Environmental Product Declaration

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for:

Fabricated steel reinforcement products (cut and bent rebar)

EPD of multiple fabricated steel reinforcement products, based on the average results of the product group

from

HY-TEN

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-02388
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An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

General information

Programme information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
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Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product Category Rules (PCR): *PCR 2019:14 Construction products v1.3.2*
PCR review was conducted by: *The Technical Committee of the International EPD System. See www.environdec.com for a list of members. Review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact*
Life Cycle Assessment (LCA)
LCA accountability: *Doyin Oladele, Environmental Resource Management (ERM)*
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by individual verifier Third-party verifier: *Dr Matt Fishwick*, Fishwick Environmental Ltd   Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☒ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation

factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

Company information

Owner of the EPD: HY-TEN Ltd., Chatham Docks, Chatham, Kent, ME4 4SR, United Kingdom.

Contact: Jodi Chater, +44 (0)1634 893487, j.chater@hy-ten.co.uk

Description of the organisation: HY-TEN is a leading stockist and fabricator of concrete reinforcement bar, mesh, and accessories with a nationwide network of 14 manufacturing centres from which we provide an innovative, rapid, and cost-effective service to building and civil engineering contractors throughout the UK, Eire, and the World. HY-TEN is a major distributor of industrial welded mesh, security fencing, gabions, and other land reinforcement products. They also manufacture structural steelwork and general steel fabrications.

Product-related or management system-related certifications: ISO 19001, ISO 14001, ISO 45001, BES 6001, member of Eco-Reinforcement, Cares Sustainability Scheme and Achilles accreditation scheme.

Name and location of production site(s):

- HY-TEN Chatham: Chatham Docks, Chatham, Kent, ME4 4SR.

Product information

Product name: Fabricated steel reinforcement products (cut and bent rebar).

Product identification: CARES approved grade 500 N/mm² cut and bent reinforcement bar to BS 4449:2005.

Product description: HY-TEN produce cut and bent hot rolled ribbed steel reinforcement bar for use in the reinforcement of concrete in the following sizes: (mm): 6, 8, 10, 12, 14, 16, 18, 20, 25, 32, 40, 50.

UN CPC code: 412: products of iron or steel.

Other codes for product classification: BS 8666:2005 shape codes: 00, 01, 11, 12, 13, 14, 15, 21, 22, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 41, 44, 46, 47, 48, 51, 52, 56, 63, 64, 67, 75, 77, 98, 99.

Geographical scope: United Kingdom.

LCA information

LCA practitioner: Doyin Oladele, ERM, doyin.oladele@erm.com
Declared unit: 1 tonne of fabricated reinforced steel product produced in the UK.
Time representativeness: Primary data covers a period of 01.01.2022 to 31.01.2022, with all secondary data used <3 years difference to year of study.
Type of EPD: EPD of multiple products, based on the average results of the product group.
Description of system boundaries:
The system boundary of this LCA study covers the cradle to gate stage (A1 to A3) plus end-of-life (C1-C4) and benefits and loads beyond the system boundary (D), because other life cycle stages are dependent on scenarios and are better developed for specific building or construction works.

