ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	MAINCOR Rohrsysteme GmbH & Co. KG
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-MAI-20240494-IBC1-EN
Issue date	19.12.2024
Valid to	18.12.2029

Multilayer pipe (PERT-Al-PERT)

Maincor Rohrsysteme GmbH & Co.KG

Institut Bauen und Umwelt e.V.

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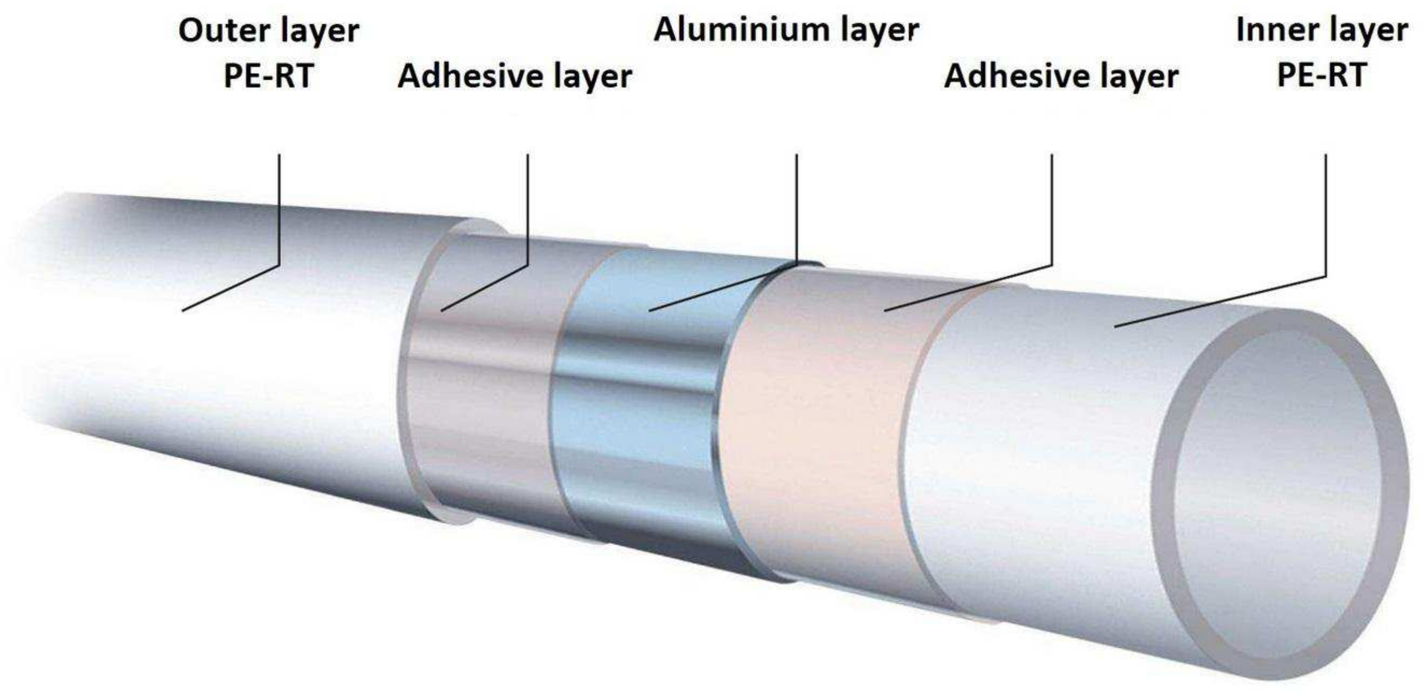
ECO PLATFORM EPD VERIFIED



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1. General Information

Maincor Rohrsysteme GmbH & Co.KG

Programme holder

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

Declaration number

EPD-MAI-20240494-IBC1-EN

This declaration is based on the product category rules:

Plastic pipe systems for hot and cold water installation in the building, 01.08.2021
(PCR checked and approved by the SVR)

Issue date

19.12.2024

Valid to

18.12.2029

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

Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

Multilayer pipe (PERT-Al-PERT)

Owner of the declaration

MAINCOR Rohrsysteme GmbH & Co. KG
Silbersteinstraße 14
97424 Schweinfurt
Germany

Declared product / declared unit

1 kg MS pipe

Scope:

he EPD applies to the MS pipe with the pipe sizes

- 16 x 2.0 mm
- 18 x 2.0 mm
- 20 x 2.0 mm
- 20 x 2.25 mm
- 25 x 2.5 mm
- 26 x 3.0 mm
- 32 x 3.0 mm
- 40 x 3.5 mm
- 40 x 4.0 mm

manufactured in the factory of MAINCOR Rohrsysteme GmbH & Co. KG in Knetzgau (Germany). This is an average EPD, based on an average, generic product variant.
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

Matthias Klingler,
(Independent verifier)

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2. Product

2.1 Product description/Product definition

The pipe covered by the study for hot and cold water installations in buildings is a five-layer aluminium-plastic multilayer pipe. The pipe can be used universally for drinking water and heating installations. The trade name is "Mehrschichtverbundrohr (MSR)". In the following, it is referred to as MS pipe. The MS pipe has an inner pipe made of polyethylene with increased temperature stability (PE-RT), a adhesive layer, an aluminium layer, a second adhesive layer and an outer layer made of PE-RT.

