European Communication Format – B2B

Environmental Product Declaration

POLYETHYLENE (PE) PIPE SYSTEM FOR WATER DISTRIBUTION

teppfa

CONTENTS

1. DECLARATION OF GENERAL INFORMATION

Introduction

The European Plastics Pipes and Fittings Association (TEPPFA) deems it important to have an insight into the integral environmental impacts that are encountered during the lifespan of particular pipe system applications.

With this framework in mind, in 2010 TEPPFA has set up an LCA/EPD project with the Flemish Institute for Technological Research (VITO) which resulted in an EPD. The present EPD is the update of the EPD issued in 2011 – foreground data remained the same, with only the datasets being updated to the latest available version (Ecoinvent 3.3 replaced Ecoinvent 2 datasets).

It outlines the various environmental aspects, which accompany the polyethylene (PE) pipe system for water distribution, from the primary extraction of raw materials up to and including the end of life (EoL) treatment after its reference service lifetime.

Name and address of manufacturers

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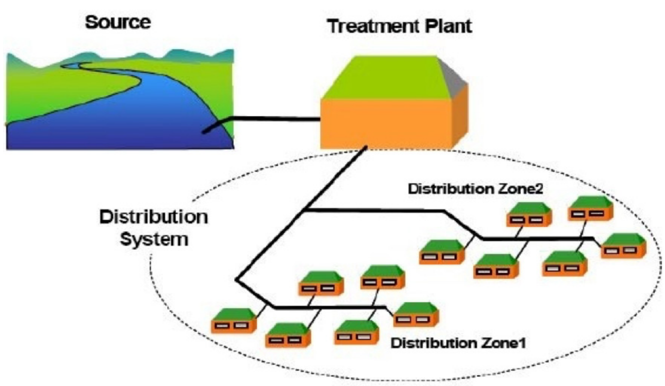
PE pipe system's use and functional unit

The EPD refers to a typical European Polyethylene (PE) pipe system for water distribution, from the cradle to the grave, raw material extraction, transportation to converters, converting process, transport to trench, construction, use and end of life. Environmental indicators are expressed for the complete life cycle, from the cradle to the grave, so for an average European PE pipe system. .

The functional unit is defined as "the below ground transportation of drinking water, over a distance of 100 m (from the exit of the water plant to the water meter of the building), by a typical public European PE water distribution pipe system (Ø 110 mm) over its complete life cycle of 100 years, calculated per year".

Product name & graphic display of product

PE pipe system for water distribution



Description of the PE pipe system's components

The environmental burdens are calculated in relation to the functional unit, which resulted for the typical European PE pipe system for water distribution in the following basic pipe system components: PE pipes; PE fittings; bolts, rings, washers, nuts (made out of galvanized steel); cutter of stainless steel and EPDM gaskets.

The PE pipe material consists of black polyethylene MRS 10 MPa (PE 100) with blue stripes. The pipe has a diameter of 110 mm (as a representative for the average pipe diameter from the exit of the water plant to the water meter of the building). Standard dimension ratio: SDR 17 with wall thickness of 6,6 mm. The 110 mm pipe has been calculated as average weight per metre from actual sales across a market in sizes 20 mm to 1000 mm. The service lifetime of 100 years is taken from: Ulrich Schulte and Joachim Hessel, 2006. 2 types of jointing have been taken into account: electro fusion, and butt welding. The popularity of fittings in "average" pipe of functional unit has been calculated from actual sales data. The weight of fittings was calculated from an actual water supply contract. Flow capacity of a 110 mm SDR 17, PE100 pipe of average roughness at 1,5 m per second (EN 805 advises that "in practice it will be desirable to avoid unduly high or low velocities. The range 0,5 m/s to 2,0 m/s may be considered appropriate).

The EPD is declared as the average environmental performance for a typical European PE pipe system, over its reference service life cycle of 100 years, calculated per year, in accordance to EN 12201-1, EN 12201-2, EN 12201-3, EN 12201-4, EN 805, EN 1295-1 and EN 1610.

Applicable Product Category Rules and programme operator

The EPD developed in 2011 was complying with the EN 15804 norm as it was available at that time. In the meanwhile the EN 15804:2012 +A1:2013 norm was updated. The aspects that differ in the two versions of the EN15804 mentioned above, and that have an impact on the EPD for PE piping system are:

- The reporting of the environmental impacts is more detailed in the EN 15804 version from 2012, where the impacts are reported per each lifecycle stage (A1, A2… to C4 and module D), while in the version valid in 2011 the reporting was done on stages (Product stage, Construction stage, Use stage and End of life stage)
- The method has been better defined with the elementary flows for each impact category updated in the latest version.
- The environmental parameters describing resource input to be reported has changed.

Considering that TEPPFA is using these EPDs for B2B communication, with knowledge already established in the use of EPDs both for TEPPFA members and its clients, TEPPFA is for the moment interested to keep the existing format of the EPD for countinuity of information reasons.

For the calculation of the environmental impacts the method used will be CML IA baseline v.3.03, the latest version provided in SimaPro. Also the environmental parameters reported are in line with the new EN 15804:2012+A1:2013 norm. This ensures that the reported results are in line with the up to date