ENVIRONMENTAL PRODUCT DECLARATION FOR HOT-DRAWN REINFORCING STEEL FOR CONCRETE IN BARS PRODUCED BY

INDUSTRIE RIUNITE ODOLESI I.R.O. S.p.A.

BASED ON: PCR ICMQ-001/15, REV.0 DEVELOPED ACCORDING TO EN 15804:2014

CERTIFICATION N°: EPDITALY0007

ECO EPD REF. N°: 00000392

REVISION 0 OF 2016/04/12

VALID UNTIL: 2021/04/12

Table of contents

Company and product presentation 3
The company 3
The product and its production 3
Environmental performance declaration 5
Methodology 5
Declared unit 5
System boundaries and main hypothesis 6
Environmental results 8
Additional information 10
Reference 11
General information 11
Contacts 11
References 12
Glossary 13

COMPANY AND PRODUCT PRESENTATION

THE COMPANY

The company Industrie Riunite Odolesi I.R.O. S.p.A. (from now on IRO S.p.A.) is placed in Odolo (BS), in via Brescia 12. Since 1951, IRO S.p.A. has been producing steel billets in electric arc furnace route (EAF) and hot-rolled reinforcing steel for concrete, coming from post and pre consumer steel scraps.
The production is divided in two areas in which steel is produced in continuous cycle through melting, casting and hot-rolling.

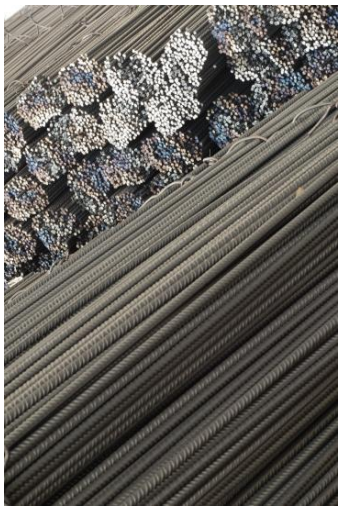
IRO S.p.A. is part of the controlled society "NOVA PIEMME SIDER S.r.l." that carry out "transformation centre" activities, as defined by D.M. 30 of 14.01.08.

THE PRODUCT AND ITS PRODUCTION

Steel bars are produced using steel scrap in a mill that uses electric-arc furnace technology, followed by casting of steel billets (squared diameter 120-130 and 140 mm and up to 9 m long) that feed rolling mill in real time. The plant turns out rebar meeting various national and international specifications.

The rolling mill plant produce:

- hot-rolled reinforcing steel for concrete, diameter 8-40mm and up to 18m long, with exceptional features regarding toughness and ductility, particularly suitable for anti-seismic purposes;
- hot-rolled reinforcing steel, CE marked, diameter 10-40mm, various length up to 18m for S355J0, S355JR, S275J0, S275JR, S355J2, S355K2 and S355J0W types.



All IRO production is monitored through continuous plant controls and periodic controls made by ministerial official laboratories and competent bodies.

IRO is committed to ensure the best results in terms of technology, patents and quality certification and it has always

boasted excellent management of the relations between human resources and the surrounding environment.

IRO is also committed to research and development for reducing atmospheric emissions and limiting energy consumption, adopting state-of-the-art technologies, quality certifications and system management UNI EN ISO 9001 (certificate number IGQ 9114, 1991/10/18) and UNI EN ISO 14001 (certificate number IGQ A2F11, 2005/12/15), certified by IGQ – Istituto italiano di Garanzia della Qualità.

The main features of the product object of this EPD and the production process are summarized in Table 1.

