFR	kg	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	281.70	0.00	0.00
MER	kg	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
EEE	MJ	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
EET	MJ	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00

Key:
GWP-t – global warming potential - total **GWP-f** – global warming potential fossil fuels **GWP-b** – global warming potential - biogenic **GWP-l** – global warming potential - land use and land use change **ODP** – ozone depletion potential **AP** - acidification potential **EP-fw** - eutrophication potential - aquatic freshwater **EP-m** - eutrophication potential - aquatic marine **EP-t** - feutrophication potential - terrestrial **POCP** - photochemical ozone formation potential **ADPF*²** - abiotic depletion potential – fossil resources **ADPE*²** - abiotic depletion potential –minerals&metals **WDP*²** – Water (user) deprivation potential **PERE** - Use of renewable primary energy **PERM** - use of renewable primary energy resources **PERT** - total use of renewable primary energy resources **PENRE** - use of non-renewable primary energy **PENRM** - use of non-renewable primary energy resources **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** - net use of fresh water **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 **EET** - exported thermal energy

Results per 1 m² Dennert wall system																
	Unit	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Additional environmental impact indicators																
PM	Disease incidence	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IRP*[1]	kBq U235-eq.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw*[2]	CTUe	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-c*[2]	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-nc*[2]	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SQP*[2]	dimensionless	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Key:
PM – particulate matter emissions potential **IRP*[1]** – ionizing radiation potential – human health **ETP-fw*[2]** - Eco-toxicity potential – freshwater **HTP-c*[2]** - Human toxicity potential – cancer effects **HTP-nc*[2]** - Human toxicity potential – non-cancer effects **SQP*[2]** – soil quality potential

Disclaimers:

*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.

*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 experience with the indicator.

6.4 Interpretation, LCA presentation and critical review

Evaluation

The environmental impacts of

- Dennert DX ceiling (DX20)
- Dennert wall system

The LCA results show that for the declared product Dennert DX ceiling (DX20), the cement and reinforcement used are primarily decisive for the environmental impact. A secondary role is played by the transport, the aggregates (sand and lime chippings), the superplasticizer and the manufacturing process.
The environmental impacts of Dennert wall systems are also most influenced by the cement or reinforcement used in all environmental categories. The production process, transport, aggregates (sand, gravel, pumice) and superplasticizer/hardening accelerator play a subordinate role in the environmental impact.
The charts below show the allocation of the main environmental impacts.

The values obtained from the LCA calculation are suitable for the certification of buildings.

Diagrams

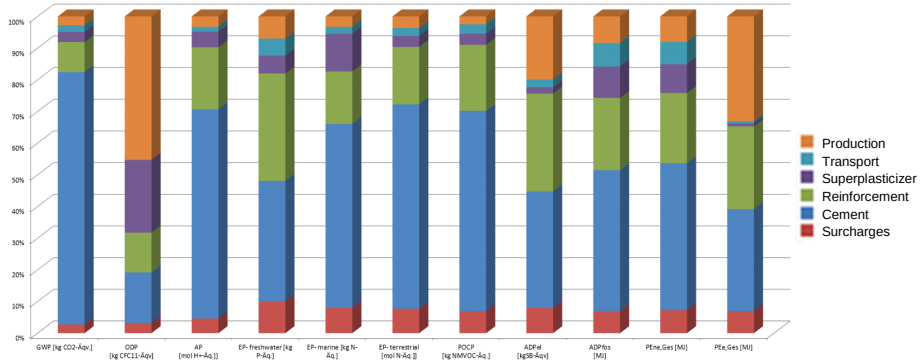


Illustration 3 Percentage shares of components, production and transport in the production stage in selected environmental impact indicators of Dennert DX ceiling (DX 20)

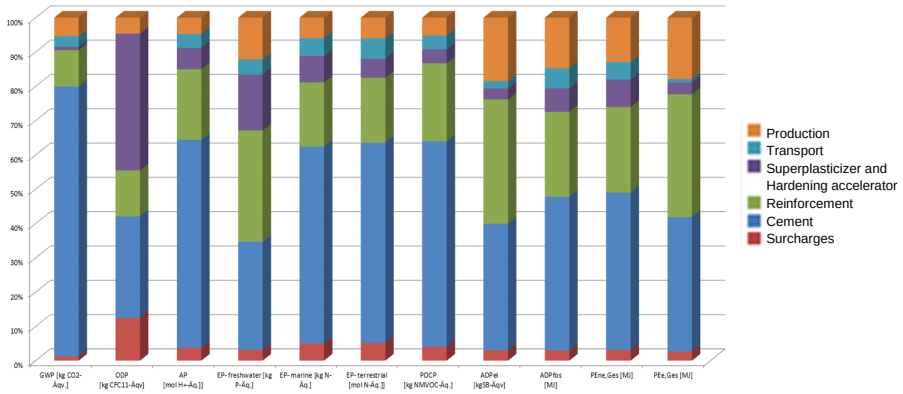


Illustration 4 Percentage shares of components, production and transport in the production stage in selected environmental impact indicators of Dennert wall systems

Report

The LCA report underlying this EPD was developed according to the requirements of DIN EN ISO 14040 and DIN EN ISO 14044 as well as DIN EN 15804 and DIN EN ISO 14025. It is deposited with ift Rosenheim. The results and conclusions reported to the target group are complete, correct, without bias and transparent. The results of the study are not designed to be used for comparative statements intended for publication.

Critical review

The critical review of the LCA and of the report took place in the course of verification of the EPD and was carried out by the external auditor Prof. Dr.-Ing. Eric Brehm.

