Athena Sustainable Materials Institute

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A Life Cycle Assessment of FORTA-FERRO® Manufactured by FORTA

This project report supports the development of an Environmental Product Declaration (EPD) for the production of FORTA-FERRO® at FORTA's production facility.

V1.0

Commissioner:	FORTA
EPD Program Operator:	ASTM International
Prepared by:	Athena Sustainable Materials Institute
Version:	1.0 (June 2022)

Disclaimer

Although the Athena Sustainable Materials Institute has gone to great lengths to ensure the accuracy and reliability of the information in this report, this study is based on both proprietary and third-party (secondary) life cycle inventory (LCI) data sources provided by government agencies, research institutes, consultancies and other open and grey literatures, therefore the Institute does not warrant the accuracy thereof. If notified of any errors or omissions, the Institute will take reasonable steps to correct such errors or omissions.

Contents

Acronyms and Abbreviations

CED	Cumulative Energy Demand
CF	Characterization Factor
EPDs	Environmental Product Declarations
GWP	Global Warming Potential
ISO	International Organization for Standardization
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory Analysis
LCIA	Life Cycle Impact Assessment
LEED	Leadership in Energy & Environmental Design
PCR	Product Category Rules
TRACI	Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts
US EPA	United States Environmental Protection Agency

1.0 General Information

The Athena Sustainable Materials Institute was commissioned to conduct a cradle-to-gate LCA of FORTA's FORTA-FERRO®. The scope of the LCA includes the cradle-to-gate production (A1-A3).

The LCA provides the scientific basis for a product specific EPD for FORTA's FORTA-FERRO®. This project report documents the research, including the primary gate-to-gate production data collection and the state-of-the-art background data choices, as well as the LCA results and their interpretation.

This research has been completed in accordance with the most recent version of with ISO 14040 [4], ISO 14044 [5] and ISO 21930 [6].

Version	Date
1.0	June 1, 2022

2.0 Study Goals and Scope

2.1 Goals of the study

2.1.1. Reasons for carrying out the study

The EPD developed from this LCA study is intended for use in Business to Business (B-to-B) communication.

2.1.2. Intended uses

Specifically, the LCI and LCIA profile for FORTA's FORTA-FERRO® can be utilized in the following applications:

- Process Improvements and New Technology Evaluation – The completed LCA can be used internally to evaluate possible process and parameter improvements and new technologies;
- Market Support – The LCA will provide a detailed product profile, with key indicators of environmental performance for the complete manufacturing process. The LCA will be used to support the development of a Type III environmental product declaration (EPD). The product profile can also be used in other education and marketing efforts with environmentally conscious customers or organizations (e.g., LEED and Green Globes rating systems, government procurement programs, etc.);
- ISO 14001 - The completed study may be used in the future to benchmark and track significant aspects and impacts over time within an ISO compliant environmental management program;
- Design for the Environment – the results can be used to identify "environmental hotspots" and related opportunities to improve production line processes and lessen the life cycle environmental impacts.

2.1.3. Intended audience

The primary audience for the LCA report is FORTA and the verifier of the subsequent EPDs.

The intended audience for the EPD includes FORTA, their suppliers, architectural, engineering, and specifying professionals, LCA practitioners and tool developers, academia, governmental organizations, policy makers and other interested value chain parties who require reliable information on products produced by FORTA at their production facility.

2.1.4. Comparative assertions

This LCA study does not include comparative assertions. However, it may lead to future comparative studies intended to be disclosed to the public. As a result, an internal critical review was convened to ensure that the completion of this LCA study is consistent with the ISO 14040/44.

2.2 Scope of the study

2.2.1 Methodological Framework

This LCA follows the attributional approach as outlined in ISO 21930 Section 7.1.1.

2.2.2 Declared Unit

This LCA considers the life cycle from cradle-to-gate. The functional unit for FORTA-FERRO® is defined as "the production of 1,000 kg of FORTA-FERRO® produced at their production facility". The technical data for FORTA-FERRO® can be found in Table 1.

Table 1: Product technical data for FORTA-FERRO®.

