ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	Lindner Group
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-LIN-20250234-IBI1-EN
Issue date	20.08.2025
Valid to	19.08.2030

Metal Ceiling System

Lindner Group

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD VERIFIED

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1. General Information

Lindner Group

Programme holder

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number

EPD-LIN-20250234-IBI1-EN

This declaration is based on the product category rules:

Metal ceilings, 01.08.2021
(PCR checked and approved by the SVR)

Issue date

20.08.2025

Valid to

19.08.2030

Dipl.-Ing. Hans Peters
(Chairman of Institut Bauen und Umwelt e.V.)

Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

Metal Ceiling System

Owner of the declaration

Lindner Group
Bahnhofstraße 29
94424 Arnstorf
Germany

Declared product / declared unit

1 m² of Lindner Metal Ceiling system made of steel.

Scope:

The EPD refers to the metal ceiling system made of steel and applies for the following product types:

- LMD-B (Post cap ceilings)
- LMD-E (Hook-on and corridor ceilings)
- LMD-K (Cassette ceilings)
- LMD-St (Expanded metal ceilings)
- LMD-L (Baffle ceilings)
- LMD-DS (Canopy ceilings)
- LMD-TS (Torsion spring)
- Line S (Clean room post cap ceilings)
- Clip (Clean room cassette ceilings)

The production data collected refers to 2023. The metal ceiling systems made of steel are manufactured at the Lindner plant in Arnstorf.
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.

The EPD was created according to the specifications of EN 15804+A2. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally

Dr. Niels Jungbluth,
(Independent verifier)

2. Product

2.1 Product description/Product definition

Lindner metal ceiling systems made of steel are manufactured from folded, roll-formed and partially punched steel as full construction kits or individual components.
The construction kit comprises the ceiling panel and the substructure. Both the ceiling panel and the substructure are made of steel, can have various suspension heights and their design is aligned towards the shape, functional requirements and weight of the top layers.

System designations:

LMD-B (Post cap ceilings)
LMD-E (Hook-on and corridor ceilings)
LMD-K (Cassette ceilings)
LMD-St (Expanded metal ceilings)
LMD-L (Baffle ceilings)
LMD-DS (Canopy ceilings)
LMD-TS (Torsion Spring)
Line S (Clean room post cap ceilings)
Clip (Clean room cassette ceilings)

The declared product, Lindner Metal Ceiling Systems, is designed to meet a diverse array of architectural and functional requirements. The declared unit for this study is specified as 1m² of a metal ceiling system, encompassing both the panel and substructure components. This study's representativeness is anchored on the product with the highest sales within its category. In 2023, the most popular product was the Hook-on ceiling LMD-E 200/2, featuring dimensions of 1000x500 mm and a unit weight of 7.16 kg/m².
Across the product family, the total weight of metal ceiling systems ranges between 4.94 kg/m² and 35.70 kg/m². Detailed specifications and additional data for these products ensure comprehensive understanding and application across varied construction scenarios.
For the placing on the market of the product in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) *Regulation (EU) No. 305/2011 (CPR)* applies. The product needs a declaration of performance taking into consideration *EN 13964: 2014*, Suspended ceilings – Requirements and test methods.
For the application and use the respective national provisions apply.

2.2 Application

Lindner metal ceilings are primarily designed for indoor applications, providing functional and aesthetic solutions for various interior environments. These ceilings are suitable for a wide range of spaces, including commercial buildings, offices, healthcare facilities, and clean rooms, where they meet specific requirements for acoustics, hygiene, and design flexibility.
The metal ceilings described here are used in interior design as post-cap, insert, clamped and hook-in systems. The Line S and Clip type ceilings are used for applications in clean rooms, laboratories and hospitals. As an alternative, they can also be designed as canopy ceilings, baffle ceilings or expanded metal ceilings for ceiling panelling. The product is manufactured in accordance with the respective customer's requirements.

2.3 Technical Data

The technical specifications of the products within the scope of the EPD are listed in the table.

Structural data

Name	Value	Unit
Weighted sound absorption (/EN ISO 354/, /EN ISO 11654/)	≤ 0,75	-
Grammage	4.94 - 35.7	kg/m²
Approval of formaldehyde (/EN13964/)	Class E1	-

2.4 Delivery status

The metal ceiling construction kits or components are produced in individual sizes. Packaging is usually on pallets and/or in cardboard boxes. Area weight (kg/m²) depends on the specific product.
The area weight, measured in kg/m², varies depending on the specific product. While the declared unit is standardised to 1 kg/m² for consistency across the product group, further details on this standardisation are available in the annex.

2.5 Base materials/Ancillary materials

Name	Value	Unit
Steel	≥97	%
Surface coating	≤1.5	%
Acoustic non-woven (cellulose/glass)	≤1	%
Hotmelt adhesive	≤0.5	%

