Environmental Product Declaration

as per ISO 14025 and EN 15804 +A1

Owner of the declaration:	EEW Pipe Production Erndtebrueck GmbH & Co. KG
Publisher:	Kiwa BCS Öko-Garantie GmbH - Ecobility Experts
Programme holder:	Kiwa BCS Öko-Garantie GmbH - Ecobility Experts
Declaration number:	EPD-EEW-099-EN
Issue date:	07.12.2020
Valid to:	06.12.2025

Structural pipes

Ready-to-install and individually pre-fabricated single pipe and construction components for off-shore wind and offshore oil & gas platforms

1. General information

Erntdebrücker Eisenwerk (EEW)

Programme holder
Kiwa BCS Öko-Garantie GmbH
- Ecobility Experts
Marientorbogen 3-5
90402 Nürnberg
Germany

Declaration number
EPD-EEW-099-EN

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

Issue date
07.12.2020

Valid to
06.12.2025

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Structural pipes

Owner of the declaration
EEW Pipe Production
Erndtebrueck GmbH & Co. KG
Im Günewald 2
57339 Erndtebrück
Germany

Declared product / declared unit
1 ton construction steel products

Scope
The EPD is about a ready-to-install and individually pre-fabricated single pipes and construction components, manufactured in Erndtebrück, Germany. Structural pipes are used in offshore wind or offshore oil & gas platforms. Kiwa BCS Öko-Garantie GmbH – Ecobility Experts shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Verification
The CEN Norm EN 15804:2012+A1:2013 serves as the core PCR

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

☐internally ☒externally

M. Sc. Tim Lohse
(External verifier – GreenDelta GmbH)

2. Product

2.1 Product description and application

The structural pipes from EEW are ready-to-install and individually pre-fabricated single pipe and construction components for offshore wind platforms.

2.2 Technical Data

The technical data is listed in the table below. The values for the unit weight depend on the product type and its corresponding tensile strength. For this reason, only the value ranges for structural pipes are given here.

Characteristic	Value	Unit
Diameter range	406 – 2438	mm
Length range	1200 – 38.000	mm
Wall thickness range	9,5 – 100	mm
Steel Grade DIN EN 10025-2	S355J2+N	-
Weight Range	500 – 100.000	kg
Production route (EAF or BOF)	100% BOF	-
Tensile strength	490 – 630	Pa
Yield strength	275 – 345	Pa

2.3 Base materials / Ancillary materials

Raw material	Value	Unit
Heavy plate, Material S355 Base material according to EN 10225, EN 10025 or EN 10204 in various grades (unalloyed steel)	100	%

2.4 Manufacture

The production of structural pipes comprises the following process steps:

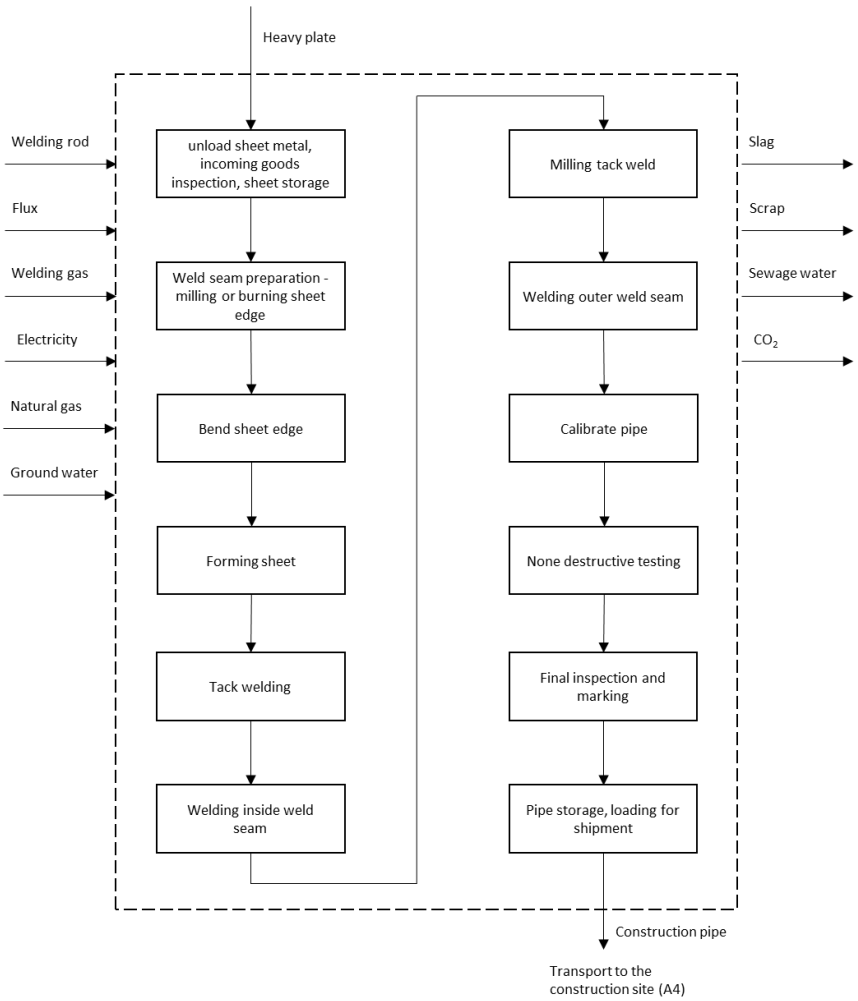
- Incoming goods - unload sheet metal, incoming goods inspection; Sheet storage
- Weld seam preparation - milling or burning sheet edge
- Bend sheet edge: pre-bending of the prepared sheets
- Forming sheet: Final bending of the bent sheets to form a raw tube preform
- Tack welding: Closing the open ends of the tube blank with a tack weld
- Welding inside weld seam: UP Internal welding of the pipe
- Milling tack weld: Milling of the outer tacking seam
- Welding outer weld seam: UP external welding of the pipe
- Calibrate pipe: Calibration of the finished welded tube
- None destructive testing
- Final inspection and marking
- Pipe storage; Loading for shipment