Table 1: Technical Data		
Property	**Value**	**Unit**
Materials	Virgin Copolymer/Polypropylene	N/A
Form	Monofilament/Fibrillated Fiber System	N/A
Specific Gravity	0.91	N/A
Tensile Strength	570-660 (83-96)	Mpa (ksi)
Length	38, 54 (1.5, 2.25)	mm (inch)
Color	Gray	N/A
Acid/Alkali Resistance	Excellent	N/A

2.2.3 Product Description and Product Application

FORTA is an American-based company that supplies high quality synthetic reinforcement fibers to the global concrete industry. These fibers aim to reduce project costs by simultaneously extending the life of the concrete application and shortening the construction time. These reinforcement fibers are tested through research and development.

The declared product is FORTA-FERRO®. This product is a colour blended fiber that is comprised of a blend of two fibers – a standard fibrillated polypropylene fiber and a heavy duty twisted bundle monofilament fiber made of a strong synthetic copolymer. The first fiber is used to reduce and control shrinkage and temperature cracking and the second fiber is used to increase load-transfer and post crack performance. The result of this blend is FORTA's extra heavy duty FORTA-FERRO® fiber that is used to reduce plastic and hardened concrete shrinkage, increase concrete toughness and fatigue resistance, and improve impact strength

2.2.4. System boundaries

This study is a cradle-to-gate LCA. A detailed description of the information modules covered in the LCA are included in Table 2.

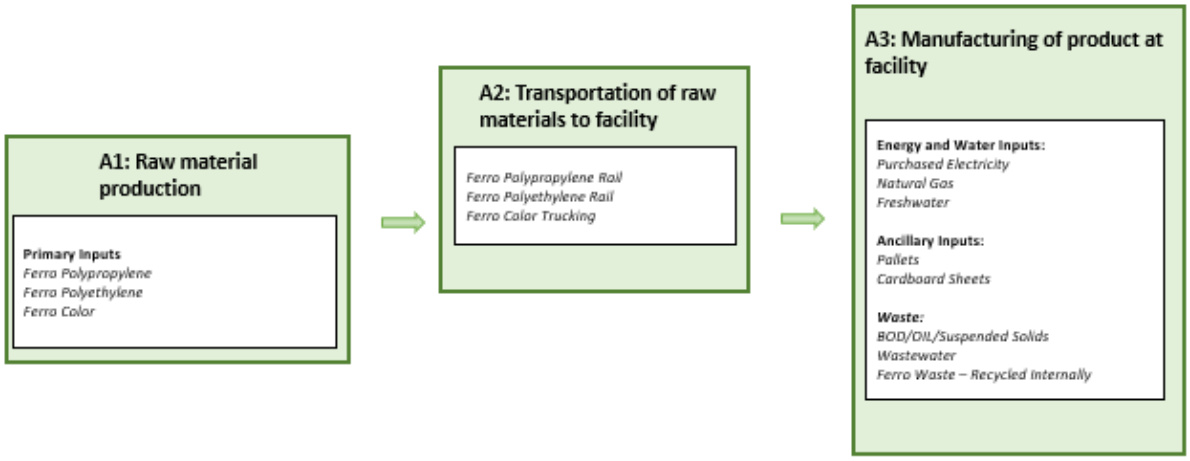
Table 2: Product System Description

Information Module		Description
A1	***Extraction and upstream production***	A1 includes the cradle-to-gate production of raw material that are used in FORTA-FERRO® product manufacture. The upstream resource extraction includes removal of raw materials and processing, processing of secondary material input (e.g., recycling processes) after crossing the system boundary of the previous product system.
A2	***Transport to facility***	Average or specific transportation of raw materials (including secondary materials and fuels) from extraction site or source to manufacturing site (including any recovered materials from source to be recycled in the process).
A3	***Manufacturing***	Manufacturing of the FORTA-FERRO® products.

Both human activity and capital equipment were excluded from the system boundary. The environmental effects of manufacturing and installing capital equipment and buildings have generally been shown to be minor relative to the throughput of materials and components over the useful lives of the buildings and equipment. Human activity involved in the manufacturing of FORTA-FERRO® products no doubt has a burden on the environment. However, the data collection required to properly quantify human involvement is particularly complicated and allocating such flows to the production of materials as opposed to other societal activities was not feasible for a study of this nature. Typically, human activity is only considered within the system boundary when value-added judgements or substituting capital for labour decisions are considered to be within the study scope. These types of decisions are outside the current goal and scope of this study.

The product system for FORTA-FERRO® is depicted in Figure 1 below. Note that the scope of the LCA includes the cradle-to-gate production (A1-A3).

Figure 1: Cradle-to-Gate FORTA-FERRO® Product System



2.3 Cut-off Criteria

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.

No material or energy input or output was knowingly excluded from the system boundary.