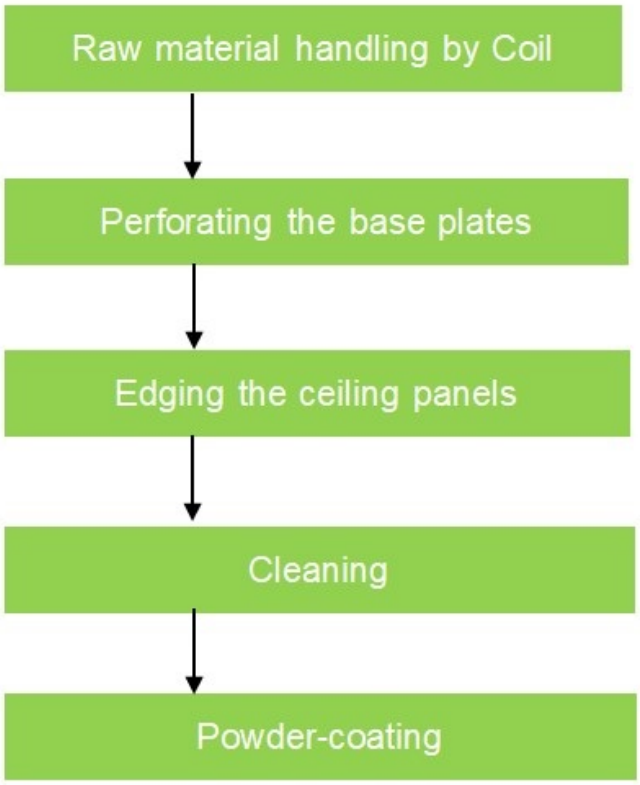
1) The product contains substances on the List of Candidates (/*REACh*/ 08.01.2019) exceeding 0.1% by mass: No

2) The product contains other carcinorgenic ,mutagenic,reprotoxic (CMR) substances in categories 1A or 1B which are not on the *List of Candidates*, exceeding 0.1% by mass: No

3) Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) *Ordinance on Biocide Products No. 528/2012):* No

2.6 Manufacture

The manufacturing process of the steel ceiling system commences with raw material handling by coil, preparing the steel coils for subsequent operations. The coils are perforated to produce base plates, integrating acoustic and aesthetic features. Edging follows, ensuring that the ceiling panels are precisely shaped for structural integrity and proper fit. Once the panels are shaped, they undergo a cleaning process to eliminate contaminants and prepare them for the next phase. Powder-coating is then applied to the cleaned panels, providing a protective, corrosion-resistant layer that enhances durability and visual appeal. Subsequently, a layer of acoustic non-woven material can be applied to the back of the panels in a continuous process to further enhance sound absorption qualities.
During production, punching and perforation waste is meticulously collected and redirected back into the external recycling facility. Quality assurance is strictly adhered to, in line with the applicable *EN 13964* standard, which outlines the requirements and test methods for suspended ceilings. This comprehensive manufacturing procedure ensures that the steel ceiling system not only meets high-performance standards but also aligns with sustainable practices, reflecting Lindner's commitment to quality and environmental responsibility.



2.7 Environment and health during manufacturing

Manufacturing conditions do not demand any particular health protection measures with the exception of those designated by the authorities for special working areas, e.g. high-visibility vests, ear protection, safety shoes. The MWC values (e.g. Germany) have fallen short of at each stage of the production process. Exhaust air generated during production is cleaned in accordance with statutory specifications. Emissions are below the TA Air/Water/Soil (technical instructions on air, water and soil quality): no contamination of water or soil. All of the values established inside and outside the production facilities are below the applicable requirements governing noise protection in Germany. Noise-intensive plant components such as perforation are insulated accordingly by structural measures. The statutory guidelines governing industrial protection for metal and drywall construction apply as well as the respective provisions of the construction industry.
Certificates and manufacturer-specific documents on environmental and health protection in accordance with *DIN EN ISO 14001* can be requested.

2.8 Product processing/Installation

The top layer of the metal ceiling system is attached to a substructure. Installation must be carried out by trained personnel, usually from the area of drywall construction.

2.9 Packaging

Wooden pallets, cardboard boxes, plastic sheeting and plastic bands are used for packaging the metal ceiling systems and components. The packaging material is easily separable and can be reused if necessary. Most of the packaging can be collected sorted by type and directed to regional recycling services. Residual materials must be disposed of in accordance with the respective national guidelines.

2.10 Condition of use

On the basis of long-term experience, there are no relevant changes concerning material composition for the period of use of metal ceiling systems.

2.11 Environment and health during use

When used normally and in accordance with the designated purpose, no health risks or restrictions are to be anticipated by metal ceiling systems in line with the current state of knowledge.

According to the present state of knowledge, hazards for water, air and soil cannot arise if the products in question are used as designated.

2.12 Reference service life

A reference service life in accordance with *ISO 15686* cannot be calculated for the product. Accordingly, the technical service life is derived from the 'Service life of components for life cycle analyses in accordance with the *BNB* assessment system for sustainable building – Code No. 353.211' table of the Federal Office of Building and Regional Planning /*BBSR*/.
BNB assumes that ceiling panelling made of metal is used for more than 50 years. The service life indicated is subject to proper use, maintenance and care. There is no influence of ageing on the material properties during the utilisation phase.

2.13 Extraordinary effects

Fire

Lindner metal ceiling systems are classified according to EN 13501-1.

Fire protection

Name	Value
Building material class	A2
Burning droplets	d0
Smoke gas development	s1

Water

No environmental influences are known in the case of unforeseen water ingress. The resistance of the ceiling system following the impact of water is dependent on the corrosion protection class in which the ceiling system is classified.

Mechanical destruction

In the event of mechanical destruction, all substances remain in a bound state. It can be assumed that in the case of coated ceiling panels, possible paint splinters arise in such small volumes that they do not result in any negative effects for the environment.

2.14 Re-use phase

Lindner metal ceiling systems can be removed and reused without damaging the product. During the reuse phase, the remaining fleece can be easily removed from the metal ceiling.

Metal top layers and substructure components made of steel can be redirected to material recycling if they are not reused. Non-woven material and varnish can be removed by melting.

2.15 Disposal

In accordance with the Waste Index Act /AVV/ and the European Waste Catalogue /EWC/, the waste key for steel as a component of metal ceiling systems made of steel is: 17 04 05 – Iron and steel.