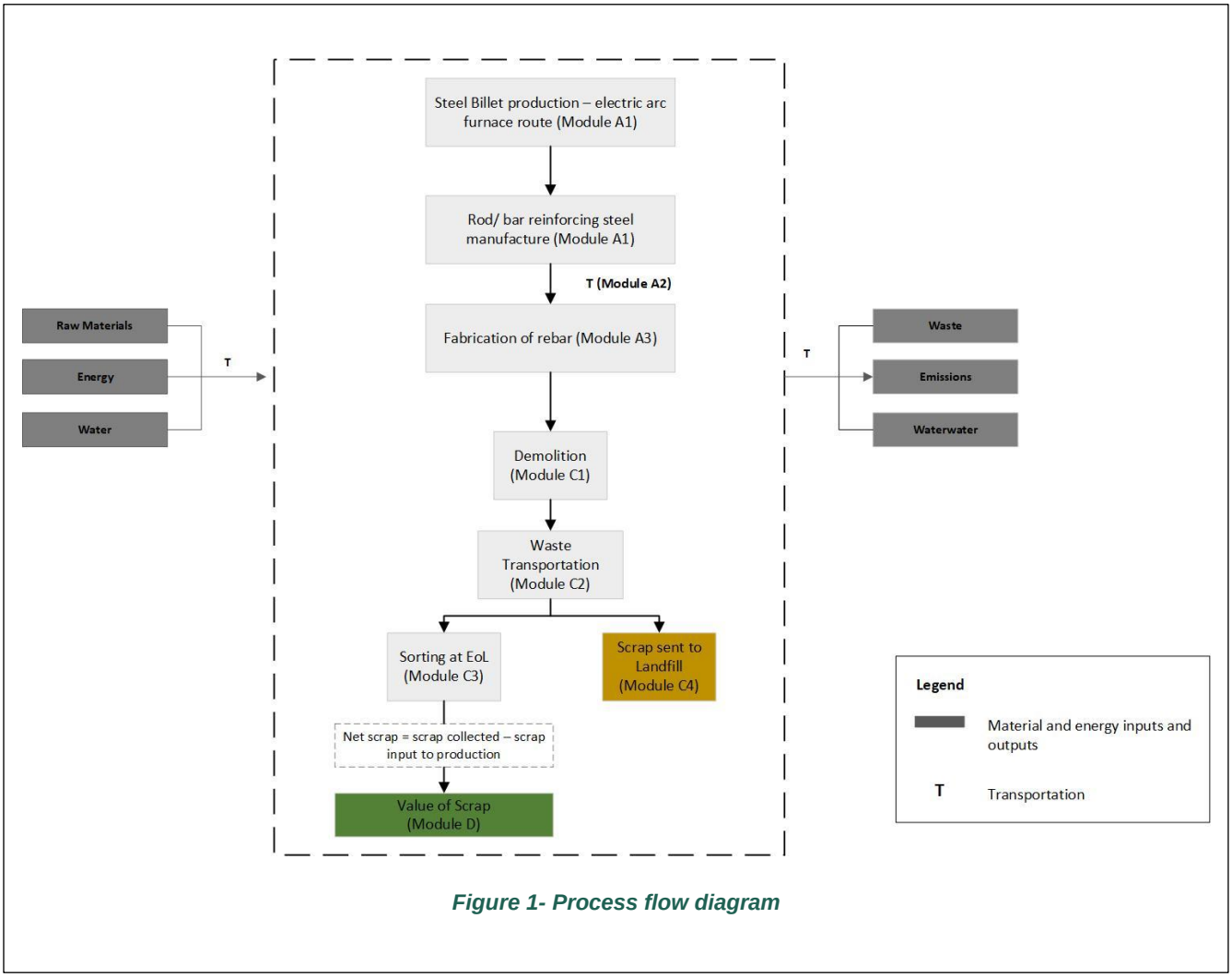

Figure 1- Process flow diagram

Product system description:

HY-TEN produce cut and bent hot rolled ribbed steel reinforcement bar for use in the reinforcement of concrete. In this EPD, the system boundary was defined as cradle-to-gate (modules A1-A3) with options C1-C4 plus module D as described below and presented in the process flow in Figure 1:

- **A1 raw materials supply**: The rod/bar reinforcing steel are produced by suppliers across mainland Europe and the United Kingdom. To make this raw material, the electric arc furnace route is used, whereby scrap steel is added to an electric arc furnace to melt it and convert it into high quality steel before it is cast into billets. Rod/bar reinforcing steel is produced by heating steel billets, which are in turn pushed through a series of rolling stands with grooved cylindrical rolls, each with a smaller diameter than the previous. The recycled content of steel supplied to HY-TEN for use in cut and bent rebar is 98.9% (external pre- and post-consumer scrap).
- **A2 transportation**: rod/bar reinforcing steel manufactured by manufacturers is transported to the HY-TEN site in the UK via road and sea.
- **A3 manufacturing**: rod/bar reinforcing steel is cut to the desired length and bend to the desired shape at HY-TEN site.
- **C1-C3 end of life**: at end of life the building is deconstructed, requiring 24 MJ diesel/tonne. The recovered steel is sent for recycling while the remaining is assumed to be sent to landfill. 92% of the steel reinforcing product is assumed to be recycled and 8% is sent to landfill (Steel

Construction Institute, 2000). It is assumed that scrap cut and bent rebar from deconstruction/demolition sites would be sorted at point of collection and has reached end of waste state. No further processing is required so there are no impacts associated with this module. Therefore, no impacts are reported in module C3.

- **D benefits and loads:** The potential benefits and loads are assigned to the net scrap steel that is generated over the product life cycle. This was obtained by calculating the difference between the total scrap recycled at end of life and scrap input to the manufacturing process. These benefits and loads are calculated by including the burdens of recycling and the benefit of avoided primary production.