Table 1 - Main information and features related to the product object of the EPD

Information	Description
Product identification	Hot-drawn reinforcing steel for concrete in bars.
Product features	Bars: Diameter from Ø 6 mm to Ø 40 mm Length from 6 to 24 m
Product properties (under EN10080:2005)	Steel coming from post and pre consumer steel scraps produced in electric arc furnace route (EAF) and further hot rolling process.
	Adherence and surface geometry f_R or f_P : - for $6 < Ø \leq 12$ mm f_R or $f_P \geq 0.040$ - for $Ø > 12$ mm f_R or $f_P \geq 0.056$
	Weldability: C_{eq} <0,52
	Typical yield stress C_v: 400 ≤ Re and/or $Rp_{0.2}$ ≤ 600 MPa
	Elongation Agt: ≥ 7,5%
	Successful in bend and rebend test
	Content of recycled materials ≥99% (Certificate IGQ n. C062 following ISO 14021)
	Successful in strength test and oligocyclic strength test
Plant features	Total EPD-covered production, year 2014: 231,927 t
	Total EPD-covered production, sold in 2014: 228,696 t
	On-site air emission control system
	On-site dumping water control system
	On-site system to recycle water used in process
	In/out materials/products and casting process monitored to prevent nuclear radiation
	Plant air emissions accounted under ETS (Emission Trading System)

Reference products, object of this EPD, have a chemical composition in compliance with national regulation of the destination countries where the products are sent.
In general, the main materials in the final product are:

- Iron > 92%
- Alloy elements (e.g. manganese, silicon, carbon): 2% c.a.

- Other elements (e.g. copper, nickel, chromium): complementary to 100%

ENVIRONMENTAL PERFORMANCE DECLARATION

In this part of the Environmental Product Declaration (EPD), the main features and the environmental results of the LCA analysis are presented.

METHODOLOGY

The environmental burden of the product has been calculated according to PCR ICMQ-001/15[1] (rev. 0) *Construction products and construction services* and EN 15804:2014[2].

This declaration is a *cradle to gate with options* EPD type, developed within EPDITALY and based on the application of Life Cycle Assessment (LCA)[3] methodology to the whole life-cycle system. In the whole LCA model, infrastructures and production equipment are not taken into account. The LCA study was performed using SimaPro 8.0.2 software and the Ecoinvent 2.2 data bank as supporting tool.

Hot-drawn reinforcing steel for concrete in bars were described by using specific data from I.R.O. S.p.A. manufacturing plant placed in Odolo (Brescia, Italy) referred to 2014 production (*239,656 t*).

Customized LCA questionnaires were used to gather in-depth information about all aspects of the production system (for example, raw materials contents and specifications, pre-treatments, process efficiencies, air and water emissions, waste management), in order to provide a complete picture of the environmental burden of the system from **Raw Materials supply (A1)** to **Transport (A2)** and **Manufacturing (A3)**.

Use phase and end of life were not considered according to EN:15804 and PCR ICMQ-001/15, while **transport to final destination** has been taken into account **(A4)**.

DECLARED UNIT

The **function** of the whole system is to produce steel products for concrete through two main processes: steel casting in electric arc furnace route (EAF) and further hot rolling process. Environmental burdens have been allocated dividing in/out system mass and energy flows on mass (products and co-products) basis.

According to EN:15804 and reference PCR, **the declared unit is 1 ton of bars**, ready to be delivered to the final customers.

[1] PCR ICMQ-001/15 (rev. 0) *Construction products and construction service*

[2] EN 15804 (2014) Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products.

[3] The LCA methodology is standardized at international level by ISO 14040 and ISO 14044.

SYSTEM BOUNDARIES AND MAIN HYPOTHESIS

Hot-drawn reinforcing steel for concrete in bars production system has been evaluated from raw materials extraction and production, steel production and transport of semi-finished products and final products (Figure 1).

Use phase and end of life stages were not considered according to EN:15804 and PCR 2012:01; in general, the certified product has a proper unlimited life cycle and ineffectiveness during use phase is bound to all the parameters that could influence concrete product durability of which steel is the core part.