2.16 Further information

Lindner Group, www.lindner-group.com

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit refers to 1 m² Lindner metal ceiling system comprising a cover panel and substructure. This unit is based on the most representative product sold Hook-on ceiling LMD-E 200/2 in 2023, with a weight of 7.16 kg/m².
Within the product family, the ceiling system varies from 4.94 to 35.70 kg/m².
The panels are perforated prior to delivery. The holes account for 20% of the surface. The overall weight was calculated accordingly.

Declared unit

Name	Value	Unit
Declared unit	1	m^2
Grammage	7.16	kg/m^2
Layer thickness	0,006	m

3.2 System boundary

The life cycle analysis for the Lindner metal ceiling system comprises the life cycle phases 'cradle to gate with options'.

Module A1-A3 | Production stage
The production phase for Lindner Metal Ceiling, encompassing Modules A1-A3, integrates all activities related to the extraction, processing, and manufacturing of raw materials. This stage includes crucial processes like perforating, punching, and edging steel sheets to create panels and substructures. Additionally, the boundary includes the production of auxiliary materials such as acoustic fleece and powder coating, which are essential for the final product's performance and aesthetics. The use of fuels for the transportation of materials and the packaging of steel ceilings are also considered to ensure they are ready for delivery. All these activities take place at Lindner's Arnstorf facility
The packaging of the products is considered in this stage.
A4-A5 | Construction phase
Module A4 accounts for the transportation of the product to the construction site, while Module A5 includes the installation phase, specifically addressing the management of waste generated from product packaging.
The modules are declared as 0 for the use phase (B1-B2). During the use phase, the product does not cause any environmental pollution.
The actual product does not require any maintenance; when used normally, neither repairs nor replacements can be anticipated during use in the building, nor does it incur any water or energy consumption during use.
Modules B3-B5 are declared as not relevant for construction products.
Modules B6 and B7 are not taken into consideration.
For the disposal phase, there are two scenarios developed to assess the end-of-life and reuse phases:

Scenario 0: Conventional Recycling: In this scenario, 95% of the metal ceiling system is assumed to be recycled. The remaining 5% of the system is directed to landfill.Regarding the steel fraction, the material flow reaching module D for recycling is declared as material for recycling in ModuleC3. Environmental impacts resulting from the grinding andsorting of steel scrap are not included, as referring energydemand is considered to be negligible. In addition, a loss rateof 5 % of the processed material is assumed. 95 % of the material can potentially be recycled. For the acoustic fleeceinlay and coating , the declared scenario is incinerated, therefore environmental impacts from the waste treatment of the fleeceinlay and coating are declared in C3.

Scenario 1: The deconstruction or disassembly of the product happens on the construction site by trained personnel, in order not to damage the product, no other burdens happen during the dismantling process. This scenario assumes that the metal ceiling system is disassembled and reused. Here, 80% of the product, including the ceiling panels, is remounted in a new building, thus extending its useful life. The remaining 20%, primarily the substructures that cannot be reused, are sent for recycling. For 20% recycling of steel, environmental impacts from the waste treatment of the fleece inlay are declared in C3/1.

Module C1:
This module includes the processes involved in the dismantling and demolition of the Metal Ceiling System from the building. It covers the sorting of materials on the construction site, particularly the separation of steel panels and substructures.
Module C2: It is assumed that the metal ceiling products are transported 100 km from the construction site to the nearest recycling centre.
Module C2/1: The 80% reused product is assumed to be transported 500 km to the new location. The remaining 20% is assumed to be transported 100 km from the construction site to the nearest recycling centre via diesel truck.
Module C3: The amount of 95% of the metal ceiling system is recycled and the environmental impacts from the waste treatment of the fleece inlay and coating are declared in C3.
Module C3/1: The amount of 20% of the metal ceiling system is recycled, and the environmental impacts from the waste treatment of the fleece inlay and coating are declared in C3/1
Module C4: The amount of 5% of the metal ceiling system is directed to landfill.
Module C4/1: The steel is more reused and the rest is recycled and does not contribute to landfill.
Module D & D/1: Credit from steel recycling for recycling from scenario 0 and Credit from reuse of 80% and the rest from steel recycling in scenario 1.

3.3 Estimates and assumptions

Specific or average data inventories for a certain material are not available for all materials. Assumptions of the amount of water and colour adhering to the panel are applied to calculate the steam water from the manufacturing process.

3.4 Cut-off criteria

All data from the operating data survey was offset, i.e. all starting materials used according to the manufacturing guidelines, the thermal energy used as well as electricity. The machinery and plants required during manufacturing were not reviewed.

Material flows of 1% by mass are considered. Energy flows accounting for a share of less than 1% are also considered. No known material flows were caused which would make significant contributions to the declared environmental impacts. However, the following sub/ancillary processes were excluded from the analysis due to the unavailability of data collection:
- Packaging waste from semi-finished products supplied to the production sites,
- Additives used in the coating process,
- Glue is used for attaching the fleece.

3.5 Background data

/LCA FE/ - the software system for life cycle analysis developed by thinkstep AG – was used for modelling the life cycle of the product under review (service pack 35). The data required for the upstream chain for which no specific details are available, is taken from the */LCA FE data base/* https://lcadatabase.sphera.com// (MLC Professional and Extension DB XIV Construction materials).

3.6 Data quality

The background data gives rise to some minor uncertainties owing to the provision of *LCA FE* data bases and which must be taken into consideration when interpreting the results. The data quality assessment considers technical, time-based, and geographical representativeness. The background data is no more than 5 years old. The data quality can be regarded as good.

