Environmental Product Declaration

as per ISO 14025 and EN 15804

Owner of the declaration:	FILIGRAN Trägersysteme GmbH & Co. KG
Publisher:	Kiwa GmbH - Ecobility Experts
Programme holder:	Kiwa GmbH - Ecobility Experts
Declaration number:	EPD-FILIGRAN-137-EN
Issue date:	29.07.2021
Valid to:	28.07.2026

FILIGRAN® Lattice Girders

FILIGRAN® Lattice Girders are factory-prefabricated reinforcement elements consisting of bottom chord, diagonal and top chord. Different Lattice Girder types and dimensions are available depending on the requirements and application

1. General information

FILIGRAN Trägersysteme GmbH & Co. KG

Programme holder
Kiwa GmbH - Ecobility Experts
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13355 Berlin
Germany

Declaration number
EPD-FILIGRAN-137-EN

This declaration is based on the Product Category Rules
PCR B - construction steel products (draft)
2020-03-13

Issue date
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Valid to
28.07.2026

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FILIGRAN® Lattice Girders

Owner of the declaration
Trägersysteme GmbH & Co. KG
Zappenberg 6
31633 Leese
Germany

Declared product / declared unit
1 ton construction steel products

Scope
The EPD (type: Cradle to gate with modules C1–C4 and module D) is about a are factory pre-fabricated reinforcing elements, manufactured in Leese (53m%) and Klieken (47m%), Germany.
Kiwa GmbH – Ecobility Experts shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Verification
The CEN Norm EN EN 15804+A2:2019 serves as the core PCR

Independent verification of the declaration and data according to ISO 14025:2011-10

☐internally ☒externally

Julian Rickert
(External verifier – GreenDelta GmbH)

2. Product

2.1 Product description

FILIGRAN® Lattice Girders are factory-prefabricated reinforcement elements consisting of bottom chord (UG), diagonal (D) and top chord (OG). Different Lattice Girder types and dimensions are available depending on the requirements and application.

Figure 1: Lattice Girders

2.2 Application

This product is available in 14 different types to cover several application possibilities.

Table 1: Dimensions and applications of FILIGRAN® Lattice Girder types

Lattice Girders type	height (H) [cm]	lower chord diameter (UG) [mm]	diameter of diagonals (D) [mm]	upper chord size (OG) [mm]	Semi-precast slab	Semi-precast wall	Beam and block floor	Lintels	Slatted floor
Type E	6-40	5-14	5-9	5-16	x	x	x		
Type D	6-20	5-14	5-7	5-16	x	x	x	x	
Type FIL	7-18	5-14	7	16	x		x		
Type EV	18-40	5-14	9(7/8)	16(10)	x				
Type EQ	8-30	5 (6)	7	5(6)	x	x			
Type S	11-42	6-16	7-9(10)	40x2		x	x		
Type DH	6-20	5-14	5-7	5-16			x	x	
Type EH	7-40	5-14	5-9	5-16			x	x	
Type SWE	12-41	5-12	5-9	5-12		x			
Type SWA	12-41	5-12	5-9	5-12		x			
Type SE2	12-41	5-12	5-9	5-12		x	x	x	
Type SE	12-41	5-16	5-9	5-12		x	x	x	
Type DSP	6-20	5-14	5-7	5-16					x
Type DSH	6-20	5-14	5-7	5-16					x

2.3 Technical Data

FILIGRAN® Lattice Girders are available in different designs (types). Therefore, only value ranges can be given in the table for most categories. Exact dimensions and application areas of the individual types can be found in Table 1.

Table 2: Technical Data – FILIGRAN® Lattice Girders

Name	Value	Unit
Height (H)	50-400	mm
lower chord diameter (UG)	5-14	mm
diameter of diagonals (D)	5-10	mm
upper chord size (OG)	5-16	mm
Steel Grade DIN 488	B500A / B500A+G	
Weight Range	1,1 – 6,3	kg/m
Density	7,85	g/cm^3
Nominal Yield strength	500	MPa

2.4 Base materials / Ancillary materials

Tabelle 1: Base materials / Ancillary materials

Name	Value	Unit
Wire rod for reinforcing steel according to customers demand. - Chemical composition fullills requirements of DIN 488 - Production route: 96,8% Electric Arc Furnance (EAF); 3,2% Basic Oxygen Furnace (BOF)	100	%

Other used Materials are Welding rod, welding powder (flux) and welding gases. There is no biogenic carbon in the products.