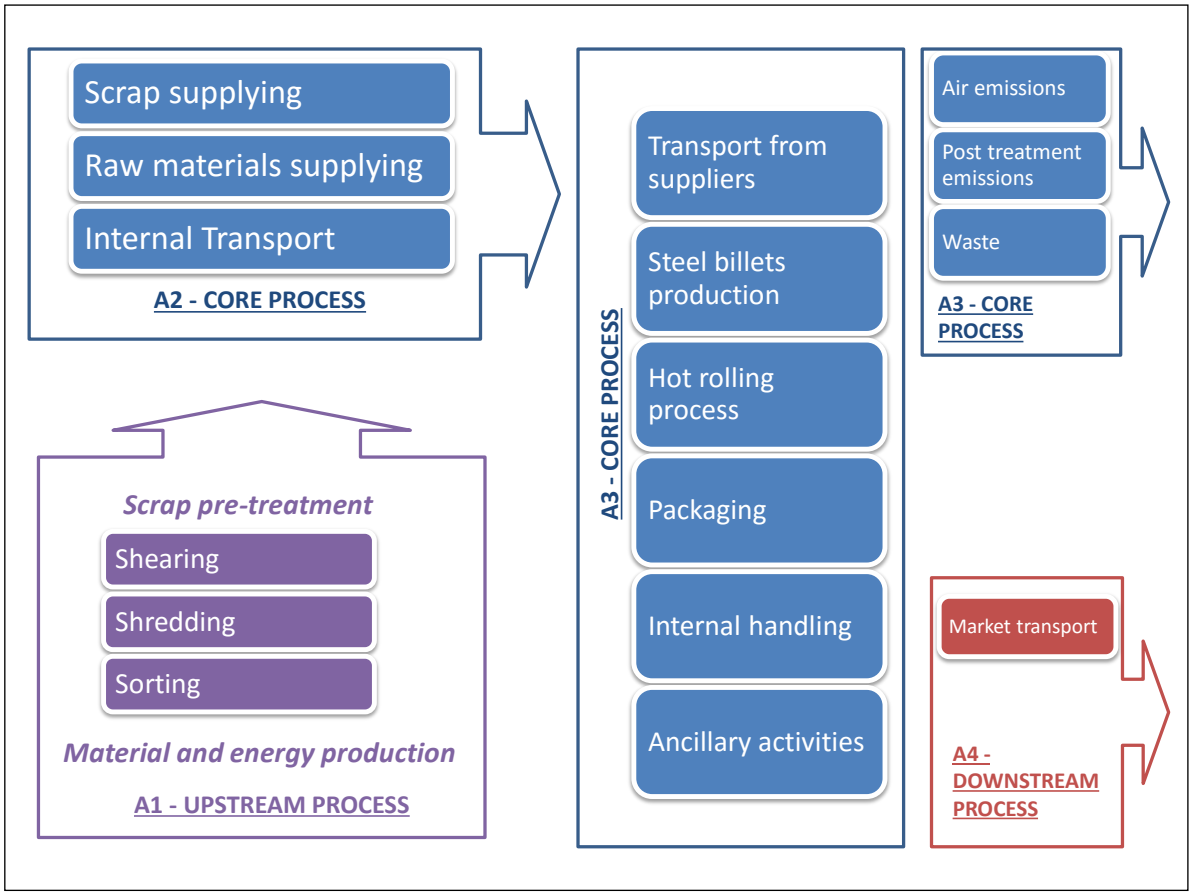


Figure 1 - Broad scheme of hot-rolled reinforcing steel for concrete production, in which the main activities included in the system boundaries, are listed and divided in the three subsystems: UPSTREAM Process, CORE Module and DOWNSTREAM Process.