3.7 Period under review

The data for this Life Cycle Assessment is based on a data survey from 2023.

3.8 Geographic Representativeness

Land or region, in which the declared product system is manufactured, used or handled at the end of the product´s lifespan: Europe

3.9 Allocation

Total production by Lindner AG comprises other products as well as the product reviewed here. While collecting data, the values for thermal and electric energy as well as raw materials refer to the product to be declared.
The manufacturing processes for the steel ceiling system are difficult to break down into various sub-processes.
The declared product and other products manufactured in the production line follow the same manufacturing steps.
Apart from steel ceilings, Lindner AG also manufactures heating and cooling ceilings, whereby the ceiling surface is the same as for a normal steel ceiling, plus the heat-conducting profiles and the meander.
Profile manufacturing takes place in a separate manufacturing facility, whereby profiles can also form the substructure for other metal ceilings: aluminium ceilings, stainless steel ceilings, fire protection ceilings, and heated and chilled ceilings.
For this reason, allocation is based on physical properties, in this case,mass.
The production data was allocated by mass according to the annual volume of metal ceiling systems. The raw materials and energy were calculated in line with this allocation key.
In the production of profiles, profiles are manufactured for dry construction or wall production, along with the substructure for the ceilings under review. The requisite profiles for ceilings were classified by weight. Steel was allocated by size.
A low percentage leaves the product system as scrap but without incurring any loads. Conversion using the available input materials and the weight of the ceiling system was considered.

3.10 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 */LCA FE database/* was used (see section 8 References).

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

The biogenic carbon content quantifies the amount of biogenic carbon in a construction product leaving the factory gate, and it shall be separately declared for the product and for any accompanying packaging.
If the total mass of biogenic carbon containing materials is less than 5 % of the total mass of the product and accompanying packaging, the declaration of biogenic carbon content may be omitted. The mass of packaging containing biogenic carbon shall always be declared.

Information on describing the biogenic carbon content at factory gate

Name	Value	Unit
Biogenic carbon content in accompanying packaging	0.198	kg C

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

The scenarios on which the LCA is based are outlined in more detail below.

Transport to construction site (A4)

Name	Value	Unit
Litres of fuel	0.0437	l/100km
Transport distance	500	km

Construction installation process (A5)

On the construction site, the ceiling system is installed mechanically by experts; prior to installation, the packaging is removed and the panel with the substructure is installed. No environmental loads arise within the framework of construction.

Module A5 only comprises the environmental loads associated with disposal of the packaging.

Name	Value	Unit
Auxiliary (not considered)	-	kg
Water consumption (not relevant)	-	m^3
Other resources	-	kg
Electricity consumption (not relevant)	-	kWh
Other energy carriers (not relevant)	-	MJ
Material loss (not relevant)	-	kg
Output substances following waste treatment on site (ceiling packaging)	0.396	kg

Use (B1), please refer to 2.12 Use

The modules are declared as 0 for the use phase (B1-B2). This does not lead to any environmental loads when used as recommended by the manufacturer.

Maintenance (B2)

The actual product does not require any maintenance. During normal use, no repairs or replacements can be anticipated during use of the building. Replacements will only become necessary after 50 years, according to the assessment system for sustainable building (BNB).

Reference Service Life

A reference service life cannot be calculated for the product. According to *BNB*, a technical service life of approx. 50 years is assumed.

Name	Value	Unit
Life Span (acc. to BBSR)	50	a

End of life (C1-C4)

For the disposal phase of Lindner metal ceiling system, there are two scenarios developed to assess the end-of-life and reuse phases:
Scenario 0: Conventional Recycling: In this scenario, 95 % of

the metal ceiling system is assumed to be recycled at the end of its lifecycle. The remaining 5 % of the system, consisting of non-recyclable components or process losses, is directed to landfill.
Scenario 1: Reuse: When the product reaches the EOL, the Metal ceilings are manually dismantled by professionals and are taken back to a nearby facility to have a further quality check, while probably some of the substructures will be sent for recycling purposes. The product, which undergoes the full quality, check requirements, is then ready to be installed into a new location. Here, 80 % of the product, including the ceiling panels, is remounted in a new building, thus extending its useful life. The remaining 20 %, primarily the substructures that cannot be reused, are sent for recycling.

Name	Value	Unit
Recycling Scenario 0	6.802	kg
Landfilling Scenario 0	0.358	kg
Reuse Scenario 1	5.728	kg
Recycling Scenario 1	1.432	kg

Re-use, recovery and recycling potential (D), relevant scenario details
Scenario 0: Following dismantling, the steel is sent to an external recycling facility, with the steel recycling considered as a benefit. Module D accounts for all benefits and debits associated with the net flows that exit the product system.
Scenario 1: In addition to the steel sent for recycling, processed under Module D/1, 80 % of the product is reused in another building. This scenario provides benefits for the reused portion by eliminating the need for new product production, thereby avoiding the environmental impacts associated with the manufacturing processes in A1 to A3. The reduction in environmental burden is reflected in the reduced impacts from A1 to A3, as the reused steel ceiling system substitutes the production of a new product. Additionally, 20 % of the metal is sent to an external facility, with the steel recycling considered a benefit.

5. LCA: Results

The following table contains the life cycle assessment results for a declared unit of 1 m² Lindner Metal Ceiling System with the representative weight of 7.16 kg/m².

