ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	Armacell International S.A.
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-ARM-20250618-IBC1-EN
Issue date	12.06.2026
Valid to	11.06.2031

ArmaFlex Duosolar/Solarflex Duo flexible pre-insulated piping system

Armacell International S.A

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD VERIFIED

www.ibu-epd.com | https://epd-online.com

1. General Information

Armacell International S.A

Programme holder

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

Declaration number

EPD-ARM-20250618-IBC1-EN

This declaration is based on the product category rules:

Pre-insulated pipe systems for use in buildings, 01.06.2023
(PCR checked and approved by the SVR)

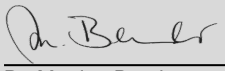
Issue date

12.06.2026

Valid to

11.06.2031

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



Dr. Martina Bender
(Managing Director Institut Bauen und Umwelt e.V.)

ArmaFlex Duosolar/Solarflex Duo flexible pre-insulated piping system

Owner of the declaration

Armacell International S.A.
Westside Village, rue Pafebruch 89B
8308 Capellen - GD of Luxembourg
Luxembourg

Declared product / declared unit

The specified products are Duosolar / Solarflex Duo. The declared unit is one tonne of pre-insulated pipe system.

Scope:

Scope:
This document applies to DuoSolar / Solarflex Duo. For the preparation of the Life Cycle Assessment, the production quantities of the company headquarters in Münster and Austria for the year 2023 were surveyed.

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

The EPD was created according to the specifications of EN 15804+A2. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally

Dr. Matthew Fishwick,
(Independent verifier)

armacell®

2. Product

2.1 Product description/Product definition

a) Information about the company:
The Armacell group develops 'Advanced Insulation' in the area of flexible insulation materials to improve the energy efficiency of technical systems. In the division of 'Engineered Foams', which are high-performance foams, Armacell group offers products for various technical applications and lightweight construction solutions.

Armacell GmbH develops and produces energy-efficient heat and cold insulation solutions as well as flexible pre-insulated piping systems.

b) Information about the product:
DuoSolar and Solarflex Duo are flexible, pre-insulated, UV-resistant double piping systems offered with a smart join-split system with two copper or stainless-steel hoses. The system includes a sensor cable. The two products are manufactured at two different production sites, one of them located in Germany, the other in Austria.
Note: DuoSolar and Solarflex Duo are in essence the same product. DuoSolar is the original product of the firm Armacell Münster, Solarflex Duo is the equivalent product of the company Armacell Austria with manufacturing facilities in Gödersdorf-Villach.

Construction / composition:
Medium pipes: Corrugated stainless-steel pipe: austenitic stainless steel, according to *EN 10088-2:* X 2 CrNiMo 17-12-2 and *DIN 17441: 1.4404*.
-> Fulfill *EN ISO 10380:2013* and *EN 13618 p.*B7.2 – alternatively copper pipes seamless drawn soft annealed copper tubes, according to *EN 1057*.

Insulation: synthetic EPDM rubber-based foam. Factory made flexible elastomeric foam (FEF) according to *EN 14304*.

Casing pipe: PE casing
Sensor cable: 2 x 0,75 mm² with halogen-free, temperature-resistant silicon coating (+180 °C)

This EPD is a representative EPD covering the product families DuoSolar and Solarflex Duo 13mm, including the variants described below.

DuoSolar is available in six different configurations, with service pipes made of either stainless steel (VA) or copper (CU) and has 14 mm of insulation. The systems vary in terms of pipe material and pipe diameter:

Stainless steel (VA):

- DuoSolar VA DN16
- DuoSolar VA DN20
- DuoSolar VA DN25

Copper (CU):

- DuoSolar CU DN12
- DuoSolar CU DN15
- DuoSolar CU DN18

Solarflex Duo is available with either 13 mm or 19 mm insulation thickness. For the purpose of this EPD, only the 13 mm variant is considered, as it is most similar to DuoSolar in terms of design and raw material composition. The service pipe is made of stainless steel and comes in four diameters:

- Solarflex Duo 2xDN12
- Solarflex Duo 2xDN16
- Solarflex Duo 2xDN20
- Solarflex Duo 2xDN25

Product without EU harmonisation provisions
For the use and application of the product, the national provisions at the place of use apply (e.g. in Germany, the building codes of the federal states and corresponding national specifications).

2.2 Application

DuoSolar and Solarflex Duo are used to connect solar collectors with hot-water storage tanks in an easy and professional way.

2.3 Technical Data

Constructional data

Name	Value	Unit
Constructional data for the entire system		-
Outer diameter	2x40 - 2x60	mm
Pipe weight	0,68-1,23	kg/m
Constructional data for insulation layer		-
Thermal conductivity 40°C	0.042	W/(mK)
Density	60-85	kg/m^3
Maximum service temperature	150	°C
Minimum service temperature	-50	°C
Insulation thickness	13-14	mm
Constructional data for service pipe		-
Pipe diameter (Da)	DN12-DN25	mm
Maximum operating pressure copper (CU) DN12, DN15, DN18	62-79	bar
Maximum operating pressure corrugated steel (VA) DN12, DN16, DN20, DN25	6-16	bar
Minimum bending radius	0,02-0,05	m

Performance data of the product with respect to the 'Declaration of Performance' in relation to its essential characteristics in accordance with:

- Temperature range of the insulation material tested acc. to *EN ISO 18096* (formerly: *EN 14707*) and *14304*
- Thermal conductivity declared acc. to *EN ISO 13787* and tested according to *EN ISO 8497*
- Water vapour diffusion resistance tested according to *EN ISO 12629 (*formerly: *EN 13469)*
- Reaction to fire – Euroclass E - Classified acc. to *EN 13501-1*. Tested according to *EN ISO 11925-2*