For the use and application of the product the respective national provisions at the place of use apply, in Germany for example the building codes of the federal states and the corresponding national specifications.

2.2 Application

The MS pipe can be used universally for drinking water and heating installations in building construction in accordance with DIN EN ISO 21003. The pipe is oxygen-tight in accordance with DIN 4726.

2.3 Technical Data

The values given in the following table apply to the MS pipe in all pipe sizes.

Technical data

Name	Value	Unit
Permissible operating pressure PN of the pipe system	10	bar
Material 1 - Outer and inner layer	PE-RT	-
Material 2 - Adhesive layer (coloured)	PE-based	-
Werkstoff 3 - Aluminium layer	Aluminium	-
Mean density of material 1 according to EN ISO 1183-1 or-2 (PE-RT)	941	kg/m^3
Mean density of material 2 according to EN ISO 1183-1 or-2 (Adhesive layer PE-based)	905	kg/m^3
Mean density of material 3 according to EN ISO 1183-1 or-2 (Aluminium)	2730	kg/m^3

Performance data of the product with respect to its characteristics in accordance with the relevant technical provision (no CE-marking).

2.4 Delivery status

The pipe is produced and supplied in the following pipe sizes:

- 14 x 2.0 mm
- 16 x 2.0 mm
- 18 x 2.0 mm
- 20 x 2.0 mm
- 20 x 2.25 mm
- 25 x 2.5 mm
- 26 x 3.0 mm
- 32 x 3.0 mm
- 40 x 3.5 mm
- 40 x 4.0 mm

The manufactured pipe is packed in bundles. The length of the pipe per bundle can be 50 m, 100 m, 200 m, 250 m, 300 m, 500 m or 600 m.

2.5 Base materials/Ancillary materials

Main product components and/or substances

Name	Value	Unit
PE-RT	67-68	wt.%
Aluminium	25-27	wt.%
Adhesive layer	4-5	wt.%
PE with fluoroelastomer	1	wt.%
Colour masterbatch	< 1	wt.%

1) The product does **not** contain substances listed in the candidate list of Substances of Very High Concern (SVHC) (date 28.26.2024) exceeding 0.1% by mass.

2) The product does **not** contain any other CMR substances of category 1A or 1B which are not on the candidate list, exceeding 0.1% by mass.

3) **No** biocidal products have been added to this construction product and it has **not** been treated with biocidal products (it is therefore **not** a treated product as defined by the (EU) Ordinance on Biocide Products No. 528/2012).

2.6 Manufacture

The MS pipe is manufactured in two production steps. First, the aluminium sheet is bent into shape and then welded into a pipe. In a second step, the adhesive layer and the PE-RT layers are extruded onto the inside and outside of the aluminium pipe. The colour masterbatch is used to colour the outer PE-RT layer in an upstream process step.

2.7 Environment and health during manufacturing

All legal regulations with regard to exhaust air, waste water and waste as well as noise emissions are complied with or undercut. The health of personnel is not jeopardised during production.

2.8 Product processing/Installation

The pipes are installed manually in buildings to create a surface heating system (floor, wall, ceiling) or a drinking water supply. The heating pipes are usually covered with mineral building materials (e.g. screed, clay, etc.). The products required for installation (insulation, fixings, etc.) are not included in this study. As slots are cut for the in-wall installation, which then have to be closed again to restore the wall, the cement consumption required for this is taken into account.

2.9 Packaging

The pipes are produced in bundles. The packaging of a bundle consists of either a plastic bag or a cardboard box. The packaged bundles are stacked on a wooden pallet. The disposable product packaging can be recycled via local recycling collections.

2.10 Condition of use

The pipes are very durable and long-lasting. There are no known special properties of the material composition for the period of use (material changes during use, environmentally relevant inherent material properties).

2.11 Environment and health during use

No negative effects on the environment and health are to be expected during use.

2.12 Reference service life

No reference service life is specified. The pipes are designed for a service life of 50 years in accordance with the DIN EN ISO 21003 standard.

2.13 Extraordinary effects

Fire
Fire performance: Building material class E (according to EN 13501-1)
Burning droplets/particles: -
Smoke density: -

Water
No consequences for the environment in the event of unforeseen exposure to water.

Mechanical destruction
No consequences for the environment in the event of unforeseen mechanical destruction.

2.14 Re-use phase

At the end of the use stage, the pipes can be thermally recovered (recovery of thermal and electrical energy) or recycled (mechanical recycling).