Scenario 0 is represented by C2, C3, C4, D
Scenario 1 is represented by C2/1, C3/1, C4/1, D/1

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

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	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 7.16 kg/m² 1 m² steel ceiling system weighing 7.16 kg

Parameter	Unit	A1-A3	A4	A5	C1	C2	C2/1	C3	C3/1	C4	C4/1	D	D/1
GWP-total	kg CO_2 eq	1.91E+01	6.48E-02	6.16E-01	0	6.09E-02	3.05E-01	2.94E-01	2.94E-01	1.66E-02	0	-1.13E+01	-1.65E+01
GWP-fossil	kg CO_2 eq	1.94E+01	6.48E-02	1.66E-01	0	6.08E-02	3.04E-01	2.94E-01	2.94E-01	1.67E-02	0	-1.13E+01	-1.66E+01
GWP-biogenic	kg CO_2 eq	-4.16E-01	-2.91E-04	4.5E-01	0	-2.76E-04	-1.38E-03	1.88E-05	1.88E-05	-2.07E-04	0	6.33E-02	8.56E-02
GWP-luluc	kg CO_2 eq	3.02E-02	3.89E-04	5.07E-06	0	3.67E-04	1.83E-03	6.09E-06	6.09E-06	1.7E-05	0	-1.5E-03	-2.29E-02
ODP	kg CFC11 eq	1.86E-11	1.6E-14	7.85E-14	0	1.07E-14	5.37E-14	5.35E-14	5.35E-14	2.76E-14	0	1.15E-11	-1.7E-11
AP	mol H^+ eq	4.15E-02	8.74E-05	1.48E-04	0	7.67E-05	3.83E-04	1.54E-04	1.54E-04	5.37E-05	0	-2.73E-02	-3.57E-02
EP-freshwater	kg P eq	1.09E-04	1.53E-07	2.83E-08	0	1.43E-07	7.15E-07	2.97E-08	2.97E-08	1.52E-08	0	-3.32E-06	-8.27E-05
EP-marine	kg N eq	1.12E-02	3.28E-05	4.9E-05	0	2.83E-05	1.42E-04	5.98E-05	5.98E-05	1.35E-05	0	-4.45E-03	-9.1E-03
EP-terrestrial	mol N eq	1.18E-01	3.87E-04	6.34E-04	0	3.37E-04	1.69E-03	6.82E-04	6.82E-04	1.48E-04	0	-4E-02	-9.54E-02
POCP	kg NMVOC eq	3.58E-02	7.76E-05	1.31E-04	0	6.68E-05	3.34E-04	1.56E-04	1.56E-04	4.22E-05	0	-1.79E-02	-2.98E-02
ADPE	kg Sb eq	8.23E-07	4.71E-09	7.03E-10	0	4.37E-09	2.18E-08	4.62E-10	4.62E-10	4.59E-10	0	-6.27E-05	-1.05E-05
ADPF	MJ	1.9E+02	8.84E-01	1.92E-01	0	8.32E-01	4.16E+00	1.42E-01	1.42E-01	2.5E-01	0	-1.14E+02	-1.63E+02
WDP	m^3 world eq deprived	3.99E-01	3.41E-04	6.92E-02	0	3.19E-04	1.6E-03	3.67E-02	3.67E-02	-2.27E-04	0	-7.51E-01	-4.18E-01

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; WDP = Water (user) deprivation potential)

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 7.16 kg/m² 1 m² steel ceiling system weighing 7.16 kg

Parameter	Unit	A1-A3	A4	A5	C1	C2	C2/1	C3	C3/1	C4	C4/1	D	D/1
PERE	MJ	1.09E+01	5.93E-02	6.43E+00	0	5.38E-02	2.69E-01	3.22E-02	3.22E-02	2.25E-02	0	2.72E+00	-1.12E+01
PERM	MJ	6.38E+00	0	-6.38E+00	0	0	0	0	0	0	0	0	0
PERT	MJ	1.72E+01	5.93E-02	4.76E-02	0	5.38E-02	2.69E-01	3.22E-02	3.22E-02	2.25E-02	0	2.72E+00	-1.12E+01
PENRE	MJ	1.83E+02	8.86E-01	8.06E+00	0	8.32E-01	4.16E+00	1.42E-01	1.42E-01	2.5E-01	0	-1.14E+02	-1.64E+02
PENRM	MJ	7.87E+00	0	-7.87E+00	0	0	0	0	0	0	0	0	0
PENRT	MJ	1.91E+02	8.86E-01	1.92E-01	0	8.32E-01	4.16E+00	1.42E-01	1.42E-01	2.5E-01	0	-1.14E+02	-1.64E+02
SM	kg	1.44E+00	0	0	0	0	0	0	0	0	0	0	-7.66E-01
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0
FW	m^3	2.27E-02	5.28E-05	1.63E-03	0	4.9E-05	2.45E-04	8.69E-04	8.69E-04	2.82E-06	0	-1.12E+00	-1.93E-01

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 – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 7.16 kg/m² 1 m² steel ceiling system weighing 7.16 kg

Parameter	Unit	A1-A3	A4	A5	C1	C2	C2/1	C3	C3/1	C4	C4/1	D	D/1

HWD	kg	1.86E-09	1.49E-12	4.54E-12	0	2.23E-12	1.11E-11	5E-12	5E-12	2.07E-11	0	-8.24E-07	-1.31E-07
NHWD	kg	6.05E-01	1.33E-04	2.96E-02	0	1.21E-04	6.07E-04	4.02E-02	4.02E-02	3.59E-01	0	1.33E+00	-2.5E-01
RWD	kg	1.99E-03	1.17E-06	9.72E-06	0	8.7E-07	4.35E-06	6.2E-06	6.2E-06	2.91E-06	0	-1.56E-04	-1.61E-03
CRU	kg	0	0	0	0	0	0	0	5.73E+00	0	0	0	0
MFR	kg	1.01E+00	0	0	0	0	0	6.8E+00	1.43E+00	0	0	0	-7.97E-01
MER	kg	0	0	0	0	0	0	0	0	0	0	0	0
EEE	MJ	1.83E-01	0	8.25E-01	0	0	0	0	0	0	0	0	-1.38E-01
EET	MJ	3.42E-01	0	1.52E+00	0	0	0	0	0	0	0	0	-2.6E-01