2.5 Packaging

There is no packaging. Only load securing - square timbers, wooden wedges and rubber mats as well as tension belts are used.

2.6 Reference Service Life (RSL)

The lifetime of structural pipes 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.



3. LCA: Calculation rules

3.1 Declared unit

The EPD refers to the declared unit of 1 metric ton structural pipe.

Product	Declared Unit
Structural pipe	1 ton construction steel

3.2 System boundary

This is a Cradle to factory gate with options. In addition to the production stage A1-A3, the EPD A4 (transport to customer) and the end-of-life stage (C2-C4 & D) are considered.

All inputs including raw materials, primary products, energy and auxiliary materials as well as the accumulated waste are considered in the assessment. The following production steps are considered during the production phase:

- Raw material supply (A1)
- Manufacture of precursors (A1)
- Transport of raw materials (A2)
- Energy supply for manufacturing (A3)
- Energy supply for the construction hall lighting and heating (A3)
- Manufacturing process (A3)
- Transport of production waste to the place of disposal (A3)
- Treatment and disposal of raw material packaging (A3)

- Transport of production waste to the place of disposal (A3)
- Treatment and disposal of production waste (A3)

3.3 Estimates and assumptions

The energy and material consumptions are average values and refer to the year 2019.
To model the base material heavy plate in the LCA, a combination of two environmental profiles is used: Steel, unalloyed, converter | production (EU) and Hot rolling, steel, | processing (EU). For the heavy plate from the supplier Dillinger Hütte, there is also an industry EPD that is taken into account in an alternative scenario.
The transport routes of the raw materials are known. The transport information of other operating materials are secondary data (Ecoinvent V3.5).
The Erndtebrück site also processes other steel products. Measured in terms of output, construction pipes account for 27 percent by mass of production. This share is taken into account in consumption of operating materials, process energy and infrastructure (lighting and heating).
Furthermore, the packaging of the supplied raw materials are not considered.
Structural pipes are marketed worldwide. No average transport distances could be determined, as the logistics are sometimes organised by the customer and sometimes by EEW. After consultation with EEW's logistics department, a very frequent transport was chosen as a representative transport route (A4): Transport by railway Erndtenbrück - Antwerpen (400 km).
Due to a high life expectancy and the fact that EEW is not responsible for this, there is no compony data available on the material recovery of installed structural pipes. There is also no literature data available, as the construction of offshore wind farms is relatively new and no major wind farms have yet been dismantled. At present time, there is still discussion about what is the most sensible solution for the end-of-life, since deconstruction is costly and the damage may be less if, the plants remain in the sea.
For this reason the default scenario consider an empty waste scenario. This means that the built-in structural pipes remain in place and there are no expenses for transport or treatment processes, and there are no credits for recycling and reuse.
The dismantling is taken into account in an alternative scenario. The waste scenario "steel, heavy" from SBK 2019 is used for this. This scenario assumes that 51 percent will be recycled and 49 percent reused.
The electricity mix was chosen according to the current electricity provider and time reference. The Composition of this mix: 7,2% Nuclear; 41,4% hard coal; 2,1% natural gas; 0,4% oil, 48,9% EEG mix (renewable energy mix in Germany). No CO_2 certificates were counted.