2.5 Manufacture

The manufacturing contains the following processes:

- Wire drawing: The wire rod is cold drawn through dry drawing machines. The cold drawn wire is wound into spools.
- Lattice Girders finished by welding in the lattice girder machine

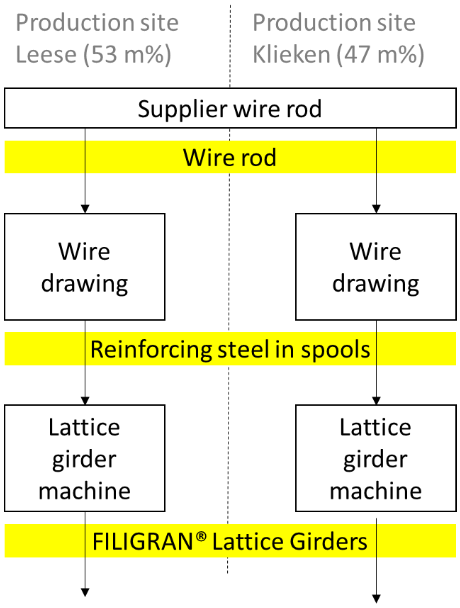

Figure 2: Overview about the production routes of Lattice Girders (A1 - A3)

2.6 Packaging

Wooden pallets and wooden blanks are used for packaging and further transport to the customer.

2.7 Production Waste

The production process generates production residues and waste: Metal scrap and scale and ancillary materials (lubricating oil, electrode copper).

3. LCA: Calculation rules

3.1 Declared unit

The EPD refers to the declared unit of 1 metric ton reinforcement steel product.

Name-	Value	Unit
Declared unit	1.000	kg
Density	7850 – 7870	kg/m^3
conversion factor to 1kg	not applicable	

3.2 System boundary

This EPD was created in accordance with EN 15804 and monitors the production stage and the end-of-life stage. According to EN 15804 this corresponds to product phases A1-A3, C2-C4 and D (EPD type: "cradle to grave + module C + D"). All inputs including raw materials, primary products, energy and auxiliary materials as well as the accumulated waste are considered in the assessment. The manufacture of end products and the use of the final product is not within the manufacturer's sphere of influence. Therefore, modules A5 and B1-7 have not been considered.

3.3 Estimates and assumptions

The energy and material consumptions are average values and refer to the year 2019.

For part of the raw material (42 m%) no primary data with LCA results according to the new standard EN 15804+A2 were available. For the modelling of the base material in the LCA, a combination of two Ecoinvent profiles is used: "Steel, low-alloy {RER}| Steel production, electric, low-alloy "or "Steel, non-alloy {RER}| Steel production, converter, non-alloy" and "Hot rolling, steel {RER}| Processing".

3.4 Cut-off criteria

All material flows that contribute to more than 1% of the total mass, energy or environmental impact of the system have been considered in the LCA. It can be assumed that the neglected processes in total contributed less than 5% to the considered impact categories. The production of the machines, plants and other infrastructure required to produce the reinforcement steel products were not taken into account in the LCA.

3.5 Background Data

The background data is taken from Ecoinvent database version 3.5 (2018). The life cycle assessment was modeled with the NIBE tool. Geographical reference space of the background data is Germany. Almost all consistent datasets contained in the Ecoinvent database are documented and can be viewed in the online Ecoinvent documentation.

3.6 Data quality

In the operating data survey all relevant process-specific data could be collected. The data relating to the manufacturing phase of the construction steel are determined by FILIGRAN and refers to the production sites (Germany).

Secondary data were taken from the Ecoinvent 3.5 database, released in 2018. The database is regularly checked and thus complies with the requirements of ISO 14040/44 (background data not older than 10 years). The background data meets the requirements of EN 15804. The quantities of raw materials, consumables and supplies used as well as the energy consumption have been recorded and averaged over the entire year of operation.

The general rule has been that specific data from specific production processes or average data derived from specific processes must be given priority when calculating an EPD or Life Cycle Assessment. Data for processes that the manufacturer cannot influence or choose, were backed up with generic data.

3.7 Period Under review

All process-specific data was collected for the operating year 2019. The quantities of raw and auxiliary materials as well as energy consumption have been recorded and averaged over the entire operating year 2019.

3.8 Allocation

There are no co-products in the raw material supply phase, so no allocation methods were used at this stage. There are no allocations during the manufacturing phase at the plant. The preparation of the construction product is an independent process.