2.4 Delivery status

DuoSolar and Solarflex Duo are produced in pipe bundles with different coil lengths of 10, 15, 20, 25, and 50 meters. In Accordance with the coil lengths, the size of the cardboard boxes also varies:

Solarflex Duo (13 mm)		
DN	Coil length	Packaging size (length x width x height) in mm
12	10	800 x 800 x 200
12	15	800 x 800 x 200
12	20	800 x 800 x 290
12	25	800 x 800 x 390
12	50	1065 x 1065 x 500
16	10	800 x 800 x 205
16	15	800 x 800 x 250
16	20	800 x 800 x 360
16	25	800 x 800 x 360
16	50	1000 x 1000 x 500
20	10	800 x 800 x 205
20	15	800 x 800 x 250
20	20	800 x 800 x 360
20	25	800 x 800 x 400
20	50	1000 x 1000 x 500
25	15	800 x 800 x 390
25	25	800 x 800 x 540

DuoSolar		
DN	Coil length	Packaging size (length x width x height) in mm
16	10	800 x 800 x 200
16	15	800 x 800 x 200
16	20	800 x 800 x 290
16	25	800 x 800 x 390
16	50	1065 x 1065 x 500
20	10	800 x 800 x 200
20	15	800 x 800 x 290
20	20	800 x 800 x 390
20	25	800 x 800 x 540
20	50	1065 x 1065 x 500
25	15	800 x 800 x 390
25	25	800 x 800 x 540
12	15	1194 x 1215 x 104
15	10	1194 x 1215 x 104
15	15	1194 x 1215 x 104
15	20	1194 x 1215 x 104
15	25	1294 x 1320 x 104
18	10	1194 x 1215 x 104
18	15	1194 x 1215 x 104
18	20	1294 x 1320 x 104
18	25	1294 x 1320 x 104

2.5 Base materials/Ancillary materials

DuoSolar and Solarflex Duo pipe systems consist of metallic service pipes and flexible elastomeric foam (FEF). The outer cover is made of PE.

The following table shows the average material composition of the product group

Name	Value	Unit
Water-bearing pipes		
Corrugated steel pipes	43,43	%
Copper pipes (CU)	0,58	%
Subtotal	44,01	%
Insulation		
Elastomer foam (EPDM)	33,56	%
Outer casing		
PE casing (LDPE)	17,67	%
Additional components		
Adhesives	1,44	%
PVC Sensor Cable	3,31	%
Total	100	%

Armacell sources the water-bearing corrugated steel pipes and copper pipes as well as the signal cable from upstream suppliers. The outer jacket made of PE is applied via a cross extruder.

1. The product/article/at least one partial product contains substances on the *ECHA* list of Substances of Very High Concern (SVHC) (20.11.2023) above 0,1% by mass: no

2. The product/article/at least one partial product contains other carcinogenic, mutagenic, reprotoxic (CMR) substances of category 1A or 1B which are not on the Candidate List, above 0,1% by mass in at least one partial product: no

3. Biocidal products have been added to the construction product in question or it has been treated with biocidal products (it is therefore a treated product within the meaning of the *Biocidal Products Regulation (EU) No. 528/2012):* no

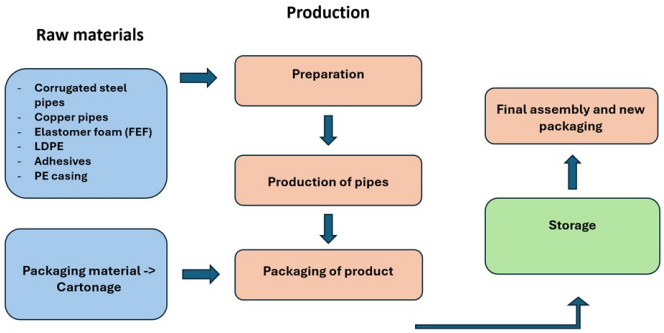
2.6 Manufacture

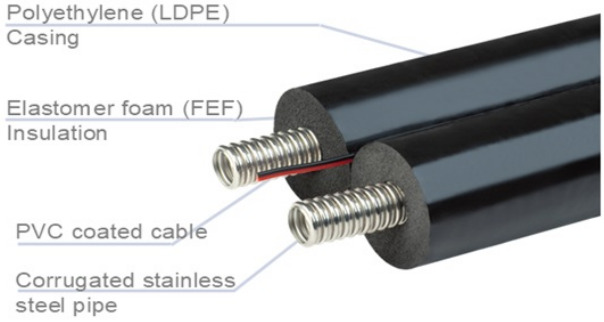
DuoSolar and Solarflex Duo products are manufactured in two Armacell plants at different locations – DuoSolar in Münster/Germany and Solarflex Duo in Gödersdorf-Villach/Austria. The elastomeric foam is produced in Münster in a continuous production process.

In the pre-insulation process, the service pipes are inserted into the foam, and the signal cable is inserted as well - together with one of the service pipes. The outer protection casing is applied with co-extrusion on to the elastomeric foam.

In the next step, the pipes are coiled, cut to length and packed in carton boxes.

Quality assurance is carried out in accordance with the related product standards. Quality management system in accordance with *ISO 9001*.





2.7 Environment and health during manufacturing

During all manufacturing steps and in all Armacell production facilities, production follows national guidelines and regulations. The cooling water is stored in the cycle. The share of electricity demand covered by green electricity within total electricity demand is 17,34 %.