Thermal utilisation (scenario 1) and mechanical recycling (scenario 2) are discussed in chapter 3.2.

2.15 Disposal

At the end of its life cycle, the MS pipe can be thermally recycled. Due to the high calorific value of polyethylene, the bound energy can be used for energy recovery.

Depending on local conditions, landfilling may take place. The possibility of landfilling (scenario 3) is discussed in chapter 3.2.

The waste code is 17 02 03 for plastic construction and demolition waste and 17 04 02 for aluminium construction and demolition waste.

2.16 Further information

Further information can be found on the homepage:

https://maincor.de/en/

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is set to "1 kg pipe". This corresponds to 0.99 kg of installed pipe (see scenario information on module A5 in chapter 4).

An average product of the MS pipe was analysed. It is based on the production volume for 2023 and thus covers all product variants (listed in chapter 2.4 "Delivery status"). The mass reference differs depending on the pipe size.

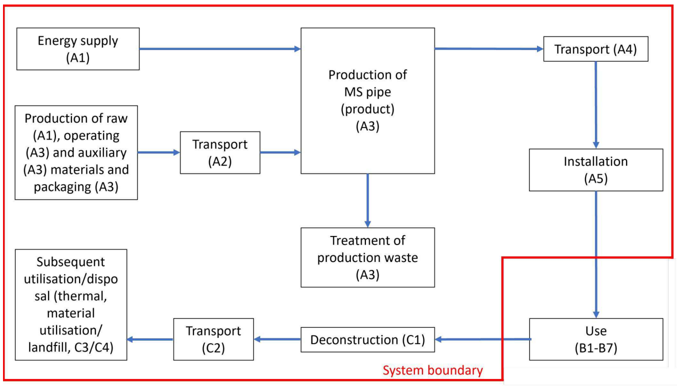
Declared unit

Name	Value	Unit
Declared unit	1	kg
Mass reference (14 x 2.0 mm)	0.087	kg/rm
Mass reference (16 x 2.0 mm)	0.103	kg/rm
Mass reference (18 x 2.0 mm)	0.122	kg/rm
Mass reference (20 x 2.0 mm)	0.139	kg/rm
Mass reference (20 x 2.25 mm)	0.148	kg/rm
Mass reference (25 x 2.5 mm)	0.225	kg/rm
Mass reference (26 x 3.0 mm)	0.250	kg/rm
Mass reference (32 x 3.0 mm)	0.320	kg/rm
Mass reference (40 x 3.5 mm)	0.429	kg/rm
Mass reference (40 x 4.0 mm)	0.492	kg/rm

3.2 System boundary

Consideration of the entire product life cycle without taking the utilisation phase into account - see illustration.
Type of EPD: cradle to gate with options (modules A4, A5, C1-C4 and D).

The following flow chart shows the system boundaries when balancing the MS pipe.



The following is a detailed list of the life cycle stages and process modules taken into account in the manufacture of the pipe:

<u>A1 - A3 Production stage:</u>

- External production of raw, auxiliary and operating materials incl. transport to the plant
- External production of the packaging materials of the raw materials incl. transport for recycling with subsequent recycling
- Return transport of the reusable packaging of the raw materials
- External production of packaging materials for the end product
- Energy supply for production
- Production of the pipes by extrusion
- External processing or thermal utilisation of production waste incl. transport

<u>A4 and A5 Construction process stage:</u>

- Transport of the pipe to the construction site
- Transport of the pipe packaging for recycling with subsequent recycling
- Provision of energy for the installation
- Cement for the case of in-wall installation
- Transport and recycling of installation waste
- Flushing of the installed pipe with tap water

<u>C1 - C4 End of life stage:</u>
Three 100% End of Life scenarios are assumed:

- EoL scenario 1 (thermal utilisation): Dismantling of the pipe incl. transport to the recycling site with energy recovery (module C1, C2, C3, C4 and D).
- EoL scenario 2 (recycling): Dismantling of the pipe incl. transport to the recycling site with mechanical recycling, i.e. washing, drying, shredding and grinding (module C1, C2/1, C3/1, C4/1 and D/1).
- EoL scenario 3 (landfill): Dismantling of the pipe incl. transport to the disposal site. Disposal takes place at a local landfill (module C1, C2/2, C3/2, C4/2 and D/2).

D Reuse, recovery and/or recycling potentials:
Reuse, recovery and/or recycling potentials are present in the EoL scenarios, as here the pipes are sent for energy or material recovery, from which energy or secondary materials are recovered that can be used outside the system boundary. Energy recovered from the incineration of packaging waste in Module A5 is not taken into account. In EoL scenarios 1 and 2, there are effects from the recovery of energy from the incineration of waste. In EoL scenario 2, benefits from the subsequent utilisation of secondary material are taken into account.

3.3 Estimates and assumptions

The primary data on the composition of the pipe as well as on energy utilisation and the transport routes and packaging of the raw materials come from MAINCOR Rohrsysteme GmbH & Co. KG.