The subsystems identified within hot-drawn reinforcing steel for concrete production are the following:

- Subsystem **"scrap pre-treatment"**: all the scrap materials is treated before being used in steel billets production (*upstream processes*); scrap pre-treatments take place in external plants;

- Subsystem "**hot-drawn reinforcing steel for concrete production**": it comprehends scrap and raw materials transports from suppliers to IRO S.p.A. steel mill, steel billets production and hot rolling process to produce steel bars, included plant ancillary activities and internal handling, air and water emissions, waste management and transport to disposal plants (*core process*). The total amount of steel billets used in IRO S.p.A. plant is an internal production;

- Subsystem "**market transport**" related to final product distribution from IRO S.p.A. plant to an average customer or place of use (*downstream process*).
  About the 50% of the final product is delivered to Italian sites (36% placed in the North, 10% in the Centre and 4% in the South) and the remaining 50% to foreign countries especially Algeria, Switzerland, Slovenia and Croatia. The means of transport are truck and freight ship. On average, a tons of steel bars (finished product) is transported for 355 km by lorry and 579 km by ship.

The main hypothesis of the LCA study are:

- All the phases related to **raw materials production and use** have been taken into account, from raw materials purchasing form suppliers to their production and sale;

- In case of **transports,** all those related to scrap and raw materials supply, waste management (from IRO S.p.A. plant to the place of disposal), internal handling and final product delivery, have been considered;

- **Ancillary activities and auxiliary materials use** (heating, lighting, etc.) are included within system boundaries and allocated to the different production stages on mass basis (allocation based on output quantities coming from pre-treatment stage, steel billets production and hot rolling process).

According to the EN:15804 general prescriptions as well as PCR on construction products, no environmental credits have been given to input scrap materials; only scrap pre-treatment process (necessary to make it suitable for steel production purpose) has been considered.

ENVIRONMENTAL RESULTS

Detailed environmental performance (in terms of ***use of resources***, ***waste generation*** and ***environmental impacts***) is presented for the three production stages (**Upstream**, **Core** and ***Downstream***) and the related sub-phases (A1-A2-A3-A4).

Note for the reader. The numbers reported in the tables below are the outcome of rounding. For this reason, total results could slightly differ from the sum of contributions of the different phases.

Table 2 - Renewable resources use referred to 1 t of hot-drawn reinforcing steel for concrete in bars

RENEWABLE Resources Net calorific value	Data referred to 1 t of hot-drawn reinforcing steel for concrete in bars				
	UPSTREAM	CORE		DOWNSTREAM	TOTAL
	A1 – Raw materials supply	A2 – Transportation	A3 – Manufacturing	A4 - Distribution	
Use of RENEWABLE primary energy excluding renewable primary energy resources used as raw materials [MJ, net calorific value]	1,118	2	44	1	**1,165**
Use of RENEWABLE primary energy resources used as raw materials [MJ, net calorific value]	-	-	-	-	**-**
Total use of RENEWABLE primary energy resources (primary energy and primary energy resources used as raw materials) [MJ, net calorific value]	1,118	2	44	1	**1,165**

Table 3 – NON renewable resources use referred to 1 t of hot-drawn reinforcing steel for concrete in bars

NON RENEWABLE Resources Net calorific value	Data referred to 1 t of hot-drawn reinforcing steel for concrete in bars				
	UPSTREAM	CORE		DOWNSTREAM	TOTAL
	A1 – Raw materials supply	A2 – Transportation	A3 – Manufacturing	A4 - Distribution	
Use of NON RENEWABLE primary energy excluding renewable primary energy resources used as raw materials [MJ, net calorific value]	7,881	1,354	748	852	**10,835**
Use of NON RENEWABLE primary energy resources used as raw materials [MJ, net calorific value]	408	-	-	-	**408**
Total use of NON RENEWABLE primary energy resources (primary energy and primary	8,289	1,354	748	852	**11,243**

energy resources used as raw materials) [MJ, net calorific value]					

Table 4- Use of secondary material referred to 1 t of hot-drawn reinforcing steel for concrete in bars