Table 1: Data used to develop End-of-Life scenario

Parameter	Value (per unit declared)
Collection process specified by type	1 tonne collected separately
Recovery system, specified by type	0 kg for reuse
	0.92 tonne for recycling
	0 kg for energy recovery
Elimination, specified by type	0.08 tonne for final disposal (landfill)
Assumptions for scenario development (transport)	Transport of waste to waste processing facility Lorry EURO 5: 50 km

Net scrap steel calculation

$$1.01\ (secondary\ material\ input) - 0.92\ (scrap\ at\ end\ of\ life) - 0.028\ (scrap\ from\ production\ A3)$$
$$= 0.0621\ tonnes\ per\ FU$$

Goal of study:

The goal of this study was to generate an environmental profile to be reported in an EPD of the following fabricated reinforcing steel product to better understand the associated lifecycle environmental impacts.

Intended use:

This LCA study will allow HY-TEN to identify the relative contribution to environmental impact of all processes in the product lifecycle. Therefore, it will allow them to identify the relative contribution to environmental impact of all processes of the product system under investigation and help identify 'hotspots' where mitigation measures can be targeted.

Cut-off criteria:

No lifecycle stages over the cradle-to-gate boundary were excluded. In this study, exclusions could be made if they were expected to be within the below criteria:

- **Mass**: if a flow is anticipated to be less than 1% of the mass of the product it may be neglected;

- **Energy**: if a flow is anticipated to be less than 1% of the cumulative energy it may be neglected; and
- **Environmental significance**: if a flow is anticipated to be less than 1% of the key impact categories it may be excluded.

The total neglected flows from the product stage is not more than 5% of product inputs by mass or 5% of primary energy contribution.

Water is not used for production but for sanitary purposes therefore it is excluded from the study.

Exclusions:

Lifecycle stages that have been omitted from the scope of the study include the following:

- Human energy inputs to processes;
- Production and disposal of the infrastructure (machines, transport vehicles, roads, etc.) and their maintenance;
- Environmental impacts related to storage phases;
- Losses of product at different points in the supply chain, for instance during handling and storage;
- Transport of employees to and from their normal place of work and business travel;
- Environmental impacts associated with support functions (e.g. R&D, marketing, finance, management etc.); and
- Primary, secondary, and tertiary packaging of raw materials and finished products (estimated to be <0.1% of product by mass for finished products).

General allocation procedures:

Allocation of different sizes of the product was carried out on a mass basis, so there is no difference in per tonne impact. EPDs from HY-TEN's suppliers were used as primary data for material input. The EPD data was allocated to the input material based on weight supplied to HY-TEN in the reference year of the study

As no co-products are produced, the flow of materials and energy and the associated release of substances and energy into the environment is therefore related exclusively to the fabricated steel reinforcement products produced. Co-product allocation was not performed for scrap produced at manufacturing (A3).

End-of-life allocation procedures:

In this study a cut-off method was applied to all cases of end-of-life allocation. This was used for the consumption of recycled materials at the start of life and for the sending of materials to recycling or material reuse at the end-of-life. In this approach the environmental burdens and benefits of recycled / reused materials are given to the product system consuming them, rather than the system providing them. This is known as the cut-off, recycled content or 100:0 approach. This is a common approach in LCA, follows the ISO standards on LCA and prescribed in EN 15804.

Data Quality:

Data quality requirements followed those of ISO 14040/44, EN 15804 and PCR 2019:14 v1.3.2. To ensure the quality of data was sufficient data quality checks were completed on key data parameters by data quality indicators using a data quality matrix and assigning scores between 1 (best) and 5 (worst). The range of scores for primary and secondary data used in this study can be summarised as:

- **Reliability**: mostly 2, some 3.
- **Representativeness**: mostly 1 and 2, some 3.
- **Temporal correlation**: all 1.

- **Geographical correlation**: mostly 2, some 1 and 3.
- **Technological correlation**: all 1.

Database(s) and LCA software used:
Secondary data are from the ecoinvent v3.9.1, cut-off by classification. The LCA model built in SimaPro (version 9) software.

Environmental data of electricity consumed on HY-TEN site was modelled using medium voltage grid mix for the UK from the ecoinvent database. This dataset was updated to take into account the 2022 residual mix for the United Kingdom published by the Association of Issuing Bodies (AIB), with a value of GHG-GWP of 0.412 kg CO_2 eq/kWh.

Life cycle impact assessment method (LCIA):
This study applies the EF 3.1 impact assessment methods. EF 3.1 characterisation factors are considered to be the most robust and up-to-date available for the European context, are widely used and respected within the LCA community, and are required for Product Environmental Footprint studies and Environmental Product Declarations under EN 15804+A2.