The environmental impacts were calculated for processes outside Module A3, taking into account the residual electricity mix. The electricity demand at the MAINCOR plant is covered by green electricity. Green electricity accounts for 100% of the total electricity demand at the MAINCOR plant.

3.4 Cut-off criteria

In this EPD, all known inputs and outputs were included in the assessment. Due to their very low relevance, single processes and materials for which no data was available were not included:

- Internal transport within the plant
- Packaging in which the packaging material is delivered
- Production of reusable packaging
- Production of lubricant

They each account for less than 1% of the environmental impact of the overall analysis.

3.5 Background data

Only background data from Sphera's LCA Content database (version 2024.1, formerly Gabi database) was used for the LCA. The modelling was carried out using the LCA for Experts software by Sphera (version 10.8.0.14, formerly GaBi)

3.6 Data quality

The specific foreground data for the production of the MS pipe comes from MAINCOR Rohrsysteme GmbH & Co. KG. The geographical, technical and temporal representativeness is rated as "good" to "very good". Overall, more than 80 % of the specific data is rated as "good" to "very good".

The background data from the Managed LCA Content database, which together make up at least 80 % of the core indicators of the impact assessment, have a good average representativeness (geographical, technical, temporal).

3.7 Period under review

The specific data on the production of MS pipes was collected for the production year 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: Global

3.9 Allocation

No co-products are produced during the manufacturing (module A1-A3) of the MS pipes. Therefore, no co-product allocation was necessary for foreground processes.

Material and energy data were available separately for each product. A differentiation from other products manufactured in the plant was therefore already given by the data collection and consequently no allocation was necessary.

Recycling and/or thermal utilisation of packaging materials, production and assembly waste (modules A1-A3 and A5): All process steps are considered until the waste loses its waste status. No benefits are recognised for the energy and material recovered during the energy and material recovery of packaging materials, production and construction waste; instead, the energy provided and the processed material are deducted.

Benefits and burdens from the recycling and/or energy recovery of the dismantled product (Module C3/1 and C3/2): All process steps are considered until the waste loses its waste status.
In the case of energy recovery from the deconstructed pipe in Module C3/1, recovered energy (thermal and electrical energy) is taken into account as a benefit in Module D/1.

If the deconstructed pipe is recycled, a PE and aluminium regrind with an economic value is obtained through processing in module C3/2 (end of waste status). The PE regrind must be regranulated before reuse, so that regranulation using an extruder (point of substitution of virgin material) is taken into account in Module D/2. The loss of quality due to recycling compared to virgin PE is modelled by a substitution factor of 0.5. The substitutable virgin PE material is taken into account as an advantage in module D/2, taking the substitution factor into account.
The waste produced during regranulation is channelled into energy recovery in Module D/2. The energy recovered from the energy recovery of the waste (thermal and electrical energy) is taken into account as a benefit in Module D/2.

The aluminium regrind must be melted into a casting ingot before being reused, so that this processing step (point of substitution of virgin material) is taken into account in Module D/2. The loss of quality due to recycling compared to virgin aluminium is represented by a substitution factor of 0.7. The substitutable aluminium virgin material is taken into account as an advantage in module D/2, taking the substitution factor into account.

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. Background database: Managed LCA Content by Sphera
(Version 2024.1, formerly GaBi database)

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

The biogenic carbon content quantifies the amount of biogenic carbon in a building product that leaves the factory gate, The table below shows the amount of biogenic carbon contained in 1 kg of pipe and the associated packaging (packaging weight: 0.06 kg).

Information on the description of the biogenic carbon content at the gate

Name	Value	Unit
Biogenic carbon content in product	0	kg C / kg pipe
Biogenic carbon content in accompanying packaging	0.42	kg C / kg packaging

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

The following technical information is the basis for the declared modules or can be used for the development of specific scenarios in the context of a building assessment if modules are not declared (MND).

Transport to the construction site (A4)

Name	Value	Unit
Truck transport to the dealer (32 tonnes	823	km
Transport to the construction site with transporter (7.5 tonnes)	30	km

Installation in the building (A5)

Name	Value	Unit
Water consumption	0.018	m^3
Electricity consumption	0.062	kWh
Material loss	0.01	kg

End of Life (C1-C4)

Name	Value	Unit
Scenario 1: 100 % energy recovery	0.99	kg
Scenario 2: 100 % recycling	0.99	kg
Scenario 3: 100 % landfill	0.99	kg

Reuse, recovery and recycling potential (D), relevant scenario information

The advantages and burdens of subsequent utilisation are shown in the following table. Please refer to section 3.9 forfurther information.