Use of secondary material	Data referred to 1 t of hot-drawn reinforcing steel for concrete in bars				
	UPSTREAM	CORE		DOWNSTREAM	TOTAL
	A1 – Raw materials supply	A2 – Transportation	A3 – Manufacturing	A4 - Distribution	
Use of secondary material [kg]	1,197	-	-	-	**1,197**
Use of renewable secondary fuels [MJ, net calorific value]	-	-	-	-	**-**
Use of NON renewable secondary fuels [MJ, net calorific value]	-	-	-	-	**-**

Table 5 – Net use of fresh water referred to 1 t of hot-drawn reinforcing steel for concrete in bars

Net use of fresh water	Data referred to 1 t of hot-drawn reinforcing steel for concrete in bars				
	UPSTREAM	CORE		DOWNSTREAM	TOTAL
	A1 – Raw materials supply	A2 – Transportation	A3 – Manufacturing	A4 - Distribution	
Net use of fresh water [m^3]	1.9	0.1	2.2	0.1	**4.3**

Table 6 – Waste production referred to 1 t of hot-drawn reinforcing steel for concrete in bars

Waste production and treatment	Data referred to 1 t of hot-drawn reinforcing steel for concrete in bars				
	UPSTREAM	CORE		DOWNSTREAM	TOTAL
	A1 – Raw materials supply	A2 – Transportation	A3 – Manufacturing	A4 - Distribution	
Hazardous waste disposed [kg]	-	-	20	-	**20**
NON hazardous waste disposed [kg]	-	-	228	-	**228**
Radioactive waste disposed [kg]	-	-	-	-	**-**

Table 7 – Parameters describing environmental impacts referred to 1 t of hot-drawn reinforcing steel for concrete in bars

Environmental impacts parameters	Data referred to 1 t of hot-drawn reinforcing steel for concrete in bars				
	UPSTREAM	CORE		DOWNSTREAM	TOTAL
	A1 – Raw materials supply	A2 – Transportation	A3 – Manufacturing	A4 - Distribution	
Global Warming Potential [kg CO_2 eq]	456	95	168	60	**779**
Ozone Depletion Potential [kg CFC-11 eq]	< 0.1	< 0.1	< 0.1	< 0.1	**< 0.1**
Acidification Potential [kg SO_2 eq]	0.6	0.4	0.1	0.3	**1.4**
Eutrophication Potential P. [kg PO_4^{3-} eq]	0.2	0.1	0.1	0.1	**0.5**
Photochemical Ozone Creation [kg C_2H_4 eq]	0.2	0.1	0.1	< 0.1	**0.4**
Depletion of abiotic resources (elements) [kg Sb eq]	< 0.1	< 0.1	< 0.1	< 0.1	**< 0.1**
Depletion of abiotic resources (fossil) [MJ, net calorific value]	7,497	1,343	488	845	**10,173**

ADDITIONAL INFORMATION

IRO S.p.A. plant in Odolo (BS) is equipped with prevention and reduction systems for air emissions, a recirculating loop cooling to minimize water consumption and a waste management plan to prevent and reduce waste generation.

In Table 8 some additional environmental information is reported.

Table 8 - Other environmental indicators referred to 1 t of hot-drawn reinforcing steel for concrete in bars

Other environmental indicator for 1 t of product		Unit	UPSTREAM	CORE	DOWNSTREAM	*TOTAL*
Air emissions	**Dust from electric-arc furnace**	[g]	-	10.9	-	**10.9**
	CO_2 from electric-arc furnace	[g]	-	76,184	-	**76,184**
	NO_x from hot rolling process	[g]	-	15.2	-	**15.2**

In accordance with general EPD requirements the LCA study used specific, generic and other generic data. This last data is contributing to the environmental indicators less than 10%.

Furthermore, some consideration on the contribution of other generic data in the environmental indicators considered in Table 8 is available in the final LCA report.

REFERENCE

GENERAL INFORMATION

This declaration has been developed referring to the EPDITALY, following the General Programme Information; further information and the document itself are available at: www.epditaly.it.