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 OF THE LCA – additional impact categories according to EN 15804+A2-optional: 7.16 kg/m² 1 m² steel ceiling system weighing 7.16 kg

Parameter	Unit	A1-A3	A4	A5	C1	C2	C2/1	C3	C3/1	C4	C4/1	D	D/1
PM	Disease incidence	6.32E-07	7.17E-10	1.02E-09	0	6.25E-10	3.13E-09	1.05E-09	1.05E-09	5.79E-10	0	-2.56E-07	-4.86E-07
IR	kBq U235 eq	1.98E-01	1.25E-04	1.51E-03	0	8.97E-05	4.48E-04	9.5E-04	9.5E-04	4.3E-04	0	2.31E-01	-1.21E-01
ETP-fw	CTUe	4.53E+01	6.45E-01	8.43E-02	0	6.25E-01	3.13E+00	7.19E-02	7.19E-02	7.44E-02	0	-6.44E+00	-3.51E+01
HTP-c	CTUh	2.33E-08	1.29E-11	7.77E-12	0	1.23E-11	6.17E-11	5.58E-12	5.58E-12	8.81E-12	0	4.48E-09	-1.69E-08
HTP-nc	CTUh	8.81E-08	5.4E-10	5.04E-10	0	5.1E-10	2.55E-09	4.58E-10	4.58E-10	8.41E-10	0	2.04E-08	-6.37E-08
SQP	SQP	1.15E+02	3.15E-01	5.61E-02	0	2.95E-01	1.48E+00	3.82E-02	3.82E-02	2.34E-02	0	-2.56E+00	-2.44E+01

PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

Disclaimer 1 – for the indicator “Potential Human exposure efficiency relative to U235”. 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 or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, radon and from some construction materials is also not measured by this indicator.

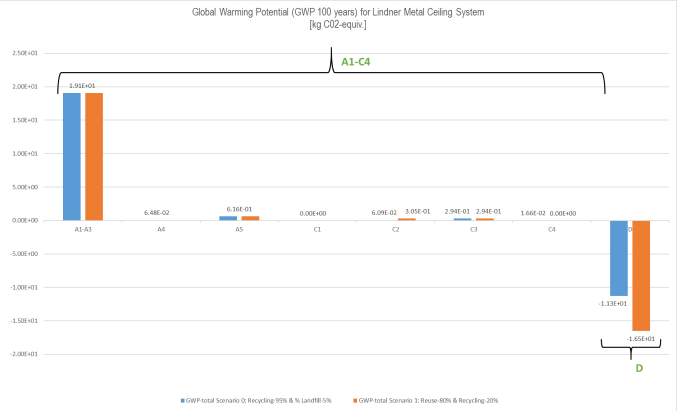
Disclaimer 2 – for the indicators “abiotic depletion potential for non-fossil resources”, “abiotic depletion potential for fossil resources”, “water (user) deprivation potential, deprivation-weighted water consumption”, “potential comparative toxic unit for ecosystems”, “potential comparative toxic unit for humans – cancerogenic”, “Potential comparative toxic unit for humans - not cancerogenic”, “potential soil quality index”. The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high as there is limited experience with the indicator.

6. LCA: Interpretation

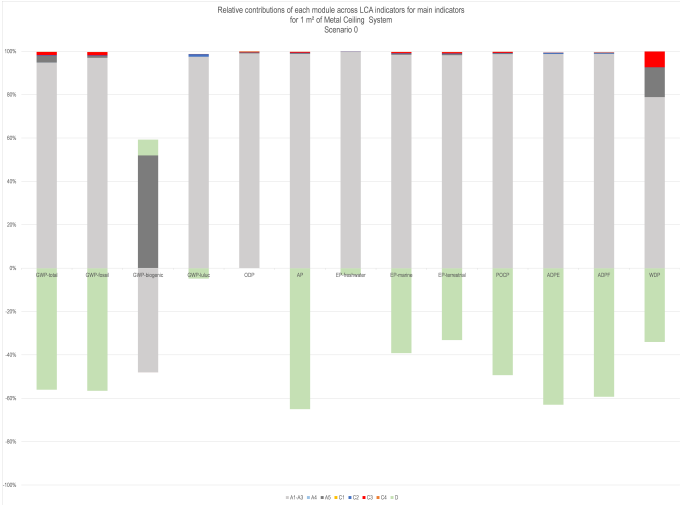
The Environmental Product Declaration (EPD) is valid for a product family, showing minimal differences in thickness, density, and weight, with deviations from the declared unit of 7.16 kg/m².