7 General information regarding the EPD

Comparability

This EPD was prepared in accordance with DIN EN 15804 and is therefore only comparable to those EPDs that also comply with the requirements set out in DIN EN 15804.
Any comparison must refer to the building context and the same boundary conditions of the various life cycle stages.
For comparing EPDs of construction products, the rules set out in DIN EN 15804, Clause 5.3, apply.

Communication

The communications format of this EPD meets the requirements of EN 15942:2012 and is therefore the basis for B2B communication. Only the nomenclature has been changed according to DIN EN 15804.

Verification

Verification of the Environmental Product Declaration is documented in accordance with the ift "Richtlinie zur Erstellung von Typ III Umweltproduktdeklarationen" (Guidance on preparing Type III Environmental Product Declarations) in accordance with the requirements set out in DIN EN ISO 14025.

This declaration is based on the PCR documents "PCR Part A" PCR-A-0.3:2018 and "Construction products made of concrete and concrete elements" PCR PB-1.1: 2020.

The European standard EN 15804 serves as the core PCR [a)]
Independent verification of the Declaration and statement according to EN ISO 14025:2010 ☐ internal ☒ external
Independent third party verifier: [b)] Eric Brehm
[a)] Product category rules [b)] Optional for business-to-business communication Mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4).

Revisions of this document

No.	Date	Note	Person in charge	Testing personnel
1	24.05.2023	External verification	Pscherer	Brehm

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9 Annex

Description of life cycle scenarios for Dennert DX ceiling (DX20) and Dennert wall system

Product stage			Con-struction process stage		Use stage							End-of-life stage				Benefits and loads beyond system boundaries
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Production	Transport	Construction/installation process	Use	maintenance	Repair	replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/demolition	Transport	Waste processing	Disposal	Reuse Recovery Recycling potential
✓	✓	✓	—	—	✓	—	—	—	—	—	—	✓	✓	✓	✓	✓

The scenarios were based on information provided by the manufacturer.

The carbonation to be optionally considered according to EN 16757 as a function of the modeled storage period is taken into account in module B1. Storage after demolition is not considered or considered zero.
Carbonation is a natural process that occurs during the life cycle of concrete. This can be taken into account in the use phase, disposal phase as well as the manufacturing phase of the product. For concrete, this means that during the use and disposal phases of a building, some of the carbon dioxide emitted during cement production is recaptured in the concrete.

Note: The standard scenarios selected are presented in bold type. They were also used for calculating the indicators in the summary table.

- ✓ Included in the LCA
- — Not included in the LCA

A5 Construction/installation - not considered, informative module		
No.	**Scenario**	**Description**
A5	**Disposal of packaging**	**There is no packaging involved. Module A5 has not been declared and is listed here as an informative module.**
In the selected scenario, no environmental impacts arise from the use of packaging.		

C1 Deconstruction		
No.	**Scenario**	**Description**
C1	**Deconstruction**	**100% deconstruction rate of the declared products and their inputs. Deconstruction is carried out by excavators (diesel-powered, 100 kW). Further deconstruction rates are possible, give adequate reasons.**
No relevant inputs or outputs apply to the scenario selected. No transport expenses during dismantling are generated. Ancillary materials, consumables, leaching, direct emissions, waste materials and other scenarios are negligible. Since this is a single scenario, the results are shown in the relevant summary table. In case of deviating consumption the removal of the products forms part of site management and is covered at the building level.		

C2 Transport		
No.	**Scenario**	**Description**
C2	**Transport**	**Transport to collection point with truck (Euro 6) more than 32 t gross weight, diesel, 24 t payload, 85 % capacity used, 25 km**
Since this is a single scenario, the results are shown in the relevant summary table.		

C3 Waste management		
No.	**Scenario**	**Description**
C3	**Current market situation**	**Share for recirculation of materials:** • **Construction waste 93.9 % Recycling;** • **Remainder to landfill/disposal,** (Circular Economy Construction, Monitoring Report 2018)

Electricity consumption is included in the "Construction waste processing" data set.

The below table presents the disposal processes and their percentage by mass/weight. The calculation is based on the above mentioned shares in percent related to the declared unit of the product system.

C3 Disposal	Unit	Dennert DX ceiling (DX20)	Dennert wall system
Collection process, collected separately	kg	308	300
Collection process, collected as mixed construction waste	kg	0	0
Recovery system, for re-use	kg	0	0
Recovery system, for recycling	kg	289.21	281.70
Recovery system, for energy recovery	kg	0	0
Disposal	kg	18.79	18.30

The 100% scenarios differ from the average current recovery (C3.4). The evaluation of each scenario is described in the background report.

Since this is a single scenario, the results are shown in the summary table.

C4 Disposal

No.	Scenario	Description
C4	**Disposal**	**The non-recordable amounts and losses within the re-use/recycling chain (C1 and C3) are modelled as “disposed” (DE).**

The 100% scenarios differ from the average current recovery (C4.4). The evaluation of each scenario is described in the background report.

The consumption in scenario C4 results from physical pre-treatment, waste recycling and management of the disposal site. The benefits obtained here from the substitution of primary material production are allocated to Module D, e.g. electricity and heat from waste incineration.

Since this is a single scenario, the results are shown in the summary table.

D Benefits and loads from beyond the system boundaries		
No.	**Scenario**	**Description**
D	**Recycling potential**	• **Construction waste from C3 replaces 94% gravel 2/32** • **Steel scrap (reinforcement) from C3 already consists of 100% secondary material and is therefore not credited**

The values in Module D result from deconstruction at the end of service life.

The 100% scenarios differ from the average current recovery (D4). The evaluation of each scenario is described in the background report.

For the environmental category global warming potential GWP, environmental impacts to be credited as a result of carbonation are determined according to DIN EN 16757 Annex BB and reported in Module D.

Since this is a single scenario, the results are shown in the summary table.

Imprint

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Notes
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