ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	DSI Underground Merol Sp. z o.o.
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-DSI-20240251-IBA1-EN
Issue date	11.09.2024
Valid to	10.09.2029

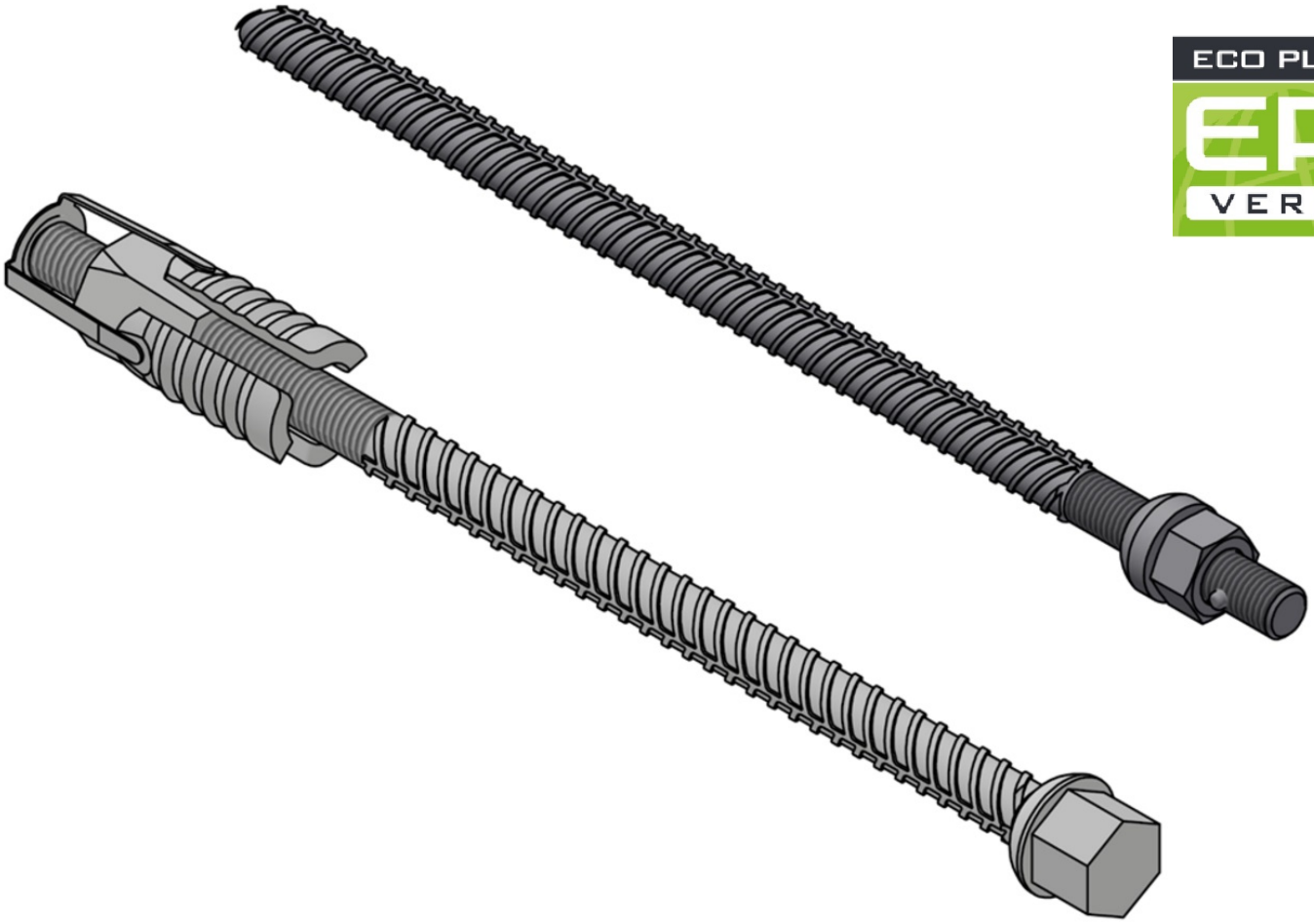
DSI REBAR BOLT

DSI Underground Merol Sp. z o.o.

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD VERIFIED

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1. General Information

DSI Underground Merol Sp. z o.o.