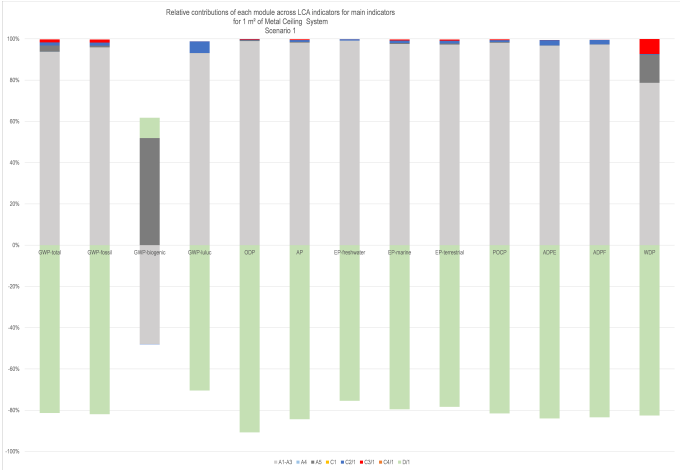
Total Global Warming Potential (GWP)

The total Global Warming Potential (GWP) across the life cycle of the Lindner Metal Ceiling System is depicted in the provided Scenario 0 (Recycling: 95 % & Landfill: 5 %) and Scenario 1 (Reuse: 80 % & Recycling: 20 %), the GWP for stages A1-A3 is 19.1 kg CO_2-equivalent, representing the most significant portion of the lifecycle's carbon footprint. In both scenarios, the GWP in Module C3 and C3/1 is 0.29 kg CO_2-equivalent. However, the fleece and coating are sent for incineration in Module C3 and C3/1 without any associated credits in Module D.



In Scenario 0, the total GWP in Module D is -11.3 kg CO_2-equivalent. This negative value indicates a substantial reduction in emissions due to the high percentage of recycling, emphasising the benefits of recovering raw materials for reuse. The benefits in Module D are partly derived from steel recycling.
In Scenario 1, the total GWP in Stage D/1 is even lower, at -16.5 kg CO_2-equivalent. This scenario displays a further reduction in emissions by repurposing 80 % of the system, which proves more effective than recycling alone. Reuse avoids the need for new production, significantly offsetting the initial GWP. Moreover, Scenario 1 benefits from the value of 20 % of the scrap steel sent to an external facility for recycling.





The two scenarios demonstrate that while the initial production phases (A1-A3) are the primary contributors to Global Warming Potential (GWP), the benefits of reuse and recycling, represented by Module D. Contributions from transportation (A4), installation and packaging waste (A5), and the intermediate phases (C1-C4) are comparatively minimal.

In Module D, scenario 0 achieves a reduction in GWP in Module D through the benefits of recycling. Extensive recycling of materials significantly offsets prior lifecycle emissions by reducing the need for new resource extraction and processing, despite a small portion being sent to landfill. Scenario 1 offers a major reduction in GWP in Module D, clearly showing the benefits of reuse. By transferring the ceiling system to another building, the scenario effectively eliminates the need for new production, highlighting the superior environmental benefits of reuse over recycling alone.

Acidification Potential (AP)

In both Scenario 0 and Scenario 1, the production phase primarily drives acidification potential due to emissions from industrial processes that contribute to acid rain and related environmental issues.
Module D illustrates a 65 % reduction, underscoring the benefits of recycling scrap steel. By recovering materials, recycling effectively reduces emissions that lead to acidification.
In Module D/1, an impressive 84 % reduction highlights the advantages of reuse. By avoiding the need for new product manufacturing, reuse significantly decreases acidification potential. This scenario benefits from reusing materials and the steel sent to an external facility for recycling. Specifically, Module D/1 also gains from the value of 20 % of the recycling of scrap steel, further reducing emissions associated with acidification.

Water Depletion Potential (WDP):

In both scenarios, WDP is primarily influenced by production (79 %), showing significant water consumption during manufacturing, also 14% share in module A5 due to packaging being incinerated, 7 % share of incineration of fleece and coating in C3.
In Module D, a 34 % reduction highlights the benefits of recycling scrap steel, aiding in water conservation by lessening the demand for new raw materials. Module D/1 demonstrates an even more substantial 83 % reduction, emphasising the role of reuse in conserving water resources by eliminating the need for further production. Furthermore, this module benefits from the value of 20 % of the scrap steel sent to an external facility for recycling

7. Requisite evidence

5.2 VOC Emission Test Results after 28 Days

	CAS No.	Retention time [min]	ID-Cat	Specific Conc. [µg/m³]	Toluene eq. [µg/m³]	Specific SER [µg/(m²·h)]	R_D	R_B
VOC with NIK/LCI								
None determined								
VOC without NIK/LCI								
None determined								
Sum of VOC without NIK/LCI				< 5	< 5	< 7		
VVOC compounds								
None determined								
TVVOC				< 5	< 5	< 7		
SVOC compounds								
None determined								
TSVOC				< 5	< 5	< 7		
Carcinogens								
Total carcinogens				< 1	< 1	< 2		
CMR substances								
Benzene	71-43-2		1	< 1		< 2		
Trichloroethylene	79-01-6		1	< 1		< 2		
Dibutylphthalate (DBP)*	84-74-2		1	< 1		< 2		
Diethylhexylphthalate (DEHP)*	117-81-7		1	< 1		< 2		
Aldehydes								
Formaldehyde	50-00-0		1	< 3		< 4		
Acetaldehyde	75-07-0		1	< 3		< 4		
Propionaldehyde	123-38-6		1	< 3		< 4		
Butyraldehyde	123-72-8		1	< 3		< 4		
Acrolein *	107-02-8		1	< 5		< 7		
2-Butenal *	123-73-9		1	< 5		< 7		
Glutaraldehyde *	111-30-8		1	< 5		< 7		
Octanal *	124-13-0		1	< 5		< 7		
Nonanal *	124-19-6		1	< 5		< 7		
Decanal *	112-31-2		1	< 5		< 7		
R-values							0	0

	CAS No.	Retention time [min]	ID-Cat	Specific Conc. [µg/m³]	Toluene eq. [µg/m³]	Specific SER [µg/(m²·h)]	R_D	R_B
TVOC				< 5	< 5	< 7		
TVOC (French label)					< 2			
Toluene	108-88-3			< 2	< 2	< 3		
Tetrachloroethylene	127-18-4			< 2	< 2	< 3		
Ethylbenzene	100-41-4			< 2	< 2	< 3		
Xylene	1330-20-7			< 2	< 2	< 3		
Styrene	100-42-5			< 2	< 2	< 3		
2-Butoxyethanol	111-76-2			< 2	< 2	< 3		
1,2,4-Trimethylbenzene	95-63-6			< 2	< 2	< 3		
1,4-Dichlorobenzene	106-46-7			< 2	< 2	< 3		

/Test report no. 1119/023825/ is available for the steel ceiling system. The institute responsible for testing was /Eurofins Product Testing/ A/S Smedeskovvej 38, DK-8464 Galten, Denmark.

