Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2012+A2:2019

1kg of IRON CASTINGS

ODELWNIE POLSKIE S.A.

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ODLEWNIE POLSKIE S.A.

Programme information

Programme and Programme operator:	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com

CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
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ODLEWNIE POLSKIE S.A.

EPD®

Company information

Owner of the EPD:	**ODLEWNIE POLSKIE S.A.**
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Company identification information	Trade Register No: 664-00-05-475 NIP Fiscal Registration Code: KRS 0000024126 Subscribed and paid-in capital: PL 30,996,181.50
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The plant in Starachowice was established in 1899 as the first coke-fired blast furnace in Poland, in which the first castings were made.
In the interwar period, it was part of Zakłady Starachowickie, which was part of the Central Industrial District. At that time, the plant in Starachowice produces castings for the needs of the arms factory.
After the Second World War, until 1993, the foundries in Starachowice were part of the Truck Factory and produced automotive castings.
Since 1998, Spółka Akcyjna ODLEWNIE POLSKIE has been listed on the Warsaw Stock Exchange as the first foundry in Poland.
In 2005-2013, the foundry plants in Starachowice underwent a comprehensive modernization.

The core business of ODLEWNIE POLSKIE S.A. is the design and production of castings, mainly made of nodular cast iron, with mechanical processing (production of the so-called casting components). Production activities are carried out in factory facilities located in Starachowice.
In the production activities, the Company, together with a network of cooperating companies, offers comprehensive customer service, ranging from design, through the production of foundry equipment and production of castings, their mechanical and heat treatment, as well as painting, assembly and shipping. The course of the technological process is subject to full control in terms of the quality of the charge materials, metallurgical quality of cast iron, quick analysis of the chemical composition of plastics and molding sands and the control of the dimensions of castings.
In cooperation with other companies, services are provided in the field of surface anti-corrosion protection (galvanizing, cataphoresis, powder coating).
The Foundry Components Research and Development Center operates within ODLEWNIA POLSKIE SA in the field of implementing innovative techniques and technologies.

The scope of services provided includes the performance of foundry services for: machine industry, automotive industry, industrial instruments, plumbing and sewage systems, heavy rail industry, energy industry, appliance industry.

All details on www.odlewniepolskie.pl

The General Management understands that it is not possible to maintain the position of leadership without sufficient effort aimed at:
• Fulfilling the needs and expectations of our customers at all times.
• Manufacturing products more efficiently.
• Faithfully meeting quality commitments.
• Reducing the environmental impacts of our business.
• Preventing contamination throughout the life-cycle.
• Reinforcing the commitment to continuous improvement in all areas of our activity.

ODLEWNIE POLSKIE S.A. has implemented management systems based on the PN-EN ISO 9001 and PN-EN ISO 14001 standards (Fig.1).

ODLEWNIE POLSKIE S.A. commitment to the environment stems from the conviction that, if we want to continue in business for many years, we must contribute to the conservation, recovery and improvement of the condition of our environment.

We strictly comply with all environmental aspects of legal regulations, and where possible we are proactive when it comes to adapting to future requirements.

Figure1. ISO 9001 and ISO 14001 certifications for ODLEWNIE POLSKIE S.A.

Product information

This study deals with the life cycle analysis that has been carried out for the iron castings produced at the Starachowice plant. The function of the iron castings is anchoring railway / rail turnouts.

UN CPC code: 412 – Products of iron or steel

The castings comply with regulation “EN 1563 Founding. Spheroidal graphite cast irons”.

Castings are used to attach rails to railway and tram turnouts. Their lifetime service is corresponds to the life of the entire set of rail and anchors casts.

The castings are made of ductile iron of various size, weight (1,7 – 30 kg) and shape. These are similar products subject to the same PCR (EN 15804:A2) and manufactured by the same company and the same basic process.

The representative product (RP) is an average product. 19 iron casting products included in the representative product are presented in in the table below. All the selected products are manufactured by the same company with the same core process. Castings can also be produced in other types and shapes.