Programme holder

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

Declaration number

EPD-DSI-20240251-IBA1-EN

This declaration is based on the product category rules:

Structural steels, 01.08.2021
(PCR checked and approved by the SVR)

Issue date

11.09.2024

Valid to

10.09.2029

DSI REBAR BOLT

Owner of the declaration

DSI Underground Merol Sp. z o.o.
Przemyslowa 30
37-450 Stalowa Wola
Poland

Declared product / declared unit

1 ton DSI REBAR BOLT

Scope:

This EPD is based on a declared unit of 1 ton of DSI REBAR BOLT produced at the production site in Stalowa Wola (Poland).
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

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

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

Dr.-Ing. Nikolay Minkov,
(Independent verifier)

2. Product

2.1 Product description/Product definition

REBAR BOLTS are integral to underground mining and tunneling operations, providing essential support and stability. They come in three main types: resin grouted, cement grouted, and point anchored (expansion shell) rebar bolts. Resin grouted bolts are fast to install and achieve full strength rapidly, making them suited for time-sensitive projects. Cement grouted bolts, while slower to install, offer long-term stability and are often used in permanent installations. Point anchored rebar bolts, also known as expansion shell bolts, are used when immediate load capacity is required. DSI Underground produce REBAR BOLTS using steel grades, chosen for their optimal balance of strength and ductility. These grades ensure the bolts can withstand the intense pressures of underground environments.

The main features of a REBAR BOLT and their functions are:
1. Load-bearing stem (Rebar): This is the main body of the bolt and is responsible for bearing the load from the rock mass. It transfers the load from the rock surface to the deeper, more stable strata.
2. Ribs on the stem's surface: These provide additional surface area and friction, which helps in better bonding with the grouting material, be it resin or cement. This enhances the bolt's grip and load-bearing capacity.
3. Thread at the bolt's end: This allows for the attachment of the tightening nut or other components like a plate or a coupler. The thread ensures a secure connection and allows for tensioning of the bolt. An expansion shell can be mounted on the upper thread on the bolt, creating a solid mechanical link between the bolt and the surrounding rock.
4. Tightening Nut: This is used to apply tension to the bolt once it's installed. By tightening the nut, the bolt is pulled, which compresses the rock mass and improves stability.
It's worth noting that the tightening nut can be replaced by a forged head. This is often done when the bolt is expected to bear significant shear stress, as the forged head provides a larger surface area for load distribution. The choice between a nut and a forged head depends on the specific requirements of the project.

As per today, for the use and application of the product no harmonized standard nor regulation is applicable. The products are delivered based on customer-specific technical performance characteristics.

2.2 Application

Rebar rock bolts are used to stabilize the roof and walls of underground excavations (mine or tunnels).
They help prevent rock falls and cave-ins, ensuring the safety of the miners and the integrity of the mine structure.
As all other rock bolts, rebar bolts are installed in a pattern that distributes the load evenly across the rock mass. The bolts work in conjunction with shotcrete (sprayed concrete) or a steel mesh to form a composite shell that supports the tunnel.
The choice between resin grouted, cement grouted, and point anchored (expansion shell) rebar bolts depends on the specific requirements of the project, including the type of rock, the expected load, and the desired lifespan of the installation.

2.3 Technical Data

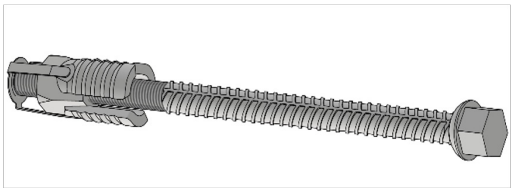
REBAR BOLTS are delivered in a wide range of versions, for which we can assume a general division into bolts with a threaded head and bolts with a forged head.
The fundamental component of the bolts is rebar delivered from steel mills where it is manufactured from high-strength steel to ensure reliable loading capacity and elongation.