3.4 Cut-off criteria

For the process modules A1 to A4 all process-specific data was collected. Nearly all flows could be assigned potential environmental impacts through the Ecoinvent database. All flows that contribute to more than 1 % of the total mass, energy or environmental impact of the system were considered in the LCA. It can be assumed that the neglected processes would have contributed less than 5 % to the impact categories considered.

3.5 Period under review

All process-specific data was collected for the operating year 2019.

3.6 Data quality

Overall, the quality of the data can be considered as good. 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 EEW and refers to the site in Erndtebrück.

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.
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.

3.7 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.

3.8 Comparability

In principle, a comparison or evaluation of EPD data is only possible if all data sets to be compared have been created in accordance with EN 15804 and the building context or the product-specific performance characteristics have been taken into account.

4. 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 manu-facturer 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	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X

X=Module declared | MND=Modules not declared

Results of the LCA –Environmental impact: 1 ton Structural pipe

Parameter	Unit	A1	A2	A3	A4	C2	C3	C4	D	Total
ADPe	[Kg Sb]	1,26E-03	6,83E-05	1,45E-04	3,22E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,51E-03
ADPf	[MJ]	2,99E+04	4,42E+02	1,52E+03	2,76E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,21E+04
AP	[Kg SO_2 Eq]	8,38E+00	1,60E-01	3,13E-01	1,31E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	8,99E+00
ODP	[Kg CFC-11 Eq]	1,30E-04	4,69E-06	5,25E-06	2,42E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,42E-04
GWP	[Kg CO_2 Eq]	2,09E+03	2,94E+01	9,93E+01	1,92E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,24E+03
EP	[Kg PO_4^{3-} Eq]	1,04E+00	3,18E-02	5,62E-02	2,57E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,15E+00
POCP	[Kg Ethene Eq]	3,34E+00	1,88E-02	5,01E-02	1,34E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,43E+00

ADPe=Depletion of abiotic resources-elements | ADPf=Depletion of abiotic resources-fossil fuels | AP=Acidification of soil and water | ODP=Ozone layer depletion | GWP=Global warming | EP=Eutrophication | POCP=Photochemical oxidants creation

Results of the LCA –Resource Use: 1 ton Structural pipe

Parameter	Unit	A1	A2	A3	A4	C2	C3	C4	D	Total
PERE	[MJ]	9,74E+02	1,89E+01	4,16E+02	2,36E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,43E+03
PERM	[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
PERT	[MJ]	9,74E+02	1,89E+01	4,16E+02	2,36E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,43E+03
PENRE	[MJ]	2,46E+04	4,82E+02	1,34E+03	3,09E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,67E+04
PENRM	[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
PENRT	[MJ]	2,46E+04	4,82E+02	1,34E+03	3,09E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,67E+04
SM	[kg]	1,83E+02	0,00E+00	3,35E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,86E+02
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	[m^3]	1,97E+01	1,37E-01	4,23E-01	1,37E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,04E+01

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 second-ary fuels | NRSF=use of non-renewable secondary fuels | FW=use of net fresh water

Results of the LCA – Output flows and waste categories: 1 ton Structural pipe

Parameter	Unit	A1	A2	A3	A4	C2	C3	C4	D	Total
HWD	[kg]	1,80E-01	4,34E-04	6,58E-03	3,98E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,87E-01
NHWD	[kg]	3,14E+02	1,78E+01	1,74E+01	3,49E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,53E+02
RWD	[kg]	5,18E-02	2,96E-03	3,89E-03	1,82E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	6,04E-02
CRU	[kg]	0,00E+00	0,00E+00	1,81E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,81E+00
MFR	[kg]	0,00E+00	0,00E+00	1,89E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,89E+00
MER	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	[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
EEE	[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
EET	[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

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| EE =Exported energy thermic| EEE= Exported energy electric | EET= Exported energy thermic

5. LCA: Interpretation

The following figure show the influence of the different life stages. As shown in figure below, the raw material (A1) has the greatest influence on the life cycle of structural pipes.