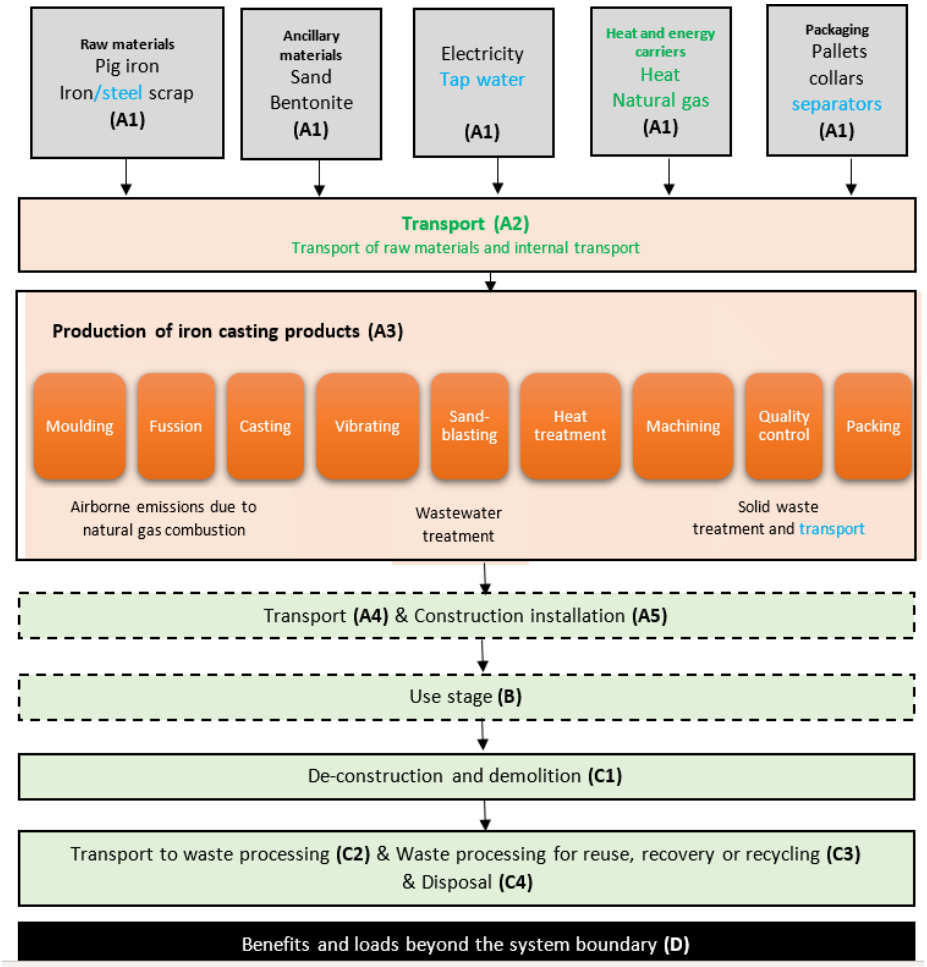
Product code	Commercial name & description products	Cast weight [kg]	Description of the material (Ductile Iron)
0241341	Check Rail Support MPL50-1	27,53	GJS 400-18 LT
0242026	Check Rail Support MPL60-1	27,65	GJS 400-18 LT
0242020	Slide Chair IBAV60-2-P	18,65	GJS 400-18 LT
0242024	Slide Chair IBAV60-3-P	26,83	GJS 400-18 LT
0242021	Slide Chair IBAV60-1-P	20,40	GJS 400-18 LT
0242690	Slide Chair IBAV60E-PR 60CG833	21,85	GJS 400-18 LT
0244120	Check Rail Support MPL54-12	23,90	GJS 400-18 LT
0241106	Slide Chair UPL-SJ50	17,75	GJS 400-18 LT
0257912	Distance Block 60BU310 LG=230	3,30	GJS 400-18 LT
0257901	Stödknap BV50-1-110	1,70	GJS 400-18 LT
0242105	Anticheminant UWZ1 (Male)	6,50	GJS 400-18 LT
0242106	Anticheminant UWG1 (Female)	11,35	GJS 400-18 LT
0257904	Stödknap BV50-2-235	3,60	GJS 400-18 LT
0241323	Slide Plate IBAV50-9-P	25,50	GJS 400-18 LT
0242025	Slide Plate IBAV60-4T-P	30,00	GJS 400-18 LT
0242032	Slide Plate IBAV60-9 TKK-1/2-F	27,10	GJS 400-18 LT
0241322	Slide Plate IBAV50-2	18,25	GJS 400-18 LT
0208336	Slide Plate IBAV50-3	27,10	GJS 400-18 LT
0208335	Slide Plate IBAV50-4T	28,60	GJS 400-18 LT