Assumptions:
The following assumptions were made for this LCA study:

- Primary data were available for 11.2% (by weight) of the rod/bar reinforcing steel supplied to HY-TEN. The remaining 88.8% was modelled using secondary data. It was assumed that the rod/bar reinforcing steel was entirely produced from secondary steel billets. Secondary steel billets production was best represented by the electric arc furnace route.
- Transportation of raw materials to the HY-TEN site was estimated based on the most logical route and transportation method from the supplier locations to Chatham.
- An average distance of 50 km using a 16-32 metric ton truck was modelled for transportation of waste from the HY-TEN site to waste treatment facilities.

Table 2: Modules declared in the fabricated steel reinforcement products LCA

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	EU	EU	EU, UK, GLO	-	-	-	-	-	-	-	-	-	GLO	EU	-	EU	GLO
Specific data	18%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation - products	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation - sites	Not relevant			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: Life cycle stages that are not covered by the EPD are indicated as ND (Module Not Declared).

Content information

Table 3: Product and packaging compostition information

Chemical composition	**Product composition material, weight-%**
Iron	95
FeSi, SiMn, CiSi, FeB, Al, FeV, C and other charge additives	5
Material	**Material, weight-%**
Post-consumer scrap	80*
Biogenic carbon dioxide	0
Packaging materials	**Weight-% (versus the product)**
Polypropylene	0.005

*Post-consumer material according to this PCR excludes pre-consumer scrap. According to ISO 14021:2016, the average recycled content, which includes external pre- and post-consumer recycled scrap, is approximately 98.9%. The figures provided represent our best estimate at the time of publication.

The fabricated steel products do not meet the criteria for PBT (Persistent, Bio-accumulative and Toxic) or vPvB (very Persistent and very Bio-accumulative) in accordance with Annex XIII of Regulation (EC) No. 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). Furthermore, the fabricated steel products are articles, and it is exempted from REACH registration.

Results of the environmental performance indicators

Table 4: Mandatory impact category indicators according to EN 15804+A2, per tonne of fabricated steel reinforcement products

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
GWP- GHG	kg CO_2 eq	5.03E+02	2.14E+01	1.81E+01	5.43E+02	2.23E+00	7.66E+00	0.00E+00	2.15E-01	1.03E+02
GWP-total	kg CO_2 eq.	5.14E+02	2.15E+01	1.82E+01	5.54E+02	2.24E+00	7.70E+00	0.00E+00	2.16E-01	1.04E+02
GWP-fossil	kg CO_2 eq.	5.05E+02	2.15E+01	1.82E+01	5.44E+02	2.24E+00	7.70E+00	0.00E+00	2.16E-01	1.04E+02
GWP-biogenic	kg CO_2 eq.	8.78E+00	3.21E-03	1.92E-03	8.79E+00	4.17E-04	1.11E-03	0.00E+00	8.50E-05	-4.51E-02
GWP-luluc	kg CO_2 eq.	6.08E-01	7.22E-04	8.98E-04	6.09E-01	9.16E-05	2.64E-04	0.00E+00	1.08E-05	2.22E-03
ODP	kg CFC 11 eq.	1.04E-05	3.12E-07	5.14E-07	1.12E-05	3.53E-08	1.05E-07	0.00E+00	3.21E-09	2.35E-13
AP	mol H^+ eq.	1.99E+00	4.85E-01	1.24E-01	2.60E+00	2.15E-02	2.25E-02	0.00E+00	2.01E-03	2.31E-01
EP-freshwater	kg P eq.	2.42E-02	2.63E-05	4.71E-05	2.43E-02	1.92E-06	1.84E-05	0.00E+00	7.63E-07	1.95E-05
EP-marine	kg N eq.	4.20E-01	1.23E-01	5.55E-02	5.99E-01	1.01E-02	8.25E-03	0.00E+00	9.12E-04	4.06E-02
EP-terrestrial	mol N eq.	4.73E+00	1.36E+00	6.04E-01	6.69E+00	1.10E-01	8.78E-02	0.00E+00	9.93E-03	3.57E-01
POCP	kg NMVOC eq.	1.52E+00	3.69E-01	1.80E-01	2.07E+00	3.23E-02	3.16E-02	0.00E+00	2.97E-03	1.65E-01
ADP-minerals&metals(1)	kg Sb eq.	6.59E-04	5.50E-07	7.03E-07	6.60E-04	9.42E-08	4.58E-07	0.00E+00	8.58E-09	2.68E-04
ADP-fossil(1)	MJ	7.36E+03	2.70E+02	3.02E+02	7.93E+03	2.95E+01	1.03E+02	0.00E+00	2.78E+00	9.88E+02
WDP(1)	m^3	2.44E+02	2.83E-01	3.69E-01	2.45E+02	3.78E-02	1.45E-01	0.00E+00	3.83E-03	1.29E+03
Acronyms	GWP-GHG = Global Warming Potential; GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption									