3.0 Life Cycle Inventory Analysis

3.1 Data Selection, Collection, and Data Quality

The life cycle inventory (LCI) for this study consists of primary and secondary data. The data selection for the three information modules is as follows:

A1 Extraction and upstream production: This information module includes the cradle-to-gate production of primary and secondary material inputs. Secondary datasets were used for all extraction and upstream production.

A2 Transport to factory: The mode of transport for both primary and secondary materials was by trucking or rail. Secondary data were used for the road and rail transport.

A3 Manufacturing: The primary gate-to-gate LCI data is based on 2020 calendar year production and was collected by means of completed surveys of FORTA's operations. For energy, packaging material and waste management secondary datasets were used.

3.2Allocation Methods

Allocation is the method used to partition the environmental load of a process when several products or functions share the same process. At FORTA several different products are produced. Since the primary data for manufacturing was only available on a facility level, the environmental load among the products produced is allocated according to its mass. For waste that is recycled, the 'recycled content approach' was chosen. The recycling of waste generated by the product system is cut off.

3.3 A1-A3 Primary Data

Table 3 summarizes the data for FORTA's FORTA-FERRO® product.

Table 3. Facility Inputs and Outputs for the Production of 1,000 kgs of FORTA's FORTA-FERRO®.

Products and Coproducts		
Primary Product		
FORTA-FERRO®	kg	1.00E+03
A1: Raw Materials		
Primary Materials		
FORTA-FERRO®.Polypropylene	kg	5.96E+02
FORTA-FERRO®. Polyethylene	kg	3.21E+02
FORTA-FERRO®. Color	kg	9.26E+00
A2: Transportation		
Ferro Polypropylene Rail	tkm	2.96E+02
Ferro Polyethylene Rail	tkm	1.59E+02
Ferro Color Trucking	tkm	4.31E-01
A3: Manufacturing		
Energy		
Purchased Electricity	kWh	1.51E+03
Natural gas	m3	5.23E-02
Ancillary		
Freshwater	liter	5.14E+03
Other Water	liter	1.50E+03
Pallets	each	2.17E+00
Cardboard sheets	each	6.50E+00
Waste		
BOD	mg/l	<5
Oil	mg/l	<5
Suspended Solids	mg/l	<5
Wastewater	liter	5.14E+03
Other Wastewater	liter	1.50E+03
Ferro Waste	kg	8.18E+01

3.4 Secondary Data Sources

Tables 5-7 show the secondary LCI data sources used in this LCA study.

Table 5. A1 Extraction and Upstream Production

A1: Raw Material Inputs				
Inputs	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
FORTA-FERRO Polypropylene	US LCI: Polypropylene, resin, at plant, CTR/kg/RNA	US	2014	**Technology:** good **Time:** good Data is <10 years old **Geography:** very good
FORTA-FERRO Polyethylene	US LCI: Polyethylene, high density, resin, at plant, CTR /kg/RNA	US	2014	**Technology:** good **Time:** good Data is <10 years old **Geography:** very good
FORTA-FERRO Color	Ecoinvent 3.7: Chemicals inorganic, at plant/GLO with US electricity U	Global	2018	**Technology:** fair **Time:** very good Data is <5 years old **Geography:** good Data is representative of global conditions.

Table 6. A2 Transportation

A2: Transportation				
Inputs	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Trucking	USLCI: Transport, single unit truck, short-haul, diesel powered, Northwest/tkm/RNA	Global	2014	**Technology:** very good **Time:** good Data is <10 years old **Geography:** very good
Rail	USLCI: Transport, train, diesel powered/US	Global	2014	**Technology:** very good **Time:** good Data is <10 years old **Geography:** very good