Name	Value	Unit
Scenario 1: Advantages		
Electrical energy (9.90E-01 kg of deconstructed pipe is thermally utilised)	4.79E+00	MJ
Thermal energy (9.90E-01 kg of deconstructed pipe is thermally utilised)	8.56E+00	MJ
Scenario 2: Advantages		
PE granulate (6.58E-01 kg with substitution factor of 0.5)	3.29E-01	kg
Cast aluminium ingot (1.24E-01 kg with substitution factor 0.7)	8.71E-02	kg
Electrical energy (4.95E-02 kg scrap from processing of recycled pipe is thermally utilised)	2.39E-01	MJ
Thermal energy (4.95E-02 kg scrap from processing of recycled pipe is thermally utilised)	4.28E-01	MJ
Electrical energy (3.50E-02 kg scrap from regranulation is thermally utilised)	2.31E-01	MJ
Thermal energy (3.50E-02 kg scrap from regranulation is thermally utilised)	4.11E-01	MJ
Scenario 2: Burdens		
Regranulation of PE regrind	6.93E-01	kg
Melting aluminium regrind into cast ingots	1.27E-01	kg
Thermal utilisation (waste from regranulation)	3.50E-02	kg
Scenario 3: Advantages and burdens		
none		

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5. LCA: Results

The results of the life cycle assessment and the impact assessment for the MS pipe analysed are listed in detail below.

EoL scenario 1 (100% energy recovery) comprises modules C1, C2, C3, C4 and D

EoL scenario 2 (100% material recycling) comprises modules C1, C2/1, C3/1, C4/1 and D/1.

EoL scenario 3 (100% landfilling) comprises modules C1, C2/2, C3/2, C4/2 and D/2.

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 kg MS-Rohr

Parameter	Unit	A1-A3	A4	A5	C1	C2	C2/1	C2/2	C3	C3/1	C3/2	C4	C4/1	C4/2	D	D/1	D/2
GWP-total	kg CO_2 eq	3.11E+00	8.64E-02	2.14E-01	4.04E-02	7.11E-03	2.01E-02	7.11E-03	2.3E+00	2.11E-01	0	0	0	2.54E-02	-9.83E-01	-1.26E+00	0
GWP-fossil	kg CO_2 eq	3.19E+00	8.5E-02	1.33E-01	4.04E-02	6.99E-03	1.98E-02	6.99E-03	2.3E+00	2.11E-01	0	0	0	2.53E-02	-9.79E-01	-1.25E+00	0
GWP-biogenic	kg CO_2 eq	-8.19E-02	0	8.19E-02	9.8E-06	0	0	0	5.86E-05	2.82E-05	0	0	0	0	-4.22E-03	-4.5E-03	0
GWP-luluc	kg CO_2 eq	1.89E-03	1.41E-03	4.23E-05	4.14E-06	1.14E-04	3.24E-04	1.14E-04	6.26E-05	2.04E-05	0	0	0	1.02E-04	-8.87E-05	-2.03E-04	0
ODP	kg CFC11 eq	6.93E-12	1.24E-14	1.33E-13	2.29E-15	1E-15	2.84E-15	1E-15	2.64E-13	1.55E-14	0	0	0	8.12E-14	-8.66E-12	-1.93E-12	0
AP	mol H^+ eq	1.03E-02	1.87E-04	1.93E-04	5.42E-05	1.07E-05	3.03E-05	1.07E-05	2.69E-04	1.43E-04	0	0	0	1.56E-04	-1.02E-03	-5.08E-03	0
EP-freshwater	kg P eq	3.43E-06	3.59E-07	1.14E-05	1.07E-08	2.91E-08	8.23E-08	2.91E-08	1.19E-07	4.96E-08	0	0	0	1.23E-05	-1.62E-06	-1.02E-06	0
EP-marine	kg N eq	2.26E-03	7.93E-05	1.07E-04	1.47E-05	4.1E-06	1.16E-05	4.1E-06	6.81E-05	3.87E-05	0	0	0	3.47E-05	-3.13E-04	-1.16E-03	0
EP-terrestrial	mol N eq	2.45E-02	9.08E-04	7.31E-04	1.6E-04	4.81E-05	1.36E-04	4.81E-05	1.29E-03	4.46E-04	0	0	0	3.82E-04	-3.36E-03	-1.26E-02	0
POCP	kg NMVOC eq	7.78E-03	1.81E-04	1.79E-04	4.17E-05	1.06E-05	3.01E-05	1.06E-05	1.96E-04	1.1E-04	0	0	0	1.1E-04	-8.86E-04	-4.09E-03	0
ADPE	kg Sb eq	2.59E-06	7.33E-09	1.86E-09	5.03E-10	5.93E-10	1.68E-09	5.93E-10	2.82E-09	1.35E-09	0	0	0	1.68E-09	-8.44E-08	-9.24E-08	0
ADPF	MJ	7.55E+01	1.11E+00	8.46E-01	5.64E-01	8.97E-02	2.54E-01	8.97E-02	4.29E-01	1.36E+00	0	0	0	4.14E-01	-1.74E+01	-3.22E+01	0
WDP	m^3 world eq deprived	6.37E-01	1.3E-03	2.07E-02	3.21E-03	1.05E-04	2.99E-04	1.05E-04	2.41E-01	8.35E-02	0	0	0	3.22E-03	-1.05E-01	-4.11E-01	0