Threaded Head



Name	Value	Unit
Weight	2.00 – 6.31	kg/m
Nominal diameter - rebar	18.0 – 32.0	mm
Thread	M18 – M33	mm
Ultimate load anchor system	140 – 442	kN
Nominal cross section	254 – 804	mm^2
Wrech size nut	30 – 50	mm
Steel grade	B500B; B500SP; Atlas III; Atlas V	-
Yield strength	> 400	N/mm^2
Tensile strength	> 550	N/mm^2
Elongation A	Agt > 5 A5 > 16	%

Forged Head



Name	Value	Unit
Weight	2.00 – 2.98	kg/m
Nominal diameter - rebar	18.0 – 22.0	mm
Ultimate load anchor system	150 – 185	kN
Nominal cross section	254 – 380	mm^2
Expansion shell diameter	25 – 36	mm
Steel grade	B500B; Atlas III	-
Yield strength	> 400	N/mm^2
Tensile strength	> 550	N/mm^2
Elongation A	Agt > 5 A5 > 19	%

Performance data of the product with respect to its characteristics in accordance with the relevant technical provision (no CE-marking).

2.4 Delivery status

REBAR BOLTS are shipped in bundles of 1 to 6 m length. One bundle holds 25 to 200 REBAR BOLTs depending on their dimension. The accessories (nuts, spherical washers and expansion shells) are mounted on the bolts and packed with them.

2.5 Base materials/Ancillary materials

The base material of all components is steel of different grades and origin. The main component of the REBAR BOLTS is ribbed steel rod which is 100% made in Europe.
All production processes like cutting, machining, head forging, thread rolling and welding are done in the factory in Stalowa Wola, Poland by DSI Underground Merol, part of Sandvik.
The accessories are purchased from suppliers in Europe and

China.
Assembly of the bolt takes place in DSI Underground Merol, Stalowa Wola and it is performed manually.

Components of the REBAR BOLTS system:

- 96 % - Rebar
- 2 % - Nut
- 1 % - Expansion Shell
- < 1 % - Spherical Washer

Ancillary materials/additives

- cooling lubricant (water based)

For the production of the REBAR BOLTS a water based cooling lubricant is used. The cooling lubricant is cleaned and circulated in the process. At the end of its lifetime it is disposed of in accordance with local regulations.

This product/article/at least one partial article contains substances listed in the candidate list (date: 18.03.2024) exceeding 0.1 percentage by mass: no

This product/article/at least one partial article contains other carcinogenic, mutagenic, reprotoxic (CMR) substances in categories 1A or 1B which are not on the candidate list, exceeding 0.1 percentage by mass: no

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 base material of all components is steel, which is purchased by the holder of this EPD or his sub-suppliers. Delivered rebars are cut to length on an eccentric press. One end of the rebar is cut at 45 degrees to ease its introduction into the hole (or blunt) in the rock structure.
In case of REBAR BOLTS with a threaded head the other end of the rebar is processed by turning and chamfering on machine tools. Then the thread is rolled onto a turned surface with a special cold rolling process which transfers material by squeezing. Nuts and spherical washers are purchased from suppliers and are mounted manually on the threaded part of the rebar. Depending on the order, the nut is secured against unscrewing by a welded point or a share pin. In case of REBAR BOLTS with a forged head the end of the rebar is shaped via a hot forging process. Depending on the order, the other end can be left cut at 45-degrees or be threaded and equipped with an expansion shell. Expansion shells are purchased from suppliers.

2.7 Environment and health during manufacturing

The production of DSI Underground Merol in Stalowa Wola is certified according to ISO 14001. Following the underlying requirements of this certification, data related to the environment and health is continuously collected and evaluated. The company continuously invests into the improvement of environmental protection, occupational health and safety and monitors and evaluates the results.

2.8 Product processing/Installation

Installation of REBAR BOLTs occurs in underground space, so the operator must respect all precautions and regulations valid in the country the project is located.
The products are typically installed on the jobsite by roto-percussive drilling with water flushing. Noise protection and dust suppression or dust collection systems ensure that no environmental and health risks result from the installation of the product described in this EPD.

2.9 Packaging

The REBAR BOLTS are bundled in 25 to 200 pieces depending on their dimension. The bundles are fixed with plastic or steel straps. No further packaging is applied within Europe.
The accessories (nuts, spherical washers and expansion shells) are mounted on the bolts and packed with them. Wooden materials are also used as auxiliaries.
The packaging can be disposed of into the local recycling system.
For transport to overseas the REBAR BOLTS with accessories are packed into containers.

2.10 Condition of use

The declared product is made of steel. On specific customer demand, REBAR BOLTS may be hot-dip-galvanized or covered by an epoxy anticorrosion coating. This declaration describes the most common version, i.e. black steel with no protective coating.