Table 7. A3 Manufacturing

A3: Manufacturing				
Energy	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Electricity	Ecoinvent 3: Electricity, low voltage {RFC}| market for | Cut-off, U	Global	2018	**Technology:** very good **Time:** very good Data is <5 years old **Geography:** very good
Natural Gas	USLCI: Natural gas, combusted in industrial boiler/US	Global	2014	**Technology:** very good **Time:** good Data is <10 years old **Geography:** very good.
Cardboard Sheets	USLCI: Paper board, packing, average, at plant/CN U	Global	2014	**Technology:** very good **Time:** good Data is <10 years old **Geography:** very good.
Pallets	USLCI: Dry rough lumber, at kiln, US SE NREL /US Packaging	Global	2014	**Technology:** very good **Time:** good Data is <10 years old **Geography:** very good.
BOD	Ecoinvent 3.7: Chemicals inorganic, at plant/GLO with US electricity U	Global	2018	**Technology:** fair **Time:** very good Data is <5 years old **Geography:** good Data is representative of global conditions.
Oil	Ecoinvent 3.7: Chemicals inorganic, at plant/GLO with US electricity U	Global	2018	**Technology:** fair **Time:** very good Data is <5 years old **Geography:** good Data is representative of global conditions.
Suspended Solids	Ecoinvent 3.7: Chemicals inorganic, at plant/GLO with US electricity U	Global	2018	**Technology:** fair **Time:** very good Data is <5 years old **Geography:** good Data is representative of global conditions.
Wastewater	Ecoinvent 3.7: Tap water {RoW} |market for | Cut-off	Global	2014	**Technology:** very good **Time:** good Data is <10 years old **Geography:** very good.

4.0 Life Cycle Inventory and Impact Assessment Results

4.1 LCIA method and inventory parameters

In the life cycle impact assessment (LCIA) phase, a set of selected environmental issues (impact categories) are modelled by using category indicators to aggregate similar resource usage and emissions to explain and summarize LCI results data.

Table 8 presents the selected impact category indicators and inventory parameters. In accordance with ISO 21930, the list includes Core Mandatory Impact Indicator, Use of Primary Resources, Secondary Material, Secondary Fuel and Recovered Energy, Mandatory Inventory Parameters, Indicators Describing Waste, and Additional Inventory Parameters.

For this study, the impact categories and characterization factors (CF)[1] from the mid-point indicators of the U.S. EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts -TRACI 2.1 [2] were applied. The TRACI methodologies were developed specifically for the US using input parameters consistent with US locations and are consistent with the ISO 21930.

The total primary energy consumption is tabulated from the LCI results based on the Cumulative Energy Demand Method published by ecoinvent[2]. Lower heating value of primary energy carriers is used to calculate the primary energy values reported in the study.

Other inventory parameters concerning material use, waste and water use were drawn from the LCI results. There are no regulated hazardous or dangerous substances released from the CtG product system assessed. We followed the ACLCA's Guidance to Calculating non-LCIA Inventory Metrics in Accordance with ISO 21930 [1].

[1] Characterization factor is a factor derived from a characterization model which is applied to convert an assigned life cycle inventory analysis result to the common unit of the category indicator. The common unit allows calculation of the category indicator result [ISO 14040:2006].

[2] Method to calculate Cumulative Energy Demand (CED) based on the method published by ecoinvent 2.0 and expanded by PRé Consultants for raw materials in the SimaPro 8 database.

Table 8. Selected Impact Category Indicators and Inventory Parameters

Core Mandatory Impact Indicator	Abbreviation	Unit	Method
Global warming potential	GWP	kg CO_2e	TRACI 2.1 V1.02
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11e	TRACI 2.1 V1.02
Acidification potential of soil and water sources	AP	kg SO_2e	TRACI 2.1 V1.02
Eutrophication potential	EP	kg Ne	TRACI 2.1 V1.02
Formation potential of tropospheric ozone	SFP	kg O_3e	TRACI 2.1 V1.02
Abiotic depletion potential for fossil resources	ADPf	MJ, NCV	CML-IA Baseline V3.02
Fossil fuel depletion	FFD	MJ Surplus	TRACI 2.1 V1.02
Use of Primary Resources			
Renewable primary energy carrier used as energy	RPRE	MJ, NCV	CED V1.10 NCV
Renewable primary energy carrier used as material	RPRM	MJ, NCV	LCI Indicator
Non-renewable primary energy carrier used as energy	NRPRE	MJ, NCV	CED V1.10 NCV
Non-renewable primary energy carrier used as material	NRPRM	MJ, NCV	LCI Indicator
Secondary Material, Secondary Fuel, and Recovered Energy			
Secondary material	SM	kg	LCI Indicator
Renewable secondary fuel	RSF	MJ, NCV	LCI Indicator
Non-renewable secondary fuel	NRSF	MJ, NCV	LCI Indicator
Recovered energy	RE	MJ, NCV	LCI Indicator
Mandatory Inventory Parameters			
Consumption of freshwater resources	FW	m^3	LCI Indicator
Indicators Describing Waste			
Hazardous waste disposed	HWD	kg	LCI Indicator
Non-hazardous waste disposed	NHWD	kg	LCI Indicator
High-level radioactive waste	HLRW	m^3	LCI Indicator
Intermediate- and low-level radioactive waste	ILLRW	m^3	LCI Indicator
Components for re-use	CRU	kg	LCI Indicator
Materials for recycling	MR	kg	LCI Indicator
Materials for energy recovery	MER	kg	LCI Indicator
Recovered energy exported from the product system	EE	MJ, NCV	LCI Indicator

4.2 Results

Table 9 shows the results for cradle-to-gate (A1-A3) for FORTA's FORTA-FERRO®.