3.9 Calculation methods

For life cycle assessment, the calculation methods described in ISO 14040 (section 4.3.2) have been applied. The evaluation is based on the phases in the system boundaries.

3.10 Mix of electricity and CO2-Certificates

The electricity mix was chosen according to the current electricity provider and time reference. The composition of this mix: 8,7% nuclear; 28,3% coal; 8,8% natural gas; 1,3% other fossils (assumption: oil), 52,9% EEG mix (renewable energy mix in Germany). No CO_2 certificates were counted.

3.11 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 considered.

3.12 Reference Service Life (RSL)

The lifetime of reinforcement will be limited by the service life of the construction. Under these circumstances, no RSL according to the relevant ISO standards and EN 15804 can be declared.

4. LCA: Scenarios and additional technical information

During deconstruction, reinforced concrete is demolished, crushed and the steel is separated from the concrete. Due to the lack of secondary data and the unforeseeable use of the steel product, an estimated value of 0,5 hours of machine use (diesel) is assumed. From experience it is assumed that C1 does not have a dominant influence on the life cycle.

The waste scenario "Steel, reinforcement" from SBK 2019 was used for modelling the production waste and the end-of-life (95% Recycling, 5% Landfill).

5. LCA: Results

The following tables show the results of the impact assessment indicators, resource use, waste and other output streams. The results presented here refer to the declared average product.

Description of the system boundary

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 manufacturer to place of use	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishmen	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X

X=Module declared | MND=Module not declared

Results of the LCA – Environmental impact: 1.000 kg FILIGRAN® Lattice Girders

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D	Total
				Core environmental impact indicators (EN 15804+A2)						
ADP-mm	kg Sb-eqv.	1,00E-03	6,63E-05	5,71E-05	8,85E-06	1,88E-05	0,00E+00	2,86E-07	-2,06E-05	1,13E-03
ADP-f	MJ	9,35E+03	4,89E+02	2,51E+02	3,84E+02	1,03E+02	0,00E+00	7,80E+00	-7,52E+02	9,83E+03
AP	mol H+ eqv.	1,74E+00	2,47E-01	6,57E-02	2,78E-01	3,80E-02	0,00E+00	2,51E-03	-3,62E-01	2,01E+00
EP-fw	kg P eqv.	3,76E-02	8,56E-04	1,17E-03	2,03E-04	9,98E-05	0,00E+00	4,56E-06	-3,49E-03	3,64E-02
EP-m	kg N eqv.	9,09E-01	9,08E-02	2,71E-02	1,20E-01	1,33E-02	0,00E+00	8,24E-04	-6,41E-02	1,10E+00
EP-T	mol N eqv.	1,19E+01	1,02E+00	3,39E-01	1,32E+00	1,47E-01	0,00E+00	9,13E-03	-7,61E-01	1,40E+01
GWP-b	kg CO2 eqv.	5,10E+00	5,93E-02	-1,08E+01	4,38E-03	1,93E-03	0,00E+00	4,42E-04	4,57E-01	-5,18E+00
GWP-f	kg CO2 eqv.	5,80E+02	3,29E+01	1,48E+01	2,65E+01	6,64E+00	0,00E+00	2,59E-01	-7,48E+01	5,86E+02
GWP-luluc	kg CO2 eqv.	5,26E-01	2,78E-02	1,66E-02	2,25E-03	1,98E-03	0,00E+00	7,00E-05	-1,44E-02	5,60E-01
GWP-total	kg CO2 eqv.	5,86E+02	3,30E+01	3,97E+00	2,65E+01	6,65E+00	0,00E+00	2,59E-01	-7,44E+01	5,82E+02
ODP	kg CFC 11 eqv.	5,61E-05	6,63E-06	1,89E-06	5,99E-06	1,55E-06	0,00E+00	1,15E-07	-3,48E-06	6,88E-05
POCP	kg NMVOC eqv.	3,09E+00	2,72E-01	9,48E-02	3,64E-01	4,19E-02	0,00E+00	2,66E-03	-4,05E-01	3,46E+00
WDP	m3 world eqv.	3,08E+02	4,33E+00	4,25E+00	2,07E+00	7,33E-01	0,00E+00	3,45E-01	-5,76E+00	3,14E+02
				Additional environmental impact indicators (EN 15804+A2)						
ETP-fw	CTUe	1,13E+04	3,76E+02	3,26E+02	2,17E+02	7,39E+01	0,00E+00	4,61E+00	-2,41E+03	9,89E+03
HTP-c	CTUh	4,65E-06	1,76E-08	8,27E-08	7,46E-09	2,80E-09	0,00E+00	1,01E-10	-4,00E-07	4,36E-06
HTP-nc	CTUh	1,16E-04	4,28E-07	2,21E-06	1,89E-07	9,41E-08	0,00E+00	3,27E-09	-2,49E-06	1,16E-04
IR	kBq U235 eqv.	4,23E+01	2,24E+00	1,06E+00	1,65E+00	4,38E-01	0,00E+00	3,23E-02	-7,32E-01	4,70E+01
PM	disease incidence	5,38E-05	2,33E-06	1,57E-06	7,29E-06	6,03E-07	0,00E+00	4,70E-08	-6,42E-06	5,92E-05
SQP	Pt	5,70E+03	3,73E+02	1,12E+03	4,86E+01	8,58E+01	0,00E+00	1,49E+01	-3,52E+02	6,99E+03