2.8 Product processing/Installation

The pipes are designed for direct installation into buildings. Connections are established with metallic fittings that are applied using standard installation tools. Additionally, neither special tools nor special protective measures are needed. The recommendations for installing the product depend on the product as well as the system and are described in the respective documentation and in the safety data sheets (e.g. in the installation instructions). For more details, see

www.armacell.com.

2.9 Packaging

The DuoSolar and Solarflex Duo pipe bundles are held together by tension straps and packed in carton boxes. The accessories are packed in boxes as well.

The cardboard boxes are recyclable.

2.10 Condition of use

When the products are used in their intended purpose, no change in the material composition occurs during use. Changes only occur in case of extraordinary effects (see 2.13).

2.11 Environment and health during use

Ingredients: There are no particular aspects of material composition during use. The product does not release water-soluble substances that can be released into the environment. No energy is required to use DuoSolar and Solarflex Duo.

2.12 Reference service life

DuoSolar and Solarflex Duo products are durable products. The results show that their useful life can be more than 50 years if used and installed properly. The thermal insulation performance is maintained almost without restriction over the entire service life. Impairments of the thermal insulation performance are only caused by extraordinary effects and damage during the construction phase.

2.13 Extraordinary effects

Fire

Fire protection

Name	Value
Building material class	E

Water

The outer jacket and the elastomeric insulation are designed in such a way that the penetration of water vapour is permanently limited to a minimum.

Mechanical destruction

DuoSolar and Solarflex Duo are designed for direct installation in the building.

2.14 Re-use phase

In principle, a material-specific separation of the product components is technically possible. However, under real construction-site conditions, it is considered unrealistic that the same separation quality can be achieved as under controlled factory conditions. Therefore, conservative assumptions are applied for end-of-life treatment.

Metallic components (stainless steel and copper pipes) are assumed to be predominantly collected separately and sent to material recycling under conservative assumptions reflecting typical construction-site conditions (approximately 97% recycling). Plastic components are assumed to be treated predominantly by thermal waste treatment with energy recovery in appropriate waste incineration plants (approximately 97%). For PVC-sheathed cables, the majority of the copper content is assumed to be recovered through material recycling (approximately 90%), while the PVC fraction is assumed to undergo thermal treatment with energy recovery (approximately 90%).

2.15 Disposal

The materials must be disposed of in accordance with local regulations, regulated by the *European Waste Catalogue*: waste code 07 02 13 (plastic waste). For the metal components, the waste code is 02 01 10. Note: Please refer to Commission Decision 2001/118/EC.

2.16 Further information

Further information and detailed specifications of DuoSolar and Solarflex Duo products can be found on the manufacturer's website: www.armacell.com.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit of one tonne refers to the average production volume of DuoSolar and Solarflex Duo in 2023. This methodology was chosen to present the different versions of the product on a balance sheet.

The pipe versions listed above (chapter 2.1) are aggregated to form a single average dataset. The average is not based on a 50:50 split but is weighted according to the respective production volumes from the year 2023 of the two products and their variants.

Declared unit

Name	Value	Unit
Declared unit	1000	kg
Mass of pipes	440,10	kg
Mass of insulation	335,64	kg
Mass of the outer sheath	176,76	kg
Mass of other components (adhesives, sensor cable)	47,52	kg
Mass reference	0,76	kg/m
Conversion factor to 1m	0,00076	t/m
Gross density	60	kg/m³

The robustness of the data is shown in section 3.6.

3.2 System boundary

The data collected refers to the annual production of 2023. Type of EPD: cradle to gate with modules C1–C4 and module D (A1–A5 + C + D)

The following stages of the life cycle are considered:

Production (A1–A3)

The LCA includes the production of DuoSolar and Solarflex Duo components, covering raw material supply (A1), transport to production facilities in Münster, Germany, and Gödersdorf, Austria (A2), on-site pipe production, packaging, and treatment of production waste.

Supplier-specific electricity data were used for both sites. In Gödersdorf (Austria), 100% renewable electricity is applied in module A3. In Münster (Germany), a mix of renewable and conventional electricity is used. No guarantees of origin were available for the renewable share; therefore, a conservative assumption was applied using the German national electricity mix for the renewable portion, while the remaining electricity demand was allocated based on the supplier-specific electricity mix.

Transport A4: Transport from the factory to the construction site

Installation A5: the installation is carried out manually and therefore requires no energy input. The module includes the disposal scenario 'recycling of cardboard' for 100% of the packaging material.

Use B1–B7: No relevant environmental impacts are expected during normal use, so the use phase is excluded in this EPD.

C1 (demolition) includes dismantling, which is carried out manually and therefore requires no energy input.
C2 considers the transport to the waste treatment plants.

C3 includes the recycling of the metallic components and the thermal treatment (R1 value > 0.6) of plastic components with potential for energy recovery.

C4 considers the incineration (R1 value < 0.6) without energy recovery of the remaining metallic and plastic components, which are contained in non-recoverable fine fractions or in fractions that cannot be easily recovered and are therefore disposed of as mixed construction waste.

Module D: covers the advantages and burdens attributed to the subsequent product system. These include:

- The generation of electrical and thermal energy resulting from the incineration of plastic product components in stage C3.
- The environmental benefits associated with the substitution of primary metals (pig iron and copper).

3.3 Estimates and assumptions

A5: An average distance of 250 km is assumed between construction site and recycling facility.

C2: An average distance of 250 km is assumed between construction site and waste treatment facilities.