Table 9: Results Summary for 1,000 kgs of FORTA-FERRO® – Cradle-to-Gate Scope

Environmental Indicator	Abbreviation	Units	Total	A1	A2	A3
Core Mandatory Impact Indicator						
Global warming potential	**GWP**	kg CO2-eq	2.94E+03	1.72E+03	1.02E+01	1.21E+03
Depletion potential of the stratospheric	**ODP**	kg CFC-11-	1.03E-04	1.02E-05	3.89E-10	9.28E-05
Acidification potential of land and water	**AP**	kg SO2-eq	1.17E+01	6.53E+00	1.80E-01	5.03E+00
Eutrophication potential	**EP**	kg PO4-eq	1.12E+01	1.74E-01	1.09E-02	1.10E+01
Formation of tropospheric ozone	**SFP**	Kg O3-eq	1.09E+02	6.57E+01	5.86E+00	3.75E+01
Abiotic depletion potential for fossil	**ADPF**	MJ Surplus	7.91E+04	6.73E+04	1.31E+02	1.17E+04
Fossil Fuel Depletion	**FFD**	MJ Surplus	1.03E+04	9.59E+03	2.25E+02	5.20E+02
Use of Primary Resources						
Renewable primary energy carrier used as energy	**RPRE**	MJ	4.82E+02	1.30E+02	0.00E+00	3.52E+02
Renewable primary energy carrier used	**RPRM**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable primary energy used as	**NRPRE**	MJ	8.66E+04	6.73E+04	1.32E+02	1.91E+04
Non-renewable primary energy used as	**NRPRM**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Secondary Material, Secondary Fuel and Recovered Energy						
Use of secondary materials	**SM**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels	**RSF**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels	**NRSF**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered energy	**RE**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mandatory Inventory Parameters						
Use of freshwater resources	**FW**	m3	4.32E+01	7.65E+00	0.00E+00	3.55E+01
Indicators Describing Waste						
Disposed of hazardous waste	**HWD**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of non-hazardous waste	**NHWD**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of high-level radioactive waste	**HLRW**	m3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of low-level radioactive waste	**LLRW**	m3	3.30E-05	9.34E-08	2.53E-06	3.04E-05
Components for reuse	**CRU**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	**MFR**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery	**MER**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported electrical energy (waste to energy)	**EEE**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported thermal energy (waste to energy)	**ETE**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00

5.0 Interpretation

5.1 A1-A3 Results Interpretation

Figure 2 shows the relative contribution to the cumulative impacts of the A1 through A3 phases of the cradle-to-gate life cycle. For all the major impact categories (GWP, ODP, AP, EP, SFP, ADPf), the biggest contributor is A1 – Raw material supply. There are some contributions from A3 – Manufacturing data, and very little from A2 – Transportation.

Figure 2: Contribution analysis for FORTA-FERRO®

5.2 Completeness and Consistency Checks

Evaluating the study's completeness, consistency and sensitivity helps to establish and enhance confidence in, and the reliability of, the results of the LCA study, including the significant issues identified in the interpretation.

The objective of the ***completeness check*** is to ensure that all relevant information and data needed for the interpretation are available and complete. The data were checked for completeness including all elements such as raw and ancillary material input, energy input, transportation, water consumption, product and co-products outputs, emissions to air, water and land and waste disposal. All the input and output data were found to be complete, and no data gaps were identified.

The objective of the ***consistency check*** is to determine whether the assumptions, methods, models and data are consistent with the goal and scope of the study. Through a rigorous process, consistency is ensured to fulfil the goal of the study in terms of assumptions, methods, models and data quality including data source, accuracy, data age, time-related coverage, technology and geographical coverage.