ADP-e=Depletion of abiotic resources-elements | **ADP-f**=Depletion of abiotic resources-fossil fuels | **AP**=Acidification of soil and water | **EP-fw** =Eutrophication, freshwater | **EP-m**=Eutrophication marine | **EP-T**=Eutrophication, terrestrial | **GWP-b**=Global warming potential - Biogenic | **GWP-f**=Global warming potential - Fossil | **GWP-luluc**=Global warming potential - Land use and land use change |**GWP-total**=Global warming potential |**ODP**=Ozone layer depletion |**POCP**=Photochemical oxidants creation | **WDP**=Water use | **ETP-fw**=Ecotoxicity, freshwater | **HTP-c**=Human toxicity, cancer | **HTP-nc**=Human toxicity, non-cancer | **IR**=Ionising radiation, human health | **PM**=Particulate Matter | **SQP**=Land use

Resource use and environmental information: 1.000 kg FILIGRAN® Lattice Girders										
Parameter	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**	**Total**
PERE	MJ	4,31E+02	1,37E+01	1,04E+02	2,22E+00	1,08E+00	0,00E+00	6,38E-02	-5,52E+01	4,97E+02
PERM	MJ	1,53E+03	0,00E+00	8,50E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,61E+03
PERT	MJ	1,96E+03	1,37E+01	1,89E+02	2,22E+00	1,08E+00	0,00E+00	6,38E-02	-5,52E+01	2,11E+03
PENRE	MJ	6,40E+03	5,19E+02	1,69E+02	4,07E+02	1,09E+02	0,00E+00	8,28E+00	-7,92E+02	6,82E+03
PENRM	MJ	3,51E+03	0,00E+00	1,02E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,61E+03
PENRT	MJ	9,91E+03	5,19E+02	2,71E+02	4,07E+02	1,09E+02	0,00E+00	8,28E+00	-7,92E+02	1,04E+04
SM	Kg	1,09E+03	0,00E+00	2,01E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-4,40E-04	1,11E+03
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	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	0,00E+00
FW	M3	8,67E+00	1,37E-01	1,27E-01	5,26E-02	1,94E-02	0,00E+00	8,14E-03	-1,54E-01	8,86E+00
HWD	Kg	2,52E-02	4,00E-04	6,27E-04	1,71E-04	6,54E-05	0,00E+00	5,22E-06	-7,69E-03	1,88E-02
NHWD	Kg	1,47E+02	1,84E+01	3,53E+00	4,09E-01	6,27E+00	0,00E+00	4,80E+01	-3,14E+00	2,20E+02
RWD	Kg	4,69E-02	3,22E-03	1,37E-03	2,66E-03	6,93E-04	0,00E+00	5,16E-05	-9,41E-04	5,40E-02
CRU	Kg	0,00E+00	0,00E+00	8,84E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	8,84E-01
MFR	Kg	9,91E+01	0,00E+00	1,84E+01	0,00E+00	0,00E+00	9,13E+02	0,00E+00	0,00E+00	1,03E+03
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	0,00E+00
EE	MJ	7,99E-01	0,00E+00	1,47E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,86E+01	1,94E+01
EET	MJ	5,05E-01	0,00E+00	9,30E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,18E+01	1,23E+01
EEE	MJ	2,93E-01	0,00E+00	5,40E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	6,85E+00	7,15E+00