2.11 Environment and health during use

During the use of the product no hazardous influence to the environment or health is to be expected. The components of the product and any potential emissions during their use were analyzed and reviewed during the evaluation of the products for technical approvals and were rated as harmless.

2.12 Reference service life

The reference service life depends on specific application conditions. Presence of water and type of water greatly influence the corrosion rate of steel installed in the ground. In general, grouted rebar bolts are considered to grant a long-lasting solution, with a service life fit for the purpose. In fact, when fully encapsulated, bonding grout offer a sufficient barrier to water and other elements responsible for steel corrosion. Service life must always be estimated case by case, evaluating several parameters and all local conditions. Only as preliminary indication, rebar bolts may offer a service life measured in years for mines and in decades in tunneling.

2.13 Extraordinary effects

Fire

Not relevant, the product is made of steel.

Water

No negative effects on the environment are to be expected from the declared product if exposed to water.

Mechanical destruction

No negative effects on the environment are to be expected from the declared product if mechanically destructed.

2.14 Re-use phase

The declared product can be recycled after use. Specifically it can be reused in the steel industry as secondary raw material.

2.15 Disposal

The declared product can be fully recycled as secondary raw material.
The waste code according to the *European Waste Index* is 17 04 05 - iron and steel.

2.16 Further information

Further information on the product declared in this EPD can be found on the website of DSI Underground Merol: https://www.dsiunderground.com

3. LCA: Calculation rules

3.1 Declared Unit

This environmental product declaration refers to a declared unit of 1 ton of average DSI REBAR BOLT.

Declared unit

Name	Value	Unit
Declared unit	1	t
Conversion factor [Mass/Declared Unit]	1000	-

For the calculation of the declared average, input and production quantities for the entire calendar year 2022 were taken into account and broken down to the declared product group. The calculated results can thus be considered representative for the declared product portfolio of REBAR BOLTS of DSI Underground Merol Sp. z o.o.

Mass fractions of individual components in the REBAR BOLTS may vary based on the specific design. The stem of the bolts (rebar) dominates with more than 90 % by mass. A linear correlation of the environmental impacts with the product weight is to be expected. Therefore, the conversion from the declared unit to a specific product is possible using a mass-specific scaling factor.

3.2 System boundary

The life cycle assessment of average DSI REBAR BOLTS refers to a cradle-to-gate analysis with modules (A1-A3 + C +D). Subsequent life cycle phases are part of the analysis:

Module A1–A3 | Production stage
The production stage includes the upstream burdens of raw material supply, their transports and production of the DSI REBAR BOLTS at DSI Underground Merol sp. z o.o. at the production site in Stalowa Wola (Poland). App. 30% of the electricity is provided by the newly installed photovoltaic plant at site. Since the PV is first installed in March 2024, no real data on the produced electricity is available and thus the 30 % electricity substitution is an estimation.The remaining share of electricity needed for production is purchased from the Polish grid (represented by the residual grid mix). In addition, the site uses thermal energy from natural gas.
The production of the packaging of the REBAR BOLTS is included in modules A1-A3 as well.

Module C1 | Deconstruction and demolition
The end-of-life scenario considers the homogenous deconstruction of the end product. Referring energy demand is considered to be negligible, resulting in a declaration of '0' in module C1.

Module C2 | Transport to disposal
The transport to the disposal of the material is estimated declaring a 50 km radius to the waste processing.

Module C3 | Waste processing
Product flows that reach Module D for recycling leave the product system in C3.
Environmental impacts resulting from the grinding and sorting of steel scrap are not included due to the negligible expected environmental impact.

Module C4 | Landfilling
Module C4 declares the environmental impacts incurred by landfilling (5 % of the product).

Module D | Benefits and loads beyond the system boundary
The potential for substituting primary steel with a recycling scenario (95 % of the product) is outlined in Module D.

3.3 Estimates and assumptions

All assumptions are verified through detailed documentation and correspond to the best possible representation of reality based on the available data. Regional applicability of the used background data refers to average data under European or Polish conditions taken from the *MLC*-database.