The average technology of iron casting production consists of the following processes: molding, fusing, casting, vibrating, sandblasting, heat treatment, machining, quality control, packaging.

Geographical scope: Castings are sold in Sweden, where they are permanently installed in railway and tram junctions, and after use, they are recovered and recycled in these countries.

Description of the production processes

The casting production process includes the following stages:



Legend:

	Upstream processes
	Core process
	Downstream processes
	Processes included in the LCA study
	Processes not included in the LCA study

Geographical scope of the product system: a production (at suppliers and core process) located in Poland and downstream processes (use and demolition and end of life) located only in Sweden.

Temporal scope of the product system: 2019 year.

The castings are packed and transported on wooden EURO pallets with wooden extensions (Pictures below), which are recoverable or recycled.

Environmental performances assessment

LCA information

The Life Cycle Assessment (LCA) has been created in compliance with ISO 14040 and ISO 14044 standards, following a cradle-to-gate with options, considering all the environmental impacts starting from the extraction of the raw materials up to product ready for the delivery as well as end-of-life stage (demolition, transportation, waste treatment, waste disposal) and supporting information (benefits and burdens beyond system boundaries)

The study was conducted following the reference PCR for the product category PCR 2019:14 Construction products (EN 15804:A2) (version 1.1).

The software **SimaPro Developer v. 9.1.1.1** has been used. Background processes have been modelled with secondary data taken from ecoinvent database v. 3.6.

Declared unit: 1 kg of representative iron casting product (representative group of product).

Reference flow: 1 kg of representative iron casting product.

System boundaries

Using terminology from EN 15804:2012+A2:2019, the cradle-to-gate with options life cycle (EN 15804 – Modules: A1-A3 product stage +C+D).

Following processes have been included in the LCA study:

- Production of raw materials and ancillary materials, energy used during manufacturing and transport of scrap → module A1 (upstream);
- Transport of virgin raw materials and ancillary materials to the manufacturer and an internal transport → module A2;
- Manufacturing (airborne emissions due to natural gas combustion + treatment of wastewater + treatment and transport of solid waste generated during manufacturing) → module A3 (core);
- De-construction and demolition (C1);
- Transport to waste processing. Waste processing for reuse, recovery or recycling. Disposal → module C2-C4 (downstream);
- Benefits and loads beyond the system boundary → module D.

Product stage			Construction		Use stage							**End of life stage**				**Resource recovery stage**
Raw materials supply	Transport	Manufacturing	Transport	Construction – instalation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, recovery, recycling - potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C 2	C 3	C4	D
√	√	√	ND	ND	ND	ND	ND	ND	ND	ND	ND	√	√	√	√	√

Cut-off rules

The standard ISO 14025 and the PCR - 2019:14 “Construction products (EN 15804:A2)” indicate that the life cycle inventory data should include a minimum of 99% of the total inputs (materials and energy) for each stage.

Allocation rules

Multifunctionality of production - as the analyzed production process is a case of shared production, so a physical criterion (mass) has been used to allocate the environmental burdens between co-products.