The main database used within the study: Ecoinvent 2.2

EPD document valid within the following geographical area: Italy and other countries according to sales market conditions (North Africa and Europe).

CEN standard EN 15804 served as the core PCR (PCR ICMQ-001/15 Construction products and construction service, rev. 0, 2015-12-10)
Independent verification of the EPD and its data, in accordance with ISO 14025 standards ☐ *EPD process certification (Internal)* ☑ *EPD verification (External)*
Third party verifier: **ICMQ SpA**, via De Castillia, 10 20124 Milano
Accredited by: Accredia

Environmental declarations published within the same product category, though originating from different programs, may not be comparable. In particular, EPDs of construction products may not be comparable if they do not comply with EN 15804.

CONTACTS

Environmental Manager: ing. Andrea Tisi

Phone: +39 0365826089 Fax : +39 0365860564 E-mail: tisiandrea@iro-spa.it

Technical support to I.R.O (Industrie Riunite Odolesi) S.p.A. was provided by Life Cycle Engineering, Italy (info@studiolce.it, www.lcengineering.eu).

REFERENCES

- Life Cycle Assessment (LCA) for hot-drawn reinforcing steel for concrete in bars produced by I.R.O (Industrie Riunite Odolesi) S.p.A. for EPD® purpose - 12/04/2016 FINAL report
- UNI EN 15804: 2014 Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products.
- EPDITALY® General Programme Information (GPI) (version 2, 2016-04-11) available at: http://www.epditaly.it/general-programme-information/
- PCR ICMQ-001/15 (rev. 0) Construction products and construction service, emission date: 10/12/2015/12/10, valid until: 2020/12/10; available at: http://www.epditaly.it/pcr/pcr-per-i-prodotti-da-costruzione
- Reference energy mix, IEA (International Energy Agency) data (related to year 2013)
- SimaPro 8.1.0.60 from Prè Consultant
- Ecoinvent v. 2.2
- UNI EN 10080-2005 (Steel For The Reinforcement Of Concrete - Weldable)

GLOSSARY

Considered parameters describing environmental impacts:

- **Global Warming – GWP**: Phenomenon in which the infrared rays emitted from the Earth's surface, as a result of solar heating, are absorbed by molecules in the atmosphere and re-emitted as heat, causing the over-warming of the atmosphere. The indicator used to evaluate this contribution is the GWP (Global Warming Potential), which includes primarily the emissions of carbon dioxide, the main greenhouse gas, as well as other gases with a lower degree of absorption of infrared rays, such as methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFC) (g CO_2).

- **Acidification Potential – AP**: It is a form of precipitation that is unusually acidic, meaning that it possesses substandard levels of pH. It can have harmful effects on plants, aquatic animals and infrastructure. Acid rain is caused by emissions of SO_2, NO_x and NH_3. The acidification potential is measured in grams of equivalent Sulphur Dioxide (SO_2).

- **Ozone Depletion Potential – ODP**: degradation to the ozone layer, useful to block the ultraviolet component of sunlight, caused by some substances such as chlorofluoromethans or chlorocarbons. Trichlorofluoromethane (R-11 or CFC-11) is the reference substance, being fixed at an ODP of 1.0. The ozone depletion potential is measured in g CFC-11 eq.

- **Eutrophication potential – EP**: It is an extreme proliferation of vegetation in the aquatic ecosystem caused by the addition of nutrients into rivers, lakes or ocean, which determinates a lack of oxygen. Eutrophication potential is mainly caused by emission into water of phosphate and nitrates. It is expressed in equivalent grams of (g PO_4^-).

- **Photochemical ozone creation potential – POCP**: Chemical reactions brought about by the light energy of the sun. The reaction of nitrogen oxides with hydrocarbons in the presence of sunlight forms the ozone in the troposphere. The indicator mainly consists of VOCs (Volatile Organic Compounds) and is usually expressed in grams of equivalent ethylene oxide (g C_2H_4).