C3: Separation and collection at the construction site are assumed to be of lower quality than under factory conditions; therefore, conservative assumptions are applied. 97 % of metallic components are assumed to be recycled and 97 % of plastic components are assumed to undergo thermal treatment with energy recovery (R1 > 0.6). For PVC-sheathed cables, 90 % of the copper content is assumed to be recycled and 90 % of the PVC content to be treated by incineration with energy recovery. Metallic waste is assumed to reach the end-of-waste state after recycling, while plastic waste reaches the end-of-waste state after incineration, with recovered energy considered outside the system boundary. The useful energy generated during the process of waste treatment is declared as exported energy in C3 (EEE and EET indicators) and the advantages and burdens associated with the useful energy generated are declared in module D.

C4: The remaining fractions (3 % of metallic and plastic components and 10 % of PVC-sheathed cable materials) are assumed to consist of non-recoverable fractions and are disposed of as mixed construction waste. These wastes are treated by thermal treatment without energy recovery and therefore classified as waste disposal. Incineration residues (bottom ash and fly ash) are assumed to be landfilled, and metal recovery from residues is not considered due to uncertain quality and recovery rates.

D: The useful energy produced is declared as exported energy in C3 and the advantages and burdens associated with the useful energy produced in module D. According to the dataset used for the incineration of the plastic components in C3 'Treatment of waste plastic, mixture, municipal incineration [RoW]', 3,92 MJ/kg of electrical energy and 7,66 MJ/kg of thermal energy are recovered.

The environmental benefits associated with the substitution of primary metals (pig iron and copper) are also taken into account in module D. These benefits are determined on the basis of the net flow. The net flow is calculated as the difference between the output of recovered metal components and the input of secondary metals. For metal recycling, a quality factor of 1 is applied, reflecting the assumption of recycling without any loss of material quality.

3.4 Cut-off criteria

The maximum cut-off applied for all excluded inputs and outputs in this EPD is 5 % of the total energy and mass per module, in accordance with *EN 15804 + A2* and *PCR Part A*.

For this LCA, all available inputs and outputs, including those below the 1% threshold, are considered, except for tension straps, as well as site-specific buildings, machinery, and production infrastructure at the manufacturing plant.

3.5 Background data

The LCA model was created using SimaPro software (version 10.2). The '*EN 15804+A2* Method' was used to calculate the core indicators (except 'Climate Change – biogenic') for the environmental impacts and the additional environmental indicators. This method takes into account the characterisation factors of the Ecological Footprint Method, version 3.1. The *ecoinvent* database (version 3.11) provides the LCA data from the underlying system for various raw and process materials. The system models of the ecoinvent datasets are based on 'cut-off by classification' allocation.

3.6 Data quality

The foreground data collected by the manufacturer is based on production volumes and sales volumes in 2023 and extrapolations of measurements for specific machines and equipment at the production site.

Temporal representativeness:
The data on which the EPD is based originate from the 2023 financial year and include all inputs and outputs that occurred during that year.

Geographical representativeness:
The production of the product Solarflex Duo takes place in Austria, while DuoSolar is produced in Germany. For the modelling of product use and end-of-life treatment, Austrian and German datasets were primarily applied. Where Austria-specific or Germany-specific data were not available, European, global, or Rest-of-World datasets were used.

Technological representativeness:
The production of the pipes takes place in company-owned extrusion lines and reflects the current state of the art. Production processes differ between the products: DuoSolar combines FEF foam tubes with a co-extruded LDPE outer layer and winds two finished tubes onto cardboard reels within a single production line, while Solarflex Duo applies the LDPE layer, inserts corrugated tubes into 100 m FEF foam tubes in separate lines, and then combines and reels the tubes for packaging.

The pipes within the DuoSolar and Solarflex Duo product group vary in diameter and thickness of the individual layers. Since the average environmental performance of the product is

calculated using site-specific production volumes, the results also provide a representative picture of site-specific production technologies.
There is a valid certificate for the green electricity, as well as proof of the composition of the sources. For thermal energy, the region-specific natural gas supply is taken into account.

Most of the necessary Life Cycle Inventories (LCI) of the basic materials are available in the *ecoinvent* database. LCA data not available in ecoinvent is approximated using LCIs of similar materials or estimated by combining available LCIs. The dataset for stainless steel was adapted to reflect specific alloy compositions, recycling content, and production routes (EAF and converter) and the dataset für styrene-butadien-rubber adhesive was created a new, based on a LCA study by Joana Rita Pereira Dias (2022).

A detailed assessment of the data quality according to *EN 15804* (Annex E) was carried out and presented in the associated project report. Geographical representativeness and technological representativeness are rated as 'good' on average, while temporal representativeness is rated as 'very good' on average.

LCA results for the material production stage (Modules A1–A3) are considered robust, reflecting the environmental performance of the products across variations in production processes, material composition, and site-specific conditions. The main contributors to environmental impacts are metal selection (copper vs. stainless steel) and the metal and plastic content. Percentage differences of the LCA results for AP, GWP-fossil and PENRT between materials range from approximately 22–48 %, while variations within a single material class are moderate. Absolute differences are small and the production site (Austria vs. Germany) has only a minor influence on Modules A1–A3.

The data are also plausible, as deviations from comparable results (other manufacturers, literature, or similar products) are consistent and understandable.

3.7 Period under review

The production data refers to an average value from 2023.

3.8 Geographic Representativeness

Land or region, in which the declared product system is manufactured, used or handled at the end of the product´s lifespan: Europe

3.9 Allocation

In addition to DuoSolar and Solarflex Duo, other products are manufactured at the two plants under review.

For those inputs and outputs for which precise data is not available, a mass-based allocation (based on production volumes) is used.