All the selected products are manufactured by the same company with the same core process and differences between the environmental indicators calculated with using a baseline mass allocation approach are very low (standard deviation for environmental indicators is 0.008%) for all core impact categories. The following reasons have been taken into account during making this choice:

- Main technological processes, yields and Bill of Materials are the same for all 19 selected cast irons and a consumption of main raw materials, energy and other resources is proportional to the amount of production of each of the products. It means that the mass and a share of each product in a total amount of production reflect well a way how inputs are transformed into outputs;
- In the reference year the analysed data indicated that the difference in the economic value was found as not very significant, a mass allocation has been selected as a baseline approach.
- Prices of the analysed cast ironing products are not stable over time and they show variances resulting from various reasons (e.g. fluctuations in prices of raw metals and in the exchange rate). A relationship in the economic value of the representative product and the remaining cast iron products can not be assumed as fixed too. The fluctuations in prices of the remaining products follow from different reasons: varied labour intensity, a sale to be made in various currencies and an indexation of products prices to be carried out on the basis of quarterly/semi-annual/annual quotations of the MTZ and ETZ indexes – differently for each product group and client).

Recycling

Recycled content – based on the Bill of Materials for GJS-400-18-LT a recycled content index (M_{mr_in}) has been calculated for the analysed castings $\square_{\square\square_{\square\square}} = \frac{0.2777\ \square\square + 0.1488\ \square\square}{0.992\ \square\square} = 0.43.$ It has been assumed that the scrap going into production has EoW status. The Polluter pays approach was applied, assuming that all operations until the moment of achieving the EoW status are assigned to the previous product system. Therefore, the analysed castings were assigned only scrap transport to the foundry and impacts related to the operations performed by the foundry with respect to scrap (e.g. storage).

Recycling rate of castings - the recycling rate of analysed castings was calculated at 95.3% as an arithmetic mean of the value of this parameter obtained from three sources: from Annex C to the PEF/OEF Methods as a methodological element for modelling EoL using Circular Footprint Formula (Recycling rate = 95% for steel hangers and screws category), from a study conducted by Tata Steel from data from the National Federation of Demolition Contractors in UK (Recycling rate = 93% for heavy structural sections and light structural steel category) and from the study of the Steel Recycling Institute (Recycling rate = 98% for structural steel), $\square_{\square\square_{\square\square\square}} = \frac{0.95+0.93+0.98}{3} = 0.953.$

Module C2 takes into account the transport to the processing site of waste castings (similarly to the environmental footprints, 50 km were assumed), in module C3 the handling of waste castings until they reach the EoW status

Recycling of production waste - production waste is entirely transferred to specialized companies, which recycle it. Theoretically, according to the Polluter pays approach, all impacts until the waste reaches EoW status should be assigned to the production of castings. The LCA study calculated the impacts associated with the temporary storage of waste at the foundry site, the transport of this waste to the recovery companies and its pre-processing until it reaches EoW status. In the last case, due to the lack of primary data from the recovery companies, some proxy secondary datasets on the handling of waste have been used.

LCIA methodology and types of impacts

The life cycle impact assessment was made for ten core impact categories and for six additional impact categories.

The following characterisation factors for CO2, $CO2_{biogenic}$, $CH4_{fossil}$, $CH4_{biogenic}$, N2O have been used to model the impact within two sub-categories of climate change [kg CO2 eq/kg]:

- GWP-fossil: CO2 = 1, $CO2_{biogenic}$ = 0 kg, $CH4_{fossil}$ = 36.8, $CH4_{biogenic}$ = 0, N2O = 298;
- GWP-biogenic: CO2 = 0, $CO2_{biogenic}$ = 1 kg, $CH4_{fossil}$ = 0, $CH4_{biogenic}$ = 36.8, N2O = 0.