3.4 Cut-off criteria

The LCA model covers all available input and output flows, which can be represented based on robust data. Data gaps are filled with conservative assumptions from average data (when available) or with generic data and are documented accordingly. Only data with a contribution lower than 1 % were cut off. Thus, no data were neglected, of which a substantial impact is to be expected. All relevant data were collected comprehensively. Cut-off material and energy flows were chosen carefully based on their expected quantitative contribution as well as potential environmental impacts. Thus, it can be assumed that the sum of all neglected input flows does not account for more than 5 % of the total material, water and energy flows. Environmental impacts of machines and infrastructure were not included.

3.5 Background data

This study uses generic background data for the evaluation of upstream environmental impacts from *MLC*-database 2023.2 and is modelled in *LCA FE*-software version 10.7.

3.6 Data quality

Data collection is based on sector-specific questionnaires. It follows an iterative process of clarifying questions via e-mail, telephone calls or web meetings. Intensive discussions between DSI Underground Merol and Daxner & Merl result in an accurate mapping of product-related material and energy flows. This leads to a high quality of foreground data collected. Data collection relies on a consistent process according to *ISO 14044*. The technological, geographical and time-related representativeness of the data base are kept in mind when selecting background data. Whenever specific data were missing, either generic datasets or representative average data were used instead. The implemented *MLC* background datasets are not more than ten years old.

3.7 Period under review

Foreground data were collected in the 2022 production year, and are based on the volumes produced on an annual basis.

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: Poland

3.9 Allocation

Background data for the supply chain of the steel are published by worldsteel (*MLC*-databases). Representing an average of the global steel industry, worldsteel background datasets ensure a good geographical and technological representation of steel production. All worldsteel datasets are modelled according to the worldsteel LCA methodology, applying the system expansion approach for the allocation of co-products from steel production. As a result, these datasets are not fully compliant with the requirements of *EN 15804*, which emphasises the so-called partitioning approach applying a

subdivision of environmental impacts according to their physical relationships. Due to their high representativeness, the worldsteel data were used to calculate the LCA.
Scrap input is regarded as burden-free. To calculate the net flows, the mass of external steel scrap used in the production, is subtracted from the total mass of the product.

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 *MLC* 2023.2 background database in the *LCA FE*-software-version 10.7 was used to calculate the LCA.

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

The declared product does not contain any biogenic carbon.

Information describing the biogenic carbon content at the factory gate

Name	Value	Unit
Biogenic carbon content in product	-	kg C
Biogenic carbon content in accompanying packaging	0.85	kg C

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

The carbon stored in the packaging was taken into account as "CO_2-neutral". Thus the storage effect of the carbon bound in the packaging is not included in the calculation but is considered as emitted immediately.

Installation in building (A5)

The end of life of the packaging materials is not declared in Module A5.

Name	Value	Unit
Packaging (steel strip)	1.68	kg
Packaging (PET-strip)	0.20	kg
Packaging (wood)	0.52	kg

After dismantling, recycling is assumed as a probable end-of-life scenario of the DSI REBAR BOLTS. A large proportion of the bolts are likely to remain in the rock structure/ground after use. As it is not possible to quantify the proportion, the end-of-life scenario must be adjusted to the respective application if necessary.
The end-of-life scenario used in this LCA study is based on the following assumptions and thus complies with the specifications published in *ökobaudat 2023*:

End-of-life (C1–C4)

Name	Value	Unit
Collected separately waste type (steel)	1000	kg
Recycling 95 %	950	kg
Landfilling 5 %	50	kg

Re-Use, recovery and recycling potential (D), relevant scenario information

Name	Value	Unit
Net flow of steel scrap	- 103	kg

This scenario contains a recycling rate of 95 %. Since a certain amount of steel scrap is used in the production of the raw materials, and steel scrap is produced in the production of the REBAR BOLTS, this is offset against the steel scrap for recycling (net flow).

5. LCA: Results

The following table contains the LCA results for a declared unit of 1 ton DSI REBAR BOLT.