Result:
The LMD metal ceiling panel product reviewed is suitable for use in interior areas in accordance with Requirements for structural installations with regard to health protection (ABG), draft 31.08.2017/August2018 (*AgBB*).

8. References

Ausschuss zur gesundheitlichen Bewertung von Bauprodukten
AgBB, updated list of LCI values 2002, Procedure for health-related evaluation of emissions of volatile organic compounds from construction products

AVV
Ordinance governing the European Waste Catalogue (List of Wastes – AVV). Issue date: 10.12.2001, last amended by Art. 1 V, dated 4.3.2016 I 382

CML 2001
Centrum voor Milieukunde (Institute of Environmental Sciences), Leiden University, The Netherlands: "Life Cycle Assessment, An operational guide to the ISO standards, Volume 1, 2 and 3", 2001

DIN 4102
DIN 4102-2:1977-09: Fire behaviour of building materials and building components – Part 2: Building materials, concepts, requirements and tests

DIN EN 13501
Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests; German version EN 13501-1:2010-01

DIN EN 13964
13964:2014-08: Suspended ceilings – Requirements and test methods

DIN EN 15804
DIN EN 15804:2019 + A2, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products

DIN EN ISO 11654:1997-07
Acoustics – Sound absorbers for use in buildings – Rating of sound absorption (ISO 11654:1997); German version EN ISO 11654:1997

DIN EN ISO 354:2003-12
Acoustics – Measurement of sound absorption in a reverberation room (ISO 354:2003); German version EN ISO 354:2003

Regulation (EU) No. 305/2011 (CPR)
Regulation (EU) No. 305/2011 (CPR), applicable to EU/EFTA countries (excluding Switzerland), mandates a declaration of performance for products, aligned with EN 13964:2014, "Suspended Ceilings – Requirements and Test Methods."

EU-BauPVO 305/2011
Directive of the European Parliament and Council dated 9 March 2011 establishing harmonised conditions for marketing construction products and replacing Council Guideline 89/106/EEC, in: EU Federal Gazette L 88/5, April 2011

Eurofins
Eurofins Product Testing A/S Smedeskovvej 38, DK-8464 Galten, Denmark

Federal Institute for Building, Urban Affairs and Regional Planning (BBSR): 353.211
Metal panelling: aluminium, steel, copper, zinc. Service lives of components. Service lives of components for Life Cycle Analyses in accordance with the evaluation system for sustainable building (BNB), in: German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (pub.), 2017

AgBB 2021
Procedure for the health-related evaluation of emissions of volatile organic compounds from construction products.

REACH Regulation
European Parliament and Council. (2006). Regulation (EC) No1907/2006 concerning the Registration, Evaluation,Authorisation, and Restriction of Chemicals (REACH). OfficialJournal of the European Union, L396, 1-849.

Biocidal Products Regulation
Regulation (EU) No 528/2012 of the European Parliament andof the Council of 22 May 2012 concerning the making availableon the market and use of biocidal products, Official Journal ofthe European Union, 2012.

Federal Ministry of Transport, Building and Urban Development
Guidelines on Sustainable Building, April 2013

German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
Initial general administrative guideline to the Federal Immission Control Act, Technical instructions on air quality – TA Air), 24 July 2002

IBU 2022 Part A
PCR Part A: Calculation rules for the life cycle assessment and requirements for the project report in accordance with EN 15804+A2:2019, Version 1.4, Institut Bauen und Umwelt eV, www.ibu-epd.com.

IBU 2023 Part B
PCR Part B: Requirements on the EPD for Metal ceilings, version 07.2023 Institut Bauen und Umwelt eV, www.ibu-epd.com.

ISO 15686-1:2011-05
Buildings and constructed assets – Service life planning – Part 1: General principles and requirements

ISO 14001
ISO 14001:2015-09, Environmental management systems – Requirements with guidance for use

ISO 14025
DIN EN /ISO 14025:2011-10/, Environmental designations and declarations – Type III Environmental Declarations – Basic principles and processes

ISO 50001
ISO 50001:2011-06, Energy management systems – Requirements with guidance for use

ISO 9001
ISO 9001:2015-09, Quality management systems – Requirements

LCA FE Professional and Extension DB XIV Construction materials database, content version 2023.2, https://lcadatabase.sphera.com

Lindner AG Test Report, PM Ceiling
Testing product emissions using the AgBB/DIBt method for LMD metal ceiling panels, Report no.1119/023825

List of MWC and BT values, 2016
Maximum workplace concentrations and biological tolerance values, permanent Senate Commission on testing materials harmful to health, Report no. 52, German Research Society

Ordinance governing the European Waste Catalogue (List of wastes – AVV)
Construction and demolition waste (including excavated soil from contaminated sites)

Waste key 17 04 05 Iron and steel, 2001

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