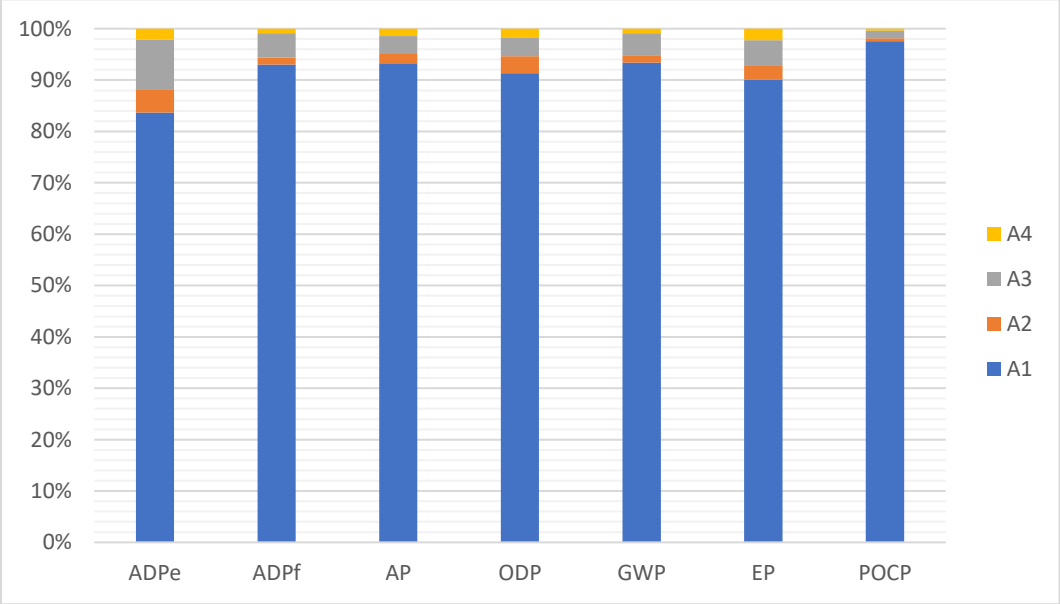


Figure 1: Influence of the modules on the environmental impacts - Standard scenario: structural pipes remain in the construction.

In an alternative scenario it was assumed that recycling of structural pipes is carried out at the end of their life (see figure below). This alternative LCA consider the waste scenario “plates, heavy” (51% recycling, 49% re-use) of SBK 2019.

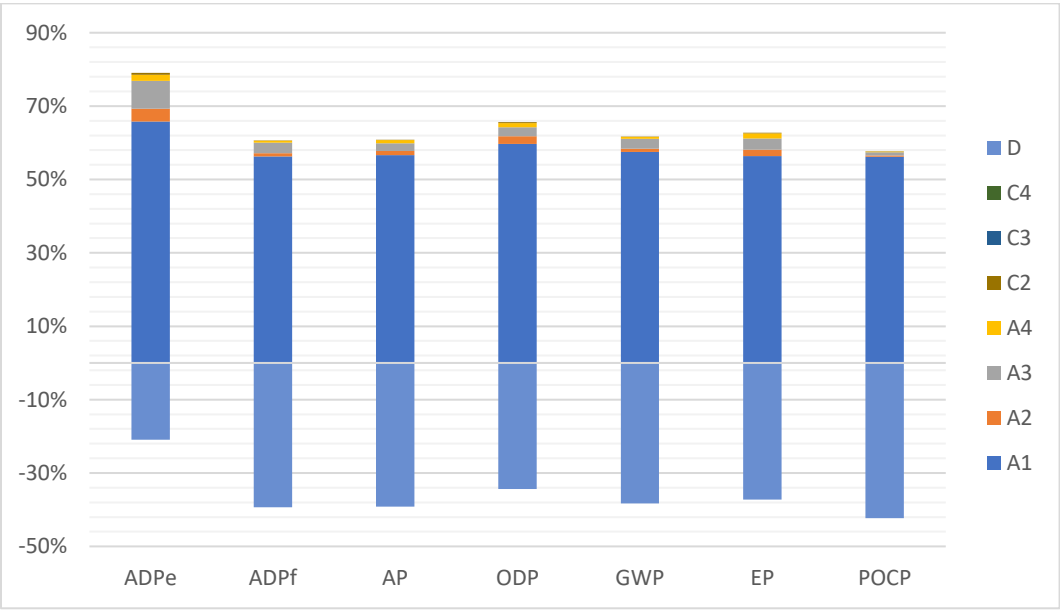


Figure 2: Influence of the modules on the environmental impacts - Alternative scenario: Structural pipes are recycled or re-used.

6. References

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