Impact categories included in the impact assessment

NAME OF IMPACT CATEGORY	UNIT	MODEL	INDICATOR	ILCD CLASSIFICATION	DISCLAIMER
CORE IMPACT CATEGORIES					
Climate change - total -fossil - biogenic - land use and land use change	kg CO2 eq	Baseline model of 100 years of the IPCC based on IPCC 2013	Global Warming Potential	ILCD Type 1	None
Ozone depletion	kg CFC-11 eq	Steady-state ODPs, WMO 2014	Depletion potential of the stratospheric ozone layer	ILCD Type 1	None
Acidification	mol H+ eq	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	Acidification potential, Accumulated Exceedance	ILCD Type 2	None
Eutrophication aquatic freshwater	kg PO4 eq	EUTREND model (Struijs et al, 2009) as implemented in ReCiPe	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment	ILCD Type 2	None
Eutrophication aquatic marine	kg N eq	EUTREND model (Struijs et al, 2009) as implemented in ReCiPe	Eutrophication potential, Fraction of nutrients reaching marine end compartment	ILCD Type 2	None
Eutrophication, terrestrial	mol N eq.	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)s	Acidification potential, Accumulated Exceedance	ILCD Type 2	None
Photochemical ozone formation	kg NMVOC eq	LOTOS-EUROS model Van Zelm et al, 2008, as implemented in ReCiPe	Formation potential of tropospheric ozone	ILCD Type 2	None
Depletion of abiotic resources – minerals and metals	kg Sb eq	CML 2002 (Guinée et al., 2002) and van Oers et al. 2002.	Abiotic depletion potential for non-fossil resources	ILCD Type 3	2
Depletion of abiotic resources – fossil fuels	MJ	CML 2002 (Guinée et al., 2002) and van Oers et al. 2002.	Abiotic depletion potential for fossil resources	ILCD Type 3	2
Water use	m3 world eq. deprived	Available WAter REmaining (AWARE)	User deprivation potential (deprivation-weighted water consumption)	ILCD Type 3	2
ADDITIONAL IMPACT CATEGORIES					
Particulate matter emissons	disease incidence	SETAC-UNEP, Fantke et al. 2016	Potential incidence of disease due to PM emissions	ILCD Type 1	None
Ionising radiation, human health	kBq U235 eq	Human health effect model as developed by Dreicer et al. 1995 (Frischknecht et al, 2000)	Potential Human exposure efficiency relative to U235	ILCD Type 2	1
Ecotoxicity, freshwater	CTUe	USEtox model version 2	Potential Comparative Toxic Unit for ecosystems	ILCD Type 3	2
Human toxicity, cancer effects	CTUh	USEtox model version 2	Potential Comparative Toxic Unit for humans	ILCD Type 3	2
Human toxicity, non-cancer effects	CTUh	USEtox model version 2	Potential Comparative Toxic Unit for humans	ILCD Type 3	2
Land use related impacts	Dimensionless	Soil quality index based on LANCA	Potential Soil quality index	ILCD Type 3	2

Disclaimer 1 This impact category deals mainly with the eventual impact of low dose ionising radiation on the 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 ironizing radiation from the soil, from radon and from some construction materials is also measured by this indicator.
Disclaimer 2 The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with this indicator.

Additional indicator for climate change impact is calculated using IPCC 2013 100a method.

Assumptions

The following assumptions have been made in this EPD:

- Upstream and core process are modelled with using of annual production data (2019) for a total annual production.
- The inventory data has been gathered for annual production of 19 casting products classified to the representative product (RP).
- Inventory results presented in the module A1 – the inputs to foundry furnace calculated with using of Bill of Materials for GJS-400-18-LT category. Use of sand, bentonite and packaging materials allocated to production of 19 products classified to RP. A general consumption of electricity, natural gas, heat and tap water inventoried for a total production and allocated to the overall production.
- Inventory results presented in the module A2 – a transport of virgin raw materials allocated to the analysed 19 products. Internal transport and transport with a company car inventoried for the entire factory firstly and later allocated to the overall production.
- Inventory results presented in the module A3 – data on emissions from a heat generation, solid waste generation and their transport and a wastewater generation gathered for the entire factory and as a next step, the data was allocated to the overall production.
- Inventory results presented in the modules C i D – data calculated for 200 062 kg of analysed 19 casting products to be sent for demolition and end of life.
- Scrap used in the production is a mix of internal scrap and post-consumer scrap, which has reached the EOW (end of waste) status.
- Background processes have been modelled with secondary datasets from Ecoinvent v.3.6 (allocation cut off by classification – system);
- The operations at the foundry with regard to production waste (temporary storage) directed to recovery/recycling recognised as insufficient for this waste to achieve EOW status. Therefore, additional operations have been included.
- EoL scenario has been modelled according to the environmental footprint calculation guidelines (Annex C to the PEF/OEF Methods Annex_C_V2.1_May2020). After subtraction of 95.3% of the mass of recycled iron castings, the remaining amount of the used castings is left for final disposal (module C4). As an use stage is to be located in Sweden, so it was assumed that 99% of the remaining waste goes to incineration and 1% to landfill. It used the values because 99% of incineration and 1% of landfilling are indicated by Annex C to the PEF/OEF Methods Annex_C_V2.1_May2020 as default to model a share between landfill and incineration of municipal waste in Sweden.
- The calorific value of steel is zero, so no energy recovery included (no credits calculated due to incineration of the wasted iron castings).
- Quality correction index QR_out/Qsub for steel was assumed to be 1 (Annex C to the PEF/OEF Methods Annex_C_V2.1_May2020).
- Due to lack of data, modelling of modules A4, A5, B1-B7 was omitted.
- Due to lack of specific data concerning emissions from combustion of fuels in the means of internal transport (module A2), these emissions were calculated using emission factors taken from the EMEP/EEA air pollutant emission inventory guidebook 2019. Information about fuel consumption for various generations of off road vehicles (forklifts) has been gathered as a part of inventory step. EMEP/EEA report has been used because it presents the emission factors for the same generations as indicated in the inventory analysis. The used version of the Ecoinvent database does not contain inventory data for various generations of forklifts.
- It was assumed that production waste and used castings are transported by the same mean of transport. The dataset Transport, freight, lorry >32 metric tons, euro4 {RER}| market for transport, freight, lorry >32 metric tons, EURO4 | Cut-off, U was used. The transport distance of used castings was 50 km.
- Electricity high voltage residual mix for Poland was used to model production and transmission of the electricity consumed during production..

- According to a specification of means of transport which have been used to transport the raw materials to the manufacturer. The following dataset was selected to model transport in the module A2: Transport, freight, lorry >32 metric ton,euro4 {RER}| market for transport, freight, lorry >32 metric ton, EURO4 | Cut-off, U.
- Data and secondary datasets quality assessment have been made by using the guidelines included in Table E.1 (activity data and direct elementary flows) and Table E.2 (dataset) from PN-EN 15802+A2:2020.
- Biogenic carbon content of the representative product is zero. Biogenic carbon content of the packaging (wooden pallets, wooden collars and fibreboard separators) is assumed as about 50%, which stands for 4,53E-02 kg per kg of representative product.
- Data for packaging has been calculated for 19 analysed products. No circularity of the pallets, collars and separators have been assumed. All used packaging are supposed to be sent for incineration (99%) or landfilling (1%) at End of Life and modelled as a part of module C4.
- Cut off criteria – 1% based on mass:
  - Due to a lack of proper secondary datasets 0.2% of production waste have been excluded from LCIA calculations. Inventory data have been collected, but not included in the impact assessment.
  - Carbonizer excluded and post-filtration dust excluded.
- Capital goods have been excluded.
- Carbon offsets and permanent biogenic carbon storage are not part of the product system under study.
- In order to model a cutting of scrap with a gas burner a secondary ecoinvent dataset named Welding, gas, steel {RER} processing | Cut off, S has been used. The dataset includes aggregated inventory per 1 metre of treated/cut material. The data relates to use of acetylene and oxygen, and to airborne emissions (e.g. CO2, CO, chromium, chromium VI, nickel, zinc).

Content Declaration

Materials used in the production of castings:

Material	Castings
Steel	100%

The casting is made of **43% recycled materials**.

Packaging material: 100% wood

Material	Weight, kg	Weight-% (versus the product)
Wooden pallets, collars and separators	9.05E-02	9%

There are no substances affected by Regulation (EC) No. 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), Substances of Very High Concern (SVHC), also substances contained in the product that are listed in the “Candidate List of Substances of Very High Concern (SVHC) for authorisation”.

Environmental performance

Main technological processes, yields and Bill of Materials are the same for all cast irons and a consumption of main raw materials, energy and other resources is proportional to the amount of production of each of the products. It means that the mass and a share of each product in a total amount of production reflect well a way how inputs are transformed into outputs.