5.3 Conclusion

This study provides a cradle-to-gate LCA of the production of FORTA's FORTA-FERRO® at FORTA's production facility. The primary goal of this LCA was to develop life cycle inventory data and impact assessment results for FORTA's FORTA-FERRO® that could be used to develop an EPD. This LCA project report provides all required impact assessment results and life cycle inventory parameters. The cradle-to-gate LCA does incorporate the necessary scope to develop a "business-to-consumer" EPD in accordance with ISO 21930.

References

1. American Center for Life Cycle Assessment (2019) ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017

2. Bare, J. (2012). Tool for the Reduction and Assessment of Chemical and other Environmental Impacts (TRACI) - Software Name and Version Number: TRACI version 2.1 - User's Manual. Washington, D.C.: U.S. EPA.

3. International Organization for Standardization (2006) International Standard ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and procedures

4. International Organization for Standardization (2006) International Standard 14040:2006/AMD 1:2020 Environmental management – Life cycle assessment – Principles and framework

5. International Organization for Standardization (2006) International Standard ISO 14044:2006/AMD 1:2017/ AMD 2:2020, Environmental management – Life cycle assessment – Requirements and guidelines

6. International Organization for Standardization (2017) International Standard ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.

7. LTS. (2019) DataSmart LCI Package http://ltsexperts.com/services/software/datasmart-life-cycle-inventory/

8. PRé Consultants BV (2018) SimaPro v9.0 LCA Software

9. U.S. Environmental Protection Agency (2019) Advancing Sustainable Materials Management: 2017 Fact Sheet (Table 4 values for Durable Goods).

10. National Renewable Energy Laboratory (2019) U.S. Life Cycle Inventory Database http://www.nrel.gov/lci/

11. Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., & Weidema, B. (2016) The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, 21, 1218–1230.

Glossary of Terms

Based on ISO 21930 [6]

average data
data based on a fully representative sample for a construction product or construction service, provided by one or more suppliers (ISO 6707-1:2004, 8.6), either from their multiple plants or based on multiple similar construction products of the supplier(s)

biogenic
produced in natural processes by living organisms but not fossilized or derived from fossil resources [SOURCE: ISO 13833:2013, 3.1]

biogenic carbon
carbon derived from biomass [SOURCE: ISO/TS 14067:2013, 3.1.8.2]

by-product
co-product from a process (ISO 21, 3.11) that is incidental or not intentionally produced and which cannot be avoided

characterization factor
factor derived from a characterization model that is applied to convert an assigned LCI result to the common unit of the impact category indicator (ISO 14040:2006, 3.40) [SOURCE: ISO 14044:2006, 3.37]

CO_2e
carbon dioxide equivalent
CO_2 equivalent
unit for comparing the radiative forcing of a greenhouse gas (ISO 14064-1:2006, 3.1) to that of carbon dioxide

comparative assertion
environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function [SOURCE: ISO 14044:2006, 3.6]

construction product
item manufactured or processed for incorporation in construction works

consumption of freshwater
net freshwater entering the product system (ISO 14040:2006, 3.28) being studied that is not returned to the same drainage basin from which it originated

co-product
any of one or more products (ISO 14050:2009, 3.2) from the same unit process, but which is not the object of the assessment [SOURCE: ISO 14040:2006, 3.10]

data quality
characteristics of data that relate to their ability to satisfy stated requirements [SOURCE: ISO 14044:2006, 3.19]

downstream process
process (ISO 21931-1:2010, 3.11) that is carried out after the designated process in the stream of relevant processes [SOURCE: ISO 21931-1:2010, 3.2]

environmental product declaration
EPD
Type III environmental declaration
environmental declaration (ISO 14025:2006, 3.1) providing quantified environmental data using predetermined parameters and, where relevant, additional environmental information

foreground data
primary data
quantified value of a unit process or an activity obtained from a direct measurement or a calculation based on direct measurements at its original source [SOURCE: ISO/TS 14067:2013, 3.1.7.1]

freshwater
water having a low concentration of dissolved solids

functional unit
quantified performance of a product system (ISO 14040:2006, 3.28) for a construction product or construction service for use as a reference unit in an EPD based on LCA that includes all stages of the life cycle

gate
point at which the construction product or material (ISO 6707-1:2004, 6.1.1) leaves the factory before it becomes an input into a subsequent manufacturing process (ISO 21931-1:2010, 3.11) or before it is transported to a distributor, another factory or a construction site [SOURCE: ISO 21931-1:2010, 3.8]