PERE=renewable primary energy ex. raw materials | **PERM**=renewable primary energy used as raw materials | **PERT**=renewable primary energy total | **PENRE**=non-renewable primary energy ex. raw materials | **PENRM**=non-renewable primary energy used as raw materials | **PENRT**=non-renewable primary energy total | **SM**=use of secondary material | **RSF**=use of renewable secondary fuels | **NRSF**=use of non-renewable secondary fuels | **FW**=use of net 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 | **EE**=Exported energy | **EET**=Exported Energy Thermic | **EEE**=Exported Energy Electric | **Carbon**=Carbon Content

Disclaimer on ADP-e, ADP-f, WDP, ETP-fw, HTP-c, HTP-nc, SQP: The results of these environmental impact indicators must be used with caution, as the uncertainties in these results are high or as there is limited experience with the indicator.

Disclaimer on IR: This impact category mainly addresses the potential effect of low dose ionizing radiation on human health in the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents and occupational exposures, nor does it consider radioactive waste disposal in underground facilities. Potential ionizing radiation from soil, radon, and some building materials is also not measured by this indicator.

6. LCA: Interpretation

The following figure shows the influence of the different life stages. Since no biogenic carbon is contained in the product and the GWP-b indicator is therefore negligible, it is not shown in the graphs. As shown in Figure 1, most of the environmental impact is attributed to the base material supply phase A1.

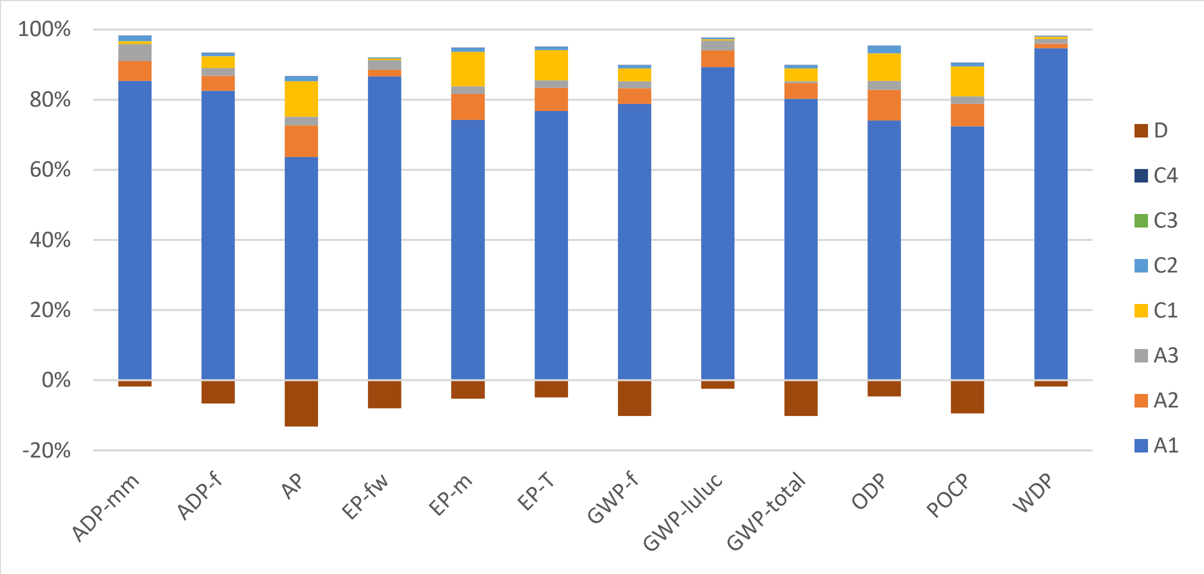

Figure 3: Influence of the modules on the environmental impacts

The data quality can be classified as good overall. All relevant process-specific data could be collected in the operational data collection. Primary data could be used for approx. 58% of the raw materials (wire rod). Consistent data sets from the Ecoinvent database were available for almost all inputs and outputs. The background data meet the requirements of EN 15804, and the production data were recorded for the 2019 operating year. The quantities of raw materials and supplies used as well as energy consumption were recorded for the entire operating year. The life cycle assessment was carried out for all the product items listed. It can be assumed that the data for the declared average product are well representative.

7. References

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Stichting Bouwkwaliteit: verification protocol - inclusion data in the Dutch environmental database, Rijswijk, Final Version 3.0, January 2019

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