The differences between the environmental indicators for EPD-covered castings are less than ± 10%, therefore they are presented in the same EPD using the impact of an environment representative product. EPD is based on an average or representative composition of products, because the results for A1-A3 are not differ by more than ±10% for the GWP-GHG indicator.

Below is the environmental profile of the casting together with other environmental indicators:

The characterised impact assessment results (per declared unit of 1 kg of iron casting)

PARAMETER	UNIT	LIFE CYCLE STAGES (MODULES)							
		A1	A2	A3	C1	C2	C3	C4	D
CORE IMPACT CATEGORIES									
Climate change - total	kg CO2 eq	2.94E+00	2.18E-02	5.07E-02	4.39E-03	4.92E-03	2.22E-02	1.33E-01	-5.16E-01
Climate change - fossil		3.12E+00	2.17E-02	5.07E-02	4.35E-03	4.91E-03	2.35E-02	1.81E-03	-5.18E-01
Climate change - biogenic		-1.80E-01	1.59E-05	2.63E-05	3.00E-05	3.60E-06	-1.35E-03	1.31E-01	2.32E-03
Climate change - land use and land use change		9.97E-04	6.41E-06	1.53E-06	4.01E-06	1.45E-06	2.63E-05	4.17E-07	-1.00E-04
Ozone depletion	kg CFC-11 eq	1.32E-07	5.15E-09	1.52E-09	2.34E-10	1.16E-09	3.38E-09	2.17E-10	-2.36E-08
Acidification	mol H+ eq	1.85E-02	1.11E-04	1.89E-04	1.86E-05	2.51E-05	2.85E-04	1.78E-05	-2.25E-03
Eutrophication aquatic freshwater	kg PO4 eq	5.33E-04	5.13E-07	3.04E-07	7.74E-07	1.16E-07	4.91E-06	8.35E-08	-7.61E-05
	kg P eq	1.74E-04	1.67E-07	9.91E-08	2.53E-07	3.78E-08	1.60E-06	2.72E-08	-2.48E-05
Eutrophication aquatic marine	kg N eq	2.79E-03	3.78E-05	8.47E-05	3.46E-06	8.52E-06	6.29E-05	7.94E-06	-4.52E-04
Eutrophication terrestrial	mol N eq.	3.13E-02	4.16E-04	5.80E-04	3.82E-05	9.40E-05	7.30E-04	8.47E-05	-4.88E-03
Photochemical ozone formation	kg NMVOC eq	1.18E-02	1.24E-04	2.48E-04	1.56E-05	2.81E-05	1.99E-04	2.17E-05	-2.75E-03
Depletion of abiotic resources – minerals and metals	kg Sb eq	5.91E-06	3.74E-07	8.09E-08	4.72E-08	8.45E-08	1.31E-06	2.67E-08	-1.01E-06
Depletion of abiotic resources – fossil fuels	MJ	3.67E+01	3.41E-01	1.02E-01	4.88E-02	7.70E-02	3.26E-01	2.04E-02	-5.20E+00
Water use	m3 world eq. deprived	3.31E-01	1.11E-03	-2.91E-02	2.47E-03	2.50E-04	3.28E-03	-1.59E-03	8.25E-03
ADDITIONAL IMPACT CATEGORIES									
Particulate matter emissions	disease incidence	2.03E-07	2.02E-09	3.17E-09	1.09E-09	4.56E-10	3.58E-09	2.74E-10	-4.50E-08
Ionising radiation, human health	kBq U235 eq	6.14E-02	1.49E-03	4.32E-04	2.40E-04	3.37E-04	1.62E-03	5.16E-05	-4.81E-03
Eco-toxicity (freshwater)	CTUe	7.47E+01	2.72E-01	4.77E-01	1.25E-01	6.13E-02	1.40E+00	4.44E-02	-1.69E+01
Human toxicity, cancer effects	CTUh	7.16E-09	6.71E-12	3.96E-09	8.21E-11	1.51E-12	3.42E-11	5.12E-12	-2.83E-09
Human toxicity, non-cancer effects	CTUh	6.30E-08	3.09E-10	5.45E-08	2.73E-10	6.98E-11	1.62E-09	2.09E-10	-1.72E-08
Land use related impacts/ Soil quality	Dimensionless	2.23E+01	3.90E-01	1.47E-01	1.39E-02	8.83E-02	6.56E-01	1.62E-02	-1.11E+00