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 kg MS-Rohr

Parameter	Unit	A1-A3	A4	A5	C1	C2	C2/1	C2/2	C3	C3/1	C3/2	C4	C4/1	C4/2	D	D/1	D/2
PERE	MJ	1.66E+01	9.55E-02	9.42E-01	2.63E-02	7.72E-03	2.19E-02	7.72E-03	1.49E-01	6.88E-02	0	0	0	6.37E-02	-5.79E+00	-5.96E+00	0
PERM	MJ	8.31E-01	0	-8.31E-01	0	0	0	0	0	0	0	0	0	0	0	0	0
PERT	MJ	1.75E+01	9.55E-02	1.11E-01	2.63E-02	7.72E-03	2.19E-02	7.72E-03	1.49E-01	6.88E-02	0	0	0	6.37E-02	-5.79E+00	-5.96E+00	0
PENRE	MJ	7.56E+01	1.11E+00	1.22E+00	5.64E-01	8.97E-02	2.54E-01	8.97E-02	3.18E+01	2.93E+00	0	0	0	4.14E-01	-1.74E+01	-3.22E+01	0
PENRM	MJ	3.17E+01	0	-3.75E-01	0	0	0	0	-3.14E+01	-3.14E+01	0	0	0	0	0	0	0
PENRT	MJ	1.07E+02	1.11E+00	8.46E-01	5.64E-01	8.97E-02	2.54E-01	8.97E-02	4.29E-01	-2.85E+01	0	0	0	4.14E-01	-1.74E+01	-3.22E+01	0

SM	kg	1.38E-01	0	0	0	0	0	0	0	0	0	0	0	0	0	8.2E-01	0
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FW	m^3	3.1E-02	1.06E-04	5.16E-04	7.86E-05	8.61E-06	2.44E-05	8.61E-06	5.66E-03	1.96E-03	0	0	0	9.64E-05	-4.43E-03	-1.41E-02	0

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 kg MS-Rohr

Parameter	Unit	A1-A3	A4	A5	C1	C2	C2/1	C2/2	C3	C3/1	C3/2	C4	C4/1	C4/2	D	D/1	D/2
HWD	kg	1.27E-08	4.24E-11	2.36E-10	6.43E-11	3.43E-12	9.72E-12	3.43E-12	3.19E-10	1.65E-10	0	0	0	1.02E-10	-1.17E-08	-3.32E-09	0
NHWD	kg	7.1E-01	1.81E-04	1.96E-02	1.55E-04	1.46E-05	4.15E-05	1.46E-05	4.53E-02	7.11E-03	0	0	0	9.87E-01	-9.06E-03	-3.38E-01	0
RWD	kg	1.2E-03	2.02E-06	6.25E-05	4.59E-05	1.63E-07	4.63E-07	1.63E-07	2.13E-05	1.09E-04	0	0	0	5.65E-06	-1.28E-03	-5.77E-04	0
CRU	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MFR	kg	9.51E-02	0	0	0	0	0	0	0	9.4E-01	0	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEE	MJ	6.24E-02	0	1.72E-01	0	0	0	0	4.79E+00	2.39E-01	0	0	0	0	0	0	0
EET	MJ	1.43E-01	0	3.4E-01	0	0	0	0	8.56E+00	4.28E-01	0	0	0	0	0	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 kg MS-Rohr

Parameter	Unit	A1-A3	A4	A5	C1	C2	C2/1	C2/2	C3	C3/1	C3/2	C4	C4/1	C4/2	D	D/1	D/2
PM	Disease incidence	1.78E-07	1.52E-09	1.81E-09	5.03E-10	1.13E-10	3.19E-10	1.13E-10	3E-09	1.32E-09	0	0	0	1.68E-09	-8.37E-09	-8.3E-08	0
IR	kBq U235 eq	1.27E-01	2.93E-04	6.84E-03	4.22E-03	2.37E-05	6.71E-05	2.37E-05	3.08E-03	1.01E-02	0	0	0	7.63E-04	-2.1E-01	-7.15E-02	0
ETP-fw	CTUe	3.32E+01	8.23E-01	5.9E-01	7.9E-02	6.66E-02	1.88E-01	6.66E-02	1.91E-01	2.02E-01	0	0	0	8.24E-01	-2.45E+00	-1.54E+01	0
HTP-c	CTUh	2.71E-09	1.66E-11	6.17E-11	3.17E-12	1.34E-12	3.81E-12	1.34E-12	1.78E-11	8.54E-12	0	0	0	1.23E-11	-1.99E-10	-1.26E-09	0
HTP-nc	CTUh	4.01E-08	7.46E-10	5.78E-09	1.22E-10	6.03E-11	1.71E-10	6.03E-11	2.06E-10	3.11E-10	0	0	0	2.71E-10	-4.69E-09	-1.57E-08	0
SQP	SQP	2.51E+01	5.45E-01	1.17E-01	4.82E-02	4.41E-02	1.25E-01	4.41E-02	1.69E-01	1.24E-01	0	0	0	7.57E-02	-3.4E+00	-8.36E-01	0