The following allocations are carried out:

A1–A3 Energy: The electricity is needed for production, storage, charging stations for electric forklifts & cars, compressed air system, lighting and administration. The annual electricity consumption for production was allocated to DuoSolar and Solarflex Duo based on produced running metres. A product-specific electricity consumption factor (kWh/m), derived in 2022 from machine power ratings and operating hours, was applied to 2023 production volumes. In the case of the specific electricity values (kWh/m), one-year average data could not be used due to the lack of sub-metering of individual machines. This deviation is considered minor, as electricity represents only a small share of the total A1–A3 environmental impacts, and the method was verified through plausibility checks, which showed only minor differences compared to annual site-level data. In the case of DuoSolar and Solarflex Duo, the extrusion line is taken into account. Mass-based allocation is used to allocate the electricity consumption for the storage, charging station for electric forklifts and cars, compressed air system, lighting and administration, as well as natural gas for heating and hot water to the individual products.

A1–A3 Transport of raw materials to the plant: The tonne-kilometres (tkm) of each product/raw material transported to the plant are calculated based on the input quantities and the distance between the manufacturer/supplier and the plant.

A1-A3: Treatment of secondary materials, pre- and post-consumer scrap:
The stainless steel pipes contain 30 % recycled content, while the copper used in the medium pipe contains 41% recycled content. The recycled content is based on *ecoinvent* datasets, which include both pre- and post-consumer scrap. As the scrap requires processing (e.g. sorting and pressing) before reuse, it is considered a waste flow until reaching end-of-waste status. Therefore, the cut-off approach is applied, assigning only recycling process impacts to the scrap inputs. A differentiation between pre- and post-consumer scrap is not possible due to the lack of data on their respective shares.

At the manufacturing site, controlled source separation allows for 100 % recycling of metallic components and 100 % incineration of plastic components (insulation and casing). For PVC-sheathed cables, 90 % of the copper content is recycled, while 10 % is incinerated due to non-recoverable fractions; 100 % of the PVC content is thermally treated.

The end-of-waste state for metals is assumed to be reached following sorting, cleaning, and testing at the scrap yard; only the transport of waste to recycling facilities and minor processes for sorting, cleaning, and testing are included. The end-of-waste state for plastics and for the fraction of copper treated by incineration is assumed to be reached after completion of thermal treatment. Incineration residues (bottom ash) are disposed of in landfill.
Packaging materials of incoming raw materials are only modelled with transport to waste treatment, representing a conservative assumption.

A1–A3: The transport of outputs for waste treatment is accounted for based on the quantities of waste generated and an assumed average distance between the plant and the respective waste treatment facility. An average distance of 25 km is assumed for recycling facilities and 330 km for thermal treatment facilities.

A4: For transport from the factory to the construction site, distances at home and abroad are weighted according to turnover. The average transport distance is estimated on the basis of order processing.

3.10 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to *EN 15804* and the building context, respectively the product-specific characteristics of performance, are taken

into account. The underlying database used is ecoinvent.

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

Biogenic carbon content at the factory gate

In the product itself, the biogenic carbon content is well below the cut-off limit of 5 %.
The proportion of biogenic carbon contained in the packaging per tonne of DuoSolar and Solarflex Duo is:

Information on describing the biogenic carbon content at factory gate

Name	Value	Unit
Biogenic carbon content in product	-	kg C
Biogenic carbon content in accompanying packaging	69.8	kg C

The biogenic carbon contained leaves the system in module A5.

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

The following technical information serves as the basis for the declared modules.

Transport from the gate to the site (A4)

Name	Value	Unit
Litres of fuel	17,8	l/100km
Average transport distance	549,52	km
Capacity utilisation (including empty runs)	80	%
Gross density of products transported	60	kg/m^3

Assembly (A5)

The figures refer to one tonne of DuoSolar and Solarflex Duo.

Name	Value	Unit
Output substances as a result of waste treatment on the construction site (= packaging)	166,95	kg
Collection for recycling Product packaging – cardboard boxes	166,95	kg

The service life declared by the manufacturer applies to the assumptions and condizions of use, which are described in section 2.12

Reference service life

Name	Value	Unit
Service life according to the manufacturer's specifications	50	a

End of life (C1-C4)

The figures refer to one tonne of DuoSolar and Solarflex Duo.

Name	Value	Unit
Collected separately waste type metals	446,55	kg
Collected separately waste type plastics	521,13	kg
Collected as mixed construction waste	32,32	kg
Recycling metals	446,55	kg
Energy recovery plastics	521,13	kg
Incineration (C4)	32,32	kg

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Module D covers the advantages and burdens of the incineration process of C3, as well as the environmental benefits associated with the substitution of primary metals (pig iron and copper).

Name	Value	Unit
Thermal recycling (C3)	521,13	kg
Net flow of secondary metals stainless steel	301,33	kg
Net flow of secondary metals copper	24,22	kg

armacell®

5. LCA: Results

The results of the indicators of the impact assessment, resource use, waste and other output streams related to one tonne of the product DuoSolar and Solarflex Duo are presented below. To calculate the core indicators of the environmental impact as well as the additional environmental indicators, the '*EN 15804+A2* Method' of the Simapro software was used. This method takes into account the characterisation factors of the Ecological Footprint Method, version 3.1.