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

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 ton DSI REBAR BOLT

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Global Warming Potential total (GWP-total)	kg CO_2 eq	8.69E+02	0	3.14E+00	0	2.45E+00	1.79E+02
Global Warming Potential fossil fuels (GWP-fossil)	kg CO_2 eq	8.4E+02	0	2.89E+00	0	2.33E+00	1.8E+02
Global Warming Potential biogenic (GWP-biogenic)	kg CO_2 eq	2.81E+01	0	2.19E-01	0	1.23E-01	-9.98E-01
Global Warming Potential luluc (GWP-luluc)	kg CO_2 eq	7.61E-01	0	2.71E-02	0	2.38E-03	2.39E-02
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC11 eq	5.03E-09	0	3.8E-13	0	3.86E-12	-2.41E-10
Acidification potential of land and water (AP)	mol H^+ eq	1.87E+00	0	2.51E-03	0	4.07E-03	3.29E-01
Eutrophication potential aquatic freshwater (EP-freshwater)	kg P eq	1.3E-03	0	1.07E-05	0	2.1E-06	4.18E-05
Eutrophication potential aquatic marine (EP-marine)	kg N eq	3.35E-01	0	6.59E-04	0	8.13E-05	1.25E-02
Eutrophication potential terrestrial (EP-terrestrial)	mol N eq	3.57E+00	0	8.26E-03	0	9.53E-04	-1.48E-03
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg NMVOC eq	1.12E+00	0	1.65E-03	0	1.19E-03	1.38E-01
Abiotic depletion potential for non fossil resources (ADPE)	kg Sb eq	1.28E-03	0	1.94E-07	0	6.4E-08	1.02E-03
Abiotic depletion potential for fossil resources (ADPF)	MJ	1.07E+04	0	3.98E+01	0	3.49E+01	1.78E+03
Water use (WDP)	m^3 world eq deprived	8.26E+02	0	2.17E-01	0	6.54E-01	2.29E+02

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 ton DSI REBAR BOLT

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Renewable primary energy as energy carrier (PERE)	MJ	2.88E+03	0	2.9E+00	0	3.14E+00	-7.04E+01
Renewable primary energy resources as material utilization (PERM)	MJ	8.58E+00	0	0	0	0	0
Total use of renewable primary energy resources (PERT)	MJ	2.88E+03	0	2.9E+00	0	3.14E+00	-7.04E+01
Non renewable primary energy as energy carrier (PENRE)	MJ	1.07E+04	0	4E+01	0	3.5E+01	1.78E+03
Non renewable primary energy as material utilization (PENRM)	MJ	4.41E+00	0	0	0	0	0
Total use of non renewable primary energy resources (PENRT)	MJ	1.07E+04	0	4E+01	0	3.5E+01	1.78E+03
Use of secondary material (SM)	kg	1.09E+03	0	0	0	0	-1.03E+02
Use of renewable secondary fuels (RSF)	MJ	0	0	0	0	0	0
Use of non renewable secondary fuels (NRSF)	MJ	0	0	0	0	0	0
Use of net fresh water (FW)	m^3	2.02E+01	0	7.12E-03	0	1.5E-02	2.3E+01

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 ton DSI REBAR BOLT

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Hazardous waste disposed (HWD)	kg	1.57E-05	0	1.24E-10	0	2.89E-09	1.33E-05
Non hazardous waste disposed (NHWD)	kg	8.05E+00	0	6.09E-03	0	5.01E+01	-2.16E+01
Radioactive waste disposed (RWD)	kg	3.47E-01	0	7.34E-05	0	3.99E-04	-1.92E-04
Components for re-use (CRU)	kg	0	0	0	0	0	0
Materials for recycling (MFR)	kg	0	0	0	9.5E+02	0	0
Materials for energy recovery (MER)	kg	0	0	0	0	0	0
Exported electrical energy (EEE)	MJ	0	0	0	0	0	0
Exported thermal energy (EET)	MJ	0	0	0	0	0	0

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 ton DSI REBAR BOLT

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Incidence of disease due to PM emissions (PM)	Disease incidence	ND	ND	ND	ND	ND	ND
Human exposure efficiency relative to U235 (IR)	kBq U235 eq	ND	ND	ND	ND	ND	ND

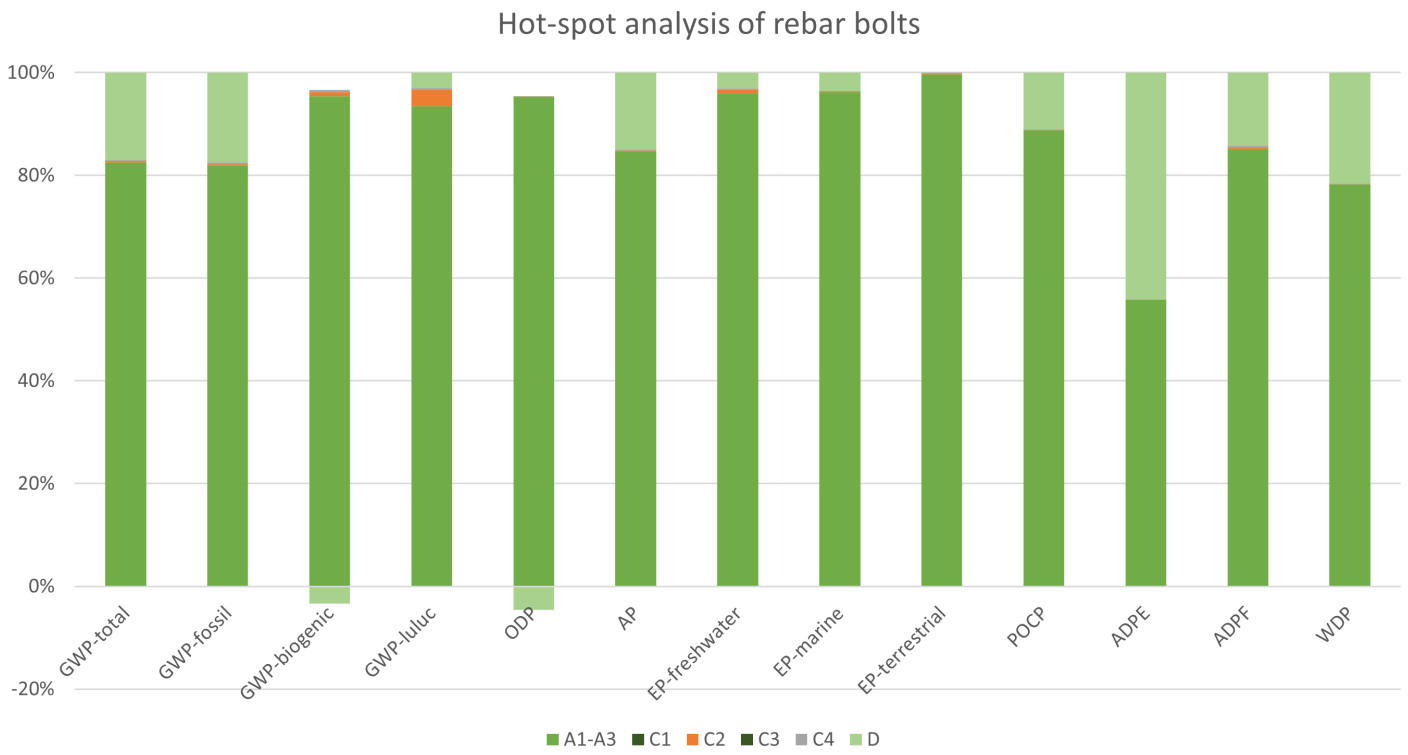
Comparative toxic unit for ecosystems (ETP-fw)	CTUe	ND	ND	ND	ND	ND	ND
Comparative toxic unit for humans (carcinogenic) (HTP-c)	CTUh	ND	ND	ND	ND	ND	ND
Comparative toxic unit for humans (noncarcinogenic) (HTP-nc)	CTUh	ND	ND	ND	ND	ND	ND
Soil quality index (SQP)	SQP	ND	ND	ND	ND	ND	ND

The additional and optional impact categories according to *EN 15804+A2* are not declared, as the uncertainty of these indicators is to be classified as high.

Disclaimer – 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 following interpretation contains a summary of the LCA results referenced to a declared unit of 1 ton DSI REBAR BOLT.



A comparison of the individual life cycle phases results in a clear dominance of the production phase (Modules A1-A3). The environmental effects in the production phase are mainly dominated by the provision of raw materials, especially steel rebar.
The product functions as a load-bearing component throughout the lifespan of the overall structure and is only demolished or removed together with the overall structure. A large proportion of the bolts are likely to remain in the rock structure/ground after use. As a result of product recyclability, the material removed at the end of life can substitute primary steel. Steel scrap is utilized in the production of the pre-materials used for REBAR BOLTS. Considering the used amount of scrap the net-flow reaching module D for recycling amounts to a negative value. This means, that more scrap is used for the production of the pre-materials than can be returned to the recycling stream after the end of the product's lifespan. This results in potential environmental burdens in Module D.

The environmental impact of the transport of the products to recycling (C2) as well as landfilling of the losses at the end of life (C4) represents a minor contribution to the overall environmental impact of the product.

When it comes to the environmental impacts in the production phase of the REBAR BOLTS, the upstream supply chain of the steel rebar represents the major hot-spot in all of the impact categories considered. In general, environmental impacts from steel production represent the decisive factors in the results. The processes at the production site of DSI are responsible for less than 10 % of the products' environmental impacts.

Specific variants differ mainly in the specification of the rebar (outer diameter, length, etc.). Thus, a linear correlation of the environmental impacts with the product weight can be assumed. Taking into account a certain degree of uncertainty from the extrapolation of the non-linearly scalable components (e.g. nut, expansion shell, spherical washer), the conversion of the declared unit into a specific product is possible via a mass-related scaling factor. Product-related variances such as the nut, expansion shell and spherical washer, which are not linearly scalable with product weight but are product-based, tend to be less dominant factors in terms of their mass-based contribution as well as the expected environmental impact.

7. Requisite evidence

The corrosion of rock bolts used in underground mines and tunnels depends on many factors and there is no harmonized norm to calculate corrosion rates. We use references and data available in literature, and the table here enclosed is a good example. REBAR BOLT service life is normally calculated case by case, setting the required loading capacity and considering the expected corrosion rate.

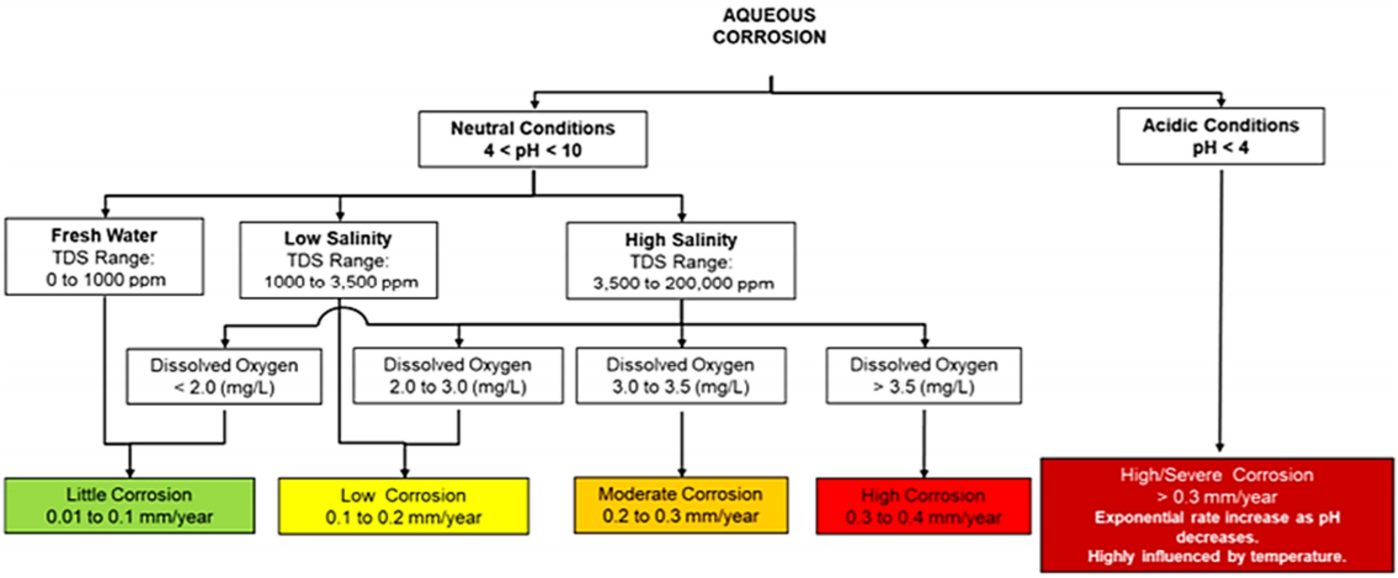


Figure 2 – Classification of aqueous corrosive environments and estimated uniform corrosion rates for carbon steel

8. References

Standards

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Further Literature

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