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

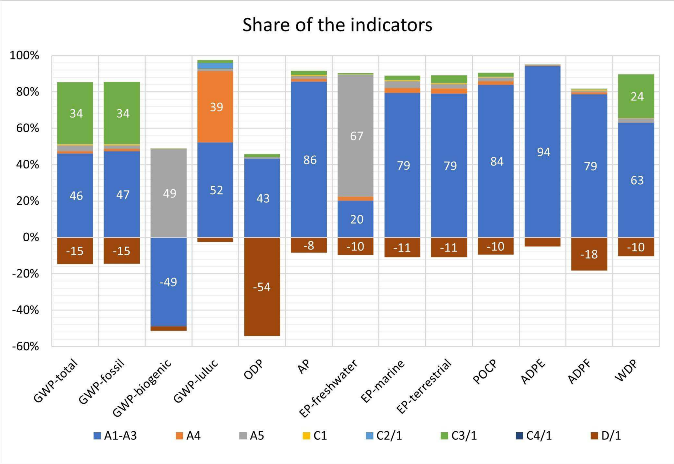
Disclaimer 1 – for the indicator "Potential Human exposure efficiency relative to U235". This impact category deals mainly with the eventual impact of low-dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure 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.

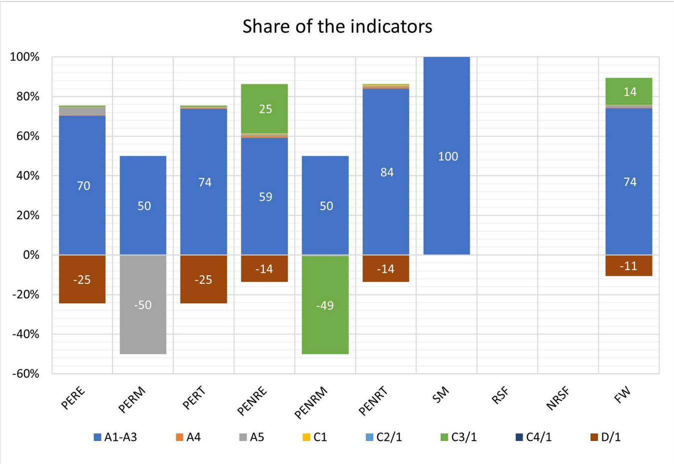
Disclaimer 2 – for the indicators "abiotic depletion potential for non-fossil resources", "abiotic depletion potential for fossil resources", "water (user) deprivation potential, deprivation-weighted water consumption", "potential comparative toxic unit for ecosystems", "potential comparative toxic unit for humans – cancerogenic", "Potential comparative toxic unit for humans - not cancerogenic", "potential soil quality index". 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.

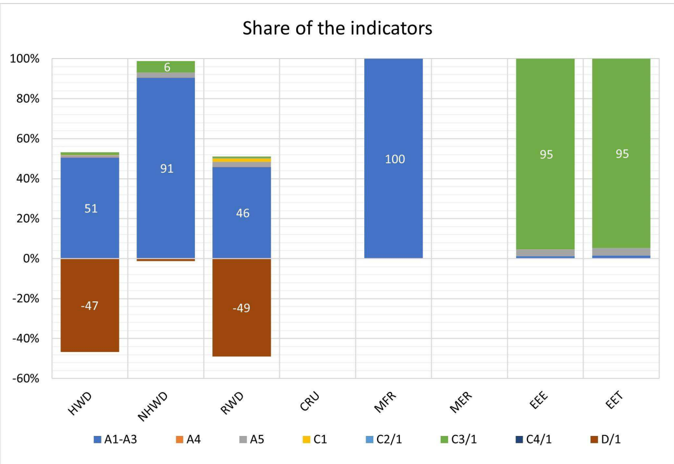
6. LCA: Interpretation

In the following section, the LCA results for scenario 1 (100 % energy recovery) are presented and interpreted graphically. The figures show the percentage shares of the modules in the indicators.

Scenario 1 - 100 % energy recovery:
The majority of the indicators on environmental impacts and resource consumption are dominated by the production phase (modules A1-A3) in scenario 1. In addition, waste treatment (module C3) also has a significant share of the indicators. Furthermore, the impacts within the system boundaries can be partially compensated by utilisation potentials outside the system boundaries (Module D). Within Modules A1-A3, the production of aluminium and polyethylene dominates the indicators. The thermal utilisation of the pipe is decisive for the environmental impacts in module C3. The advantages in module D result from the substitution of electrical and thermal energy.