The results of the biogenic global warming potential (GWP-biogenic) only take into account the greenhouse gas emissions that are stored in the packaging materials made from renewable raw materials in the form of carbon in the biomass (negative value in A1-A3) and are released back into the environment when the product is installed in the course of packaging disposal (positive value in A5). The very low biogenic greenhouse gas emissions of the energy supply processes are neglected in the present case. The product itself contains no renewable raw materials and therefore does not cause any biogenic greenhouse gas emissions.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	X	X	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 tonne DuoSolar/Solarflex Duo

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq	6.24E+03	1.03E+02	2.64E+02	0	4.67E+01	1.24E+03	4.06E+01	-9.98E+02
GWP-fossil	kg CO_2 eq	6.49E+03	1.03E+02	7.79E+00	0	4.67E+01	1.24E+03	4.06E+01	-9.97E+02
GWP-biogenic	kg CO_2 eq	-2.56E+02	0	2.56E+02	0	0	0	0	0
GWP-luluc	kg CO_2 eq	1.13E+01	3.45E-02	2.6E-03	0	1.57E-02	9.6E-03	5E-04	-7.21E-01
ODP	kg CFC11 eq	1.44E-04	2.24E-06	1.7E-07	0	1.02E-06	3.9E-07	2E-08	-1.23E-05
AP	mol H^+ eq	5.04E+01	2.2E-01	1.67E-02	0	1E-01	2.83E-01	1.08E-02	-6.55E+00
EP-freshwater	kg P eq	7.17E+00	7.1E-03	5E-04	0	3.2E-03	4.1E-03	3E-04	-3.43E+00
EP-marine	kg N eq	7.33E+00	5.31E-02	4E-03	0	2.41E-02	1.61E-01	5.8E-03	-1.82E+00
EP-terrestrial	mol N eq	8E+01	5.73E-01	4.35E-02	0	2.61E-01	1.37E+00	5.13E-02	-2.35E+01
POCP	kg NMVOC eq	2.91E+01	3.49E-01	2.65E-02	0	1.59E-01	3.45E-01	1.35E-02	-5.52E+00
ADPE	kg Sb eq	6.55E-01	4E-04	2.67E-05	0	1.6E-04	5.99E-05	2.7E-06	-5.37E-02
ADPF	MJ	1.04E+05	1.46E+03	1.11E+02	0	6.63E+02	2.33E+02	1.23E+01	-1.23E+04
WDP	m^3 world eq deprived	2.77E+03	5.73E+00	4.35E-01	0	2.61E+00	4.02E+01	1.43E+00	-9.09E+01

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential)

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 tonne DuoSolar/Solarflex Duo

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	MJ	1.34E+04	2.33E+01	2.15E+03	0	1.06E+01	9.12E+00	3.86E-01	-1.99E+03
PERM	MJ	2.15E+03	0	-2.15E+03	0	0	0	0	0
PERT	MJ	1.55E+04	2.33E+01	1.77E+00	0	1.06E+01	9.12E+00	3.86E-01	-1.99E+03
PENRE	MJ	8.71E+04	1.46E+03	1.11E+02	0	6.63E+02	1.52E+04	1.68E+03	-1.23E+04
PENRM	MJ	1.67E+04	0	0	0	0	-1.5E+04	-1.67E+03	0
PENRT	MJ	1.04E+05	1.46E+03	1.11E+02	0	6.63E+02	2.33E+02	1.23E+01	-1.23E+04
SM	kg	1.38E+02	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0
FW	m^3	3.03E+03	5.73E+00	4.35E-01	0	2.61E+00	3.99E+01	1.42E+00	-1.2E+02

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 resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2:
1 tonne DuoSolar/Solarflex Duo

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HWD	kg	1.25E+00	9.9E-03	8E-04	0	4.5E-03	2.9E-03	1E-04	-8.92E-02
NHWD	kg	8.4E+02	7.11E+01	5.4E+00	0	3.23E+01	2.39E+01	1.17E+01	-6.92E+01
RWD	kg	2.46E-01	8E-04	1E-04	0	4E-04	2E-04	0	-3.39E-02
CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	1.78E+01	0	1.67E+02	0	0	4.47E+02	0	0
MER	kg	0	0	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	2.04E+03	0	0
EET	MJ	0	0	0	0	0	3.99E+03	0	0

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional:
1 tonne DuoSolar/Solarflex Duo

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PM	Disease incidence	5.01E-04	7.7E-06	6E-07	0	3.5E-06	1.5E-06	1E-07	-7.77E-05
IR	kBq U235 eq	5.21E+02	1.76E+00	1.34E-01	0	8.01E-01	3.98E-01	1.84E-02	-6.72E+01
ETP-fw	CTUe	9.93E+04	1.96E+02	1.49E+01	0	8.9E+01	2.44E+03	8.27E+01	-3.71E+04
HTP-c	CTUh	5.9E-06	1.7E-08	1E-09	0	8E-09	1.06E-07	4E-09	-9.22E-07
HTP-nc	CTUh	2.63E-04	9.15E-07	7E-08	0	4.16E-07	3.71E-06	1.23E-07	-8.57E-06
SQP	SQP	4.7E+04	8.75E+02	6.64E+01	0	3.98E+02	6.7E+01	7.58E+00	-4.71E+03

PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

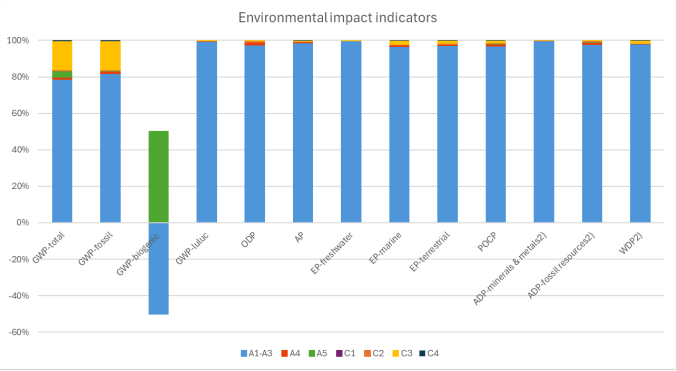
Disclaimer 1 – for the indicator 'Potential Human exposure efficiency relative to U235'. This impact category deals mainly with the eventual impact of low-dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – for the indicators 'abiotic depletion potential for non-fossil resources', 'abiotic depletion potential for fossil resources', 'water (user) deprivation potential, deprivation-weighted water consumption', 'potential comparative toxic unit for ecosystems', 'potential comparative toxic unit for humans – cancerogenic', 'Potential comparative toxic unit for humans - not cancerogenic', 'potential soil quality index', "Use of freshwater ressources" The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high as there is limited experience with the indicator. This EPD was created using a software tool.

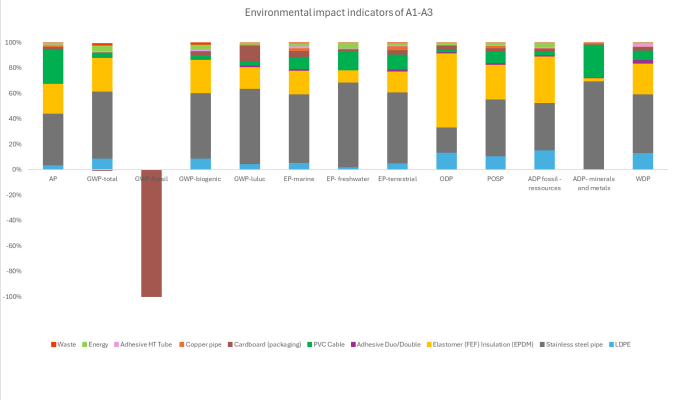
6. LCA: Interpretation

The following interpretation provides a summary of the LCA results (excluding module D) based on a declared unit of one tonne of DuoSolar & Solarflex Duo pipe.
The A1–A3 manufacturing phase is the dominant contributor to the overall environmental profile, accounting for at least 96 % of the impacts across all 13 indicators. Module C3 makes a notable contribution of 16 % to the indicator Climate Change – fossil, primarily due to the thermal recovery of the plastic components.

The negative value of the indicator Climate Change – biogenic in Modules A1–A3 is attributable to the packaging material used, which consists of cardboard. This material contains biogenic carbon in the form of carbon dioxide absorbed during plant growth (i.e., a negative greenhouse gas potential). In Module A5, the stored carbon dioxide from the packaging materials is reported as an equal positive value, since the materials leave the system at this stage. Over the entire life cycle of the product, this results in a balanced CO_2 balance for the biogenic carbon sequestered in the product packaging.



The analysis of the manufacturing phase of DuoSolar and Solarflex Duo identifies the supply of raw materials (including packaging) as a key driver with a share of at least 97,5 % in all environmental indicators. Among the individual raw materials, stainless steel pipes are responsible for an average of 46 % of the environmental impact in all environmental indicators, followed by elastomere insulation (EPDM) with 22 %, cardboard with 10 %, the PVC cable with 9 %, and LDPE with 7 %. The remaining 5 % is attributable to other components and processes, such as adhesives, copper pipe, energy use and waste treatment. For the Ozone Depletion indicator specifically, elastomer insulation contributes 58 % of the total impact.



Variation
A variance analysis was conducted for the three indicators global warming potential (GWP-fossil), acidification potential (AP), and total non-renewable primary energy demand (PENRT) per tonne of DuoSolar and Solarflex Duo pipes across the different available pipe dimensions (off-the-shelf goods), considering results over all modules but excluding Module D.

Range of the key indicators relative to the declared unit of 1 tonne:

	Pipe dimension	Unit	Total (without Modul D)	Deviation from the average (Total without Modul D)
MAX AP	Duosolar CU DN15	Mol H+-Äq.	9,43E+01	87,12%
MIN AP	Solarflex EWK double 13mm-	Mol H+-Äq.	4,46E+01	-11,49%
Variation range		*Mol H+-Äq.*	*4,97E+01*	
MAX GWP-fossil	Duosolar VA DN16	kg CO2-Äq.	8,25E+03	5,60%
MIN GWP-fossil	Duosolar CU DN18	kg CO2-Äq.	6,21E+03	-20,49%
Variation range		*kg CO2-Äq.*	*2,04E+03*	
MAX PENRT	Duosolar VA DN16	MJ	1,11E+05	5,80%
MIN PENRT	Duosolar CU DN18	MJ	7,94E+04	-24,07%
Variation range		*MJ*	*3,13E+04*	

For the AP indicator, the DuoSolar VA DN15 pipe exhibits the highest total values. This is mainly due to its high copper content, the larger proportion of PVC cables, and the greater production energy required because of its higher weight per meter compared to the DuoSolar VA DN16 pipe. In contrast, the Solarflex EWK double 13mm 2xDN25 pipe shows the lowest AP values, primarily due to its relatively low stainless steel amount and its lower production energy resulting from a smaller weight per meter, compared to the other pipes.

For GWP fossil and PENRT, the DuoSolar VA DN16 pipe exhibits the highest values, even though it contains the lowest proportion of stainless steel, which itself has high GWP fossil and PENRT impacts. This is due to its overall high share of plastic components, which undergo thermal treatment in Module C3 and generate higher emissions than pipes with a greater metal content, which is recycled burden-free. In addition, the DuoSolar VA DN16 pipe has the highest weight per meter, resulting in increased production energy requirements. Conversely, the DuoSolar CU DN18 pipe shows the lowest GWP fossil values, as it contains a high proportion of recyclable copper and has a comparatively lower weight per meter.