GWP - Climate change indicator results (per declared unit of 1 kg of iron casting)[1]

LCIA method	UNIT	LIFE CYCLE STAGES (MODULES)							
		A1	A2	A3	C1	C2	C3	C4	D
IPCC 2013 100a v. 1.03	kgCO2eq	3.03E+00	2.16E-02	5.03E-02	4.24E-03	4.88E-03	2.32E-02	1.79E-03	-4.91E-01

[1] Additional indicator result as describe par. 5.3.5 of the PCR 2019:14

Use of resources per declared unit (1 kg of the iron castings)

PARAMETER	UNIT	LIFE CYCLE STAGES (MODULES)							
		A1	A2	A3	C1	C2	C3	C4	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	1.22E+00	4.30E-03	1.16E-03	5.88E-03	9.70E-04	5.11E-02	4.39E-04	-8.54E-02
Use of renewable primary energy resources used as raw materials*	MJ. net calorific value	2.11E+00	-	-	-	-	-	-	-
Total use of renewable primary energy	MJ. net calorific value	3.33E+00	4.30E-03	1.16E-03	5.88E-03	9.70E-04	5.11E-02	4.39E-04	-8.54E-02
Use of non-renewable primary energy excluding renewable primary energy resources used as raw materials	MJ. net calorific value	3.67E+01	3.41E-01	1.02E-01	4.88E-02	7.70E-02	3.26E-01	2.04E-02	-5.20E+00
Use of non-renewable primary energy resources used as raw materials	MJ. net calorific value	-	-	-	-	-	-	-	-
Total use of non-renewable primary energy	MJ. net calorific value	3.67E+01	3.41E-01	1.02E-01	4.88E-02	7.70E-02	3.26E-01	2.04E-02	-5.20E+00
Use of secondary material**	kg	1.78E-01	6.68E-05	-4.67E-04	5.05E-04	1.51E-05	3.64E-04	-2.20E-02	3.75E-01
Use of renewable secondary fuels	MJ. net calorific value	-	-	-	-	-	-	-	-
Use of non-renewable secondary fuels	MJ. net calorific value	-	-	-	-	-	-	-	-
Net use of fresh water***	m^3	8.99E-03	1.75E-05	1.05E-05	1.30E-05	3.95E-06	9.08E-05	2.04E-05	-8.96E-04

** wooden and wood-based packaging materials*
***all direct and indirect flows of secondary material from entire product system added*
****only water specified by origin as a freshwater (e.g. lake. river. well) included. water with unspecified origin not taken into account*

Waste production per declared unit (1 kg of the iron castings)

PARAMETER	UNIT	LIFE CYCLE STAGES (MODULES)							
		A1	A2	A3	C1	C2	C3	C4	D
Hazardous waste disposed*	kg	3.58E-04	1.37E-05	9.14E-06	9.10E-07	3.10E-06	3.94E-05	8.22E-07	-1.23E-04
Non-hazardous waste disposed*	kg	1.21E-01	2.95E-02	4.27E-01	4.75E-04	6.67E-03	1.50E-02	1.57E-03	-4.10E-02
Radioactive waste disposed*	m3	1.08E-07	3.39E-09	9.11E-10	2.79E-09	7.64E-10	1.22E-08	1.60E-10	-2.20E-08

**all direct and indirect waste flows from entire product system destinated for a final disposal (e.g. landfill. incineration. underground deposit) added*

Output flows (1 kg of the iron castings)

PARAMETER	UNIT	LIFE CYCLE STAGES (MODULES)							
		A1	A2	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
Material for recycling	kg	0.00E+00	0.00E+00	4.22E-01	0.00E+00	0.00E+00	9.53E-01	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
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
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

References

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