generic data
general data used if no system specific data are available

information module
compilation of data to be used as a basis for an EPD, covering a unit process or a combination of unit processes that are part of the life cycle (ISO 14040:2006, 3.1) of a product (ISO 14050:2009, 3.2) [SOURCE: ISO 14025:2006, 3.13]

landfill
waste disposal site for the deposit of waste onto or into land (ISO 6707-1:2004, 10.1) under controlled or regulated conditions [SOURCE: ISO 472:2013, 2.1694]

life cycle
all consecutive and interlinked stages in the life of the object under consideration

life cycle assessment
LCA
compilation and evaluation of the inputs (ISO 14040:2006, 3.21), outputs (ISO 14040:2006, 3.25) and the potential environmental impacts (ISO 21931-1:2010, 3.4) of a product system (ISO 14040:2006, 3.28) throughout its life cycle (ISO 14040:2006, 3.1)

life cycle inventory analysis result
LCI result
outcome of a LCI (3.3.3) that catalogues the flows crossing the system boundary (3.4.4) and provides the starting point for LCIA (3.3.5) [SOURCE: ISO 14040:2006, 3.24]

life cycle impact assessment
LCIA
phase of LCA aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts (ISO 21931-1:2010, 3.4) for a product system (ISO 14040:2006, 3.28) throughout the life cycle (ISO 14040:2006, 3.1) of the product (ISO 14050:2009, 3.2)

primary resources
energy or material resources generated by, acquired from or extracted from the environment/nature (the geosphere or biosphere) within the life cycle of the construction product

product category
group of construction products, construction elements or integrated technical systems

product category rules
PCR
set of specific rules, requirements and guidelines for developing EPDs for one or more product categories

secondary data
background data
indirectly measured, calculated or obtained quantified value of a unit process (3.4.1) or activity and related information within a product system (ISO 14040:2006, 3.28) or organization, not based on specific original source measurements [SOURCE: ISO 16759:2013, 3.8.2, modified — An additional preferred term has been added and reference to company has been changed to organization.]

specific data
data representative of a construction product or construction service, provided by one supplier (ISO 6707-1:2004, 8.6), either from multiple plants or based on multiple similar construction products of the supplier [SOURCE: EN 15804:2012 +A1: 2013, 3.30, modified — Reference to multiple plants or multiple similar products has been added.]

system boundary
boundary representing which unit processes are part of a product system (ISO 14040:2006, 3.28)
Note 1 to entry: The term "system boundary" is not used in this document in relation to LCIA (3.3.5).
Note 2 to entry: The system boundary is established based on a set of criteria within the LCA (3.3.2) study or PCR (3.1.4). [SOURCE: ISO 14040:2006, 3.32, modified — Indication of (a) boundary as the genus for the intentional definition and Note 2 to entry has been added.]

transparency
open, comprehensive and understandable presentation of information [SOURCE: ISO 14040:2006, 3.7]

unit process
smallest element considered in the LCI (3.3.3) for which input (ISO 14040:2006, 3.21) and output (ISO 14040:2006, 3.25) data are quantified [SOURCE: ISO 14040:2006, 3.34]

upstream process
process (ISO 21931-1:2010, 3.11) that is carried out before the designated process in the stream of relevant processes [SOURCE: ISO 21931-1:2010, 3.15]

waste
substances or objects which the holder intends or is required to dispose of
Note 1 to entry: The definition is taken from the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (22 March 1989) but is not confined in this document to hazardous waste.
[SOURCE: ISO 14040:2006, 3.35]

renewable resource
resource that is grown, naturally replenished or cleansed on a human time scale
EXAMPLE Trees in forests, grasses in grasslands and fertile soil, wind.
[SOURCE: ISO 21931-1:2010]

non-renewable resource
resource that exists in a fixed amount that cannot be naturally replenished or cleansed on a human time scale

secondary material
material (ISO 5659 2:2012, 3.6) recovered from previous use or recovered from waste derived from another product system (ISO 14040:2006, 3.28) and used as an input (ISO 14040:2006, 3.21) in another product system

secondary fuel
fuel recovered from previous use or from waste, derived from a previous product system (ISO 14040:2006, 3.28) and used as an input (ISO 14040:2006, 3.21) in another product system

recovered energy
energy recovered from a process (ISO 14040:2006, 3.11), including waste treatment processes

volatile organic compound
VOC
any organic liquid and/or solid that evaporates spontaneously at the prevailing temperature and pressure of the atmosphere with which it is in contact