7. Requisite evidence

8. References

Standards

EN 1057
Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications

EN ISO 8497
Thermal Insulation — Determination of steady-state thermal transmission properties of thermal insulation for circular pipes (ISO 8497: 1996)

ISO 9001
DIN EN ISO 9001:2015-11, Quality Management Systems – Requirements (ISO 9001:2015)

EN 10088-2
Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes

EN ISO 10380
EN ISO 10380:2013, Pipework — Corrugated metal hoses and hose assemblies

EN ISO 11925-2
Reaction to fire tests — Ignitability of products subjected to direct impingement of flamePart 2: Single-flame source test (ISO 11925-2: 2026)

EN ISO 12629
Thermal insulating products for building equipment and industrial installations -
Determination of water vapour transmission properties of preformed pipe insulation (ISO 12629:2022)

EN 13501-1
Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests (ISO 13501-1: 2020)

DIN EN 13618
DIN EN 13618:2017-03 Flexible hose assemblies in drinking water installations - Functional requirements and test methods

EN ISO 13787

Thermal insulation products for building equipment and industrial
installations - Determination of declared thermal conductivity (ISO 13787:2003)

EN 14304
EN 14304:2016-03, Thermal insulation products for building equipment and industrial installations - Factory made flexible elastomeric foam (FEF) products - Specification

ISO 14025
DIN EN ISO 14025:2011-10, Environmental labelling and declarations – Type III Environmental declarations – Principles and procedures

ISO 14040
DIN EN ISO 14040:2021-02, Environmental management – Life Cycle Assessment – Principles and framework

ISO 14044
DIN EN ISO 14044:2006-10, Environmental management – Life Cycle Assessment – Requirements and Guidelines

EN 15804
EN 15804:2012+A2:2019+AC:2021,
Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products

DIN 17441
DIN 17441:1997-02, Stainless steels -
Technical delivery conditions for cold rolled strips and slit coils strip and sheets cut from such strips for pressure purposes

EN ISO 18096
Thermal insulating products for building equipment and industrial installations -
Determination of maximum service temperature for preformed pipe insulation (ISO
18096:2022)

ECHA Candidate List of substances of very high concern for Authorisation
https://chem.echa.europa.eu/obligation-lists/candidateList
Published in accordance with Article 59(10) of the REACH Regulation

Biocidal Products Regulation (EU) No. 528/2012
Regulation (EU) No 528/2012 of the European Parliament and of the
Council of 22 May 2012 concerning the making available on the market and use of biocidal products Text with EEA relevance
https://eur-lex.europa.eu/eli/reg/2012/528/oj/eng

European Waste Catalogue
https://edm.gv.at/edm_portal/redaList.do?d-49520-s=4&ubastyle_lang=en&seqCode=ev7jv8yw2ndj9a&d-49520-p=1&d-49520-o=1&entireLsq=true

Further References

bauforumstahl
bauforumstahl: Calorific Value Table, 2023; available [online] at:
https://bauforumstahl.de/upload/documents/brandschutz/kennwerte/Hei

Bundesanstalt für Geowissenschaften und Rohstoffe
Bundesanstalt für Geowissenschaften und Rohstoffe, 2020. Kupfer - *Information zur Nachhaltigkeit;* available [online] at:https://www.deutsche-rohstoffagentur.de/DE/Gemeinsames/Produkte/Downloads/Informatione
_blob=publicationFile&v=3

Destatis
Destatis, 2025. Bruttostromerzeugung in Deutschland für 2019 bis 2024; vailable [online] at:https://www.destatis.de/DE/Themen/Branchen-Unternehmen/Energie/Erzeugung/Tabellen/bruttostromerzeugung.html

Ecoinvent
Ecoinvent. Version 3.11. Zurich, Switzerland: Ecoinvent Association, 2022 [accessed on 04.09.2025]

IBU 2022
General Instructions for the EPD programme of Institut Bauen und Umwelt e.V, version 2.0, Berlin: Institut Bauen und Umwelt e.V., 2021. http://www.ibu-epd.com.

PCR, Part A
Institut Bauen und Umwelt e.V., 2022. Product category rules for building-related products and services. Part A: Calculation rules for the life cycle assessment and requirements for the project report according to EN 15804+A2:2019, version 1.3, Berlin: Institut Bauen und Umwelt e.V., 2024

PCR, Part B
Institut Bauen und Umwelt e.V., 2023. Product category rules for building-related products and services. Part B: Requirements for the EPD for pre-insulated pipe systems for use in buildings, version 1, Berlin: Institut Bauen und Umwelt e.V., 2023

SimaPro
SimaPro, version 10.2 Amersfort, Netherlands: PRé Sustainability B.V., 2023 [accessed on 04.09.2025]

Technico Lisboa
Technico Lisboa, 2022. Life Cycle Assessment Study of Styrene-Butadiene
Rubber and Polybutadiene Rubber; available [online] at:https://scholar.tecnico.ulisboa.pt/api/records/q3ydKMmHa8d_DlkaNa

armacell®

Publisher

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

+49 (0)30 3087748- 0
info@ibu-epd.com
www.ibu-epd.com

Programme holder

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

+49 (0)30 3087748- 0
info@ibu-epd.com
www.ibu-epd.com

Author of the Life Cycle Assessment

Ressourcen Management Agentur GmbH
Kölblgasse 17/30
1030 Wien
Austria

+4318905799
office@rma.at
www.rma.at

Owner of the Declaration

Armacell International S.A.
Westside Village, rue Pafebruch 89B
8308 Capellen - GD of Luxembourg
Luxembourg

+492517603227
heribert.quante@armacell.com
www.armacell.com