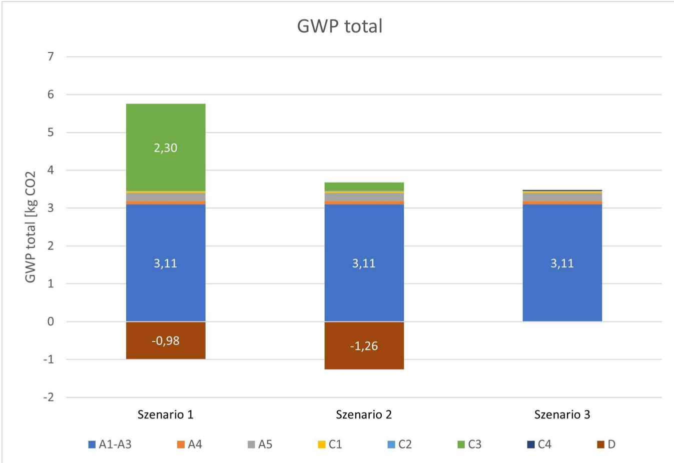




Scenario 2 - 100 % mechanical recycling:
The influence of module C3 on the indicators decreases. The advantages from Module D become slightly greater, as secondary materials from mechanical recycling can be accessed outside the system boundaries.

Scenario 3 - 100 % landfilling:
The influence of module C3 decreases completely. Instead, disposal (module C4) plays a limited role.

The following figure shows the LCA results for the "GWP total" (global warming potential) indicator. The illustration shows the absolute values (kg CO2-eq.).



In scenario 1 (100 % energy recovery), "GWP total" is dominated by the production phase (modules A1-A3) and waste treatment (module C3). The impacts within the system boundaries can be partially compensated by recovery potentials outside the system boundaries (Module D).

In Scenario 2 (100 % mechanical recycling), the influence of Module C3 on "GWP total" decreases. The benefits from Module D increase. The production phase is dominant.

In scenario 3 (100 % landfill), the influence of module C3 decreases completely. Instead, the disposal phase (Module C4) plays a limited role. The production phase is dominant.

The sensitivity analysis regarding the influence of the pipe size on the LCA results was carried out for modules A1-A3. The smallest dimension of 14 x 2.0 mm and the largest dimension of 40 x 4.0 mm were compared with the balanced average product, in each case in relation to the declared unit of 1 kg of pipe. With the exception of the potential for abiotic depletion of non-fossil resources (ADPE), the deviations for all indicators do not exceed 5 %. For the ADPE indicator, the maximum deviation from the declared product is 73%. In order to take this deviation into account and in the sense of a worst-case consideration, the value for the ADPE indicator of the MS pipe with the largest dimension is used for the EPD.
The results for the average product, with the correction of the ADPE indicator described above, can therefore be applied to all MS pipe sizes produced by MAINCOR.

7. Requisite evidence

The MS pipe fulfils the requirements of the EN ISO 21003 standard and corresponding certificates are available from MAINCOR on request.

8. References

Normen

EN 15804
EN 15804:2012+A2:2019+AC:2021, Nachhaltigkeit von Bauwerken – Umweltproduktdeklarationen – Grundregeln für die Produktkategorie Bauprodukte.

ISO 14025
EN ISO 14025:2011, Umweltkennzeichnungen und -deklarationen – Typ III Umweltdeklarationen – Grundsätze und Verfahren.

EN ISO 21003
Mehrschichtverbund-Rohrleitungssysteme für die Warm- und Kaltwasserinstallation innerhalb von Gebäuden - Teil 2: Rohre

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PCR Teil A
Institut Bauen und Umwelt e.V.: Produktkategorieregeln für gebäudebezogene Produkte und Dienstleistungen. Teil A: Rechenregeln für die Ökobilanz und Anforderungen an den Projektbericht nach EN15804+A2:2019, Version 1.4, 2024

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Institut Bauen und Umwelt e.V.: Requirements on the EPD for Plastic pipe systems for hot and cold water installation in the building, Version 7, 2024

Titel der Software/Datenbank

Datenbank
Managed LCA Content (ehemals GaBiDatenbank),Version 2024.1. Chicago (USA): Sphera Solutions, Inc. (Zugriff zuletzt 04.07.2024).

Software
LCA for Experts (ehemals GaBi), Version 10.8.0.14. Chicago (USA): Sphera Solutions, Inc. (Zugriff zuletzt 04.07.2024).

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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

SKZ - Das Kunststoff-Zentrum
Friedrich-Bergius-Ring 22
97076 Würzburg
Germany

+49 931 4104-433
kfe@skz.de
www.skz.de

Owner of the Declaration

MAINCOR Rohrsysteme GmbH & Co. KG
Silbersteinstraße 14
97424 Schweinfurt
Germany

+49 9721 65977 100
info@maincor.de
https://maincor.de/