Table 5: Additional mandatory and voluntary impact category indicators, per tonne of fabricated steel reinforcement products

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
PM	[Disease incidences]	4.84E-05	9.03E-07	3.18E-06	5.24E-05	6.05E-07	5.16E-07	0.00E+00	5.56E-08	3.88E-06
IR(2)	[kBq U235 eq.]	4.68E+01	2.87E-02	2.16E+00	4.90E+01	3.47E-03	1.03E-02	0.00E+00	3.71E-04	-2.42E+03
ETF-fw(1)	[CTUe]	4.53E+03	1.34E+02	7.93E+01	4.74E+03	1.41E+01	5.39E+01	0.00E+00	1.31E+00	4.97E+01
HTP-c (1)	[CTUh]	4.82E-05	5.42E-09	1.82E-09	4.82E-05	2.52E-10	1.15E-09	0.00E+00	3.38E-11	8.79E-08
HTP-nc(1)	[CTUh]	2.53E-05	1.90E-07	5.74E-08	2.55E-05	6.29E-09	1.11E-07	0.00E+00	7.82E-10	-2.93E-07
SQP	[Pt]	1.57E+03	5.92E-01	7.15E+00	1.58E+03	5.58E-02	3.97E-01	0.00E+00	3.30E+00	-1.63E+01
Acronyms	PM = Particulate matter emissions; IR = Ionizing radiation, human health; ETF-fw = Eco-toxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-c = Human toxicity, non-cancer effects, SQP = Soil quality potential/ Land use related impacts									

Table 6: Resource use indicators, per tonne of fabricated steel reinforcement products

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
PERE	MJ	1.14E+03	4.33E-01	2.81E+00	1.14E+03	5.74E-02	1.50E-01	0.00E+00	1.24E-02	-3.14E+00
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	1.14E+03	4.33E-01	2.81E+00	1.14E+03	5.74E-02	1.50E-01	0.00E+00	1.24E-02	-3.14E+00
PENRE	MJ	7.78E+03	2.87E+02	3.19E+02	8.38E+03	3.14E+01	1.09E+02	0.00E+00	2.95E+00	1.03E+03
PENRM	MJ	0.00E+00	0.00E+00	2.07E+00	2.07E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	7.78E+03	2.87E+02	3.21E+02	8.39E+03	3.14E+01	1.09E+02	0.00E+00	2.95E+00	1.03E+03
SM	kg	1.01E+03	0.00E+00	0.00E+00	1.01E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
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	8.29E+00	1.14E-02	2.98E-02	8.33E+00	1.46E-03	5.26E-03	0.00E+00	1.45E-04	3.28E-01
Acronyms	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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water									

Table 7: Waste indicators, per tonne of fabricated steel reinforcement products

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
Hazardous waste disposed	kg	1.47E-01	1.45E-03	4.52E-02	1.93E-01	1.97E-04	6.88E-04	0.00E+00	1.79E-05	0.00E+00
Non-hazardous waste disposed	kg	1.63E-01	1.81E-04	5.76E-04	1.64E-01	1.40E-05	1.20E-04	0.00E+00	3.44E-06	0.00E+00
Radioactive waste disposed	kg	3.73E-02	1.08E-05	8.79E-04	3.82E-02	1.44E-06	3.68E-06	0.00E+00	1.65E-07	0.00E+00

Table 8: Output flow indicators, per tonne of fabricated steel reinforcement products

Indicator	Unit	A1	A2	A3	A1-A3	C1	C2	C3	C4	D
Components for re-use	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
Material for recycling	kg	1.90E+01	0.00E+00	2.80E+01	4.69E+01	0.00E+00	0.00E+00	9.20E+02	0.00E+00	0.00E+00
Materials for energy recovery	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
Exported energy, electricity	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
Exported energy, thermal	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

Disclaimers:

1) The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.
2) This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.
3) The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks
4) We discourage the use of the results of modules A1-A3 without considering the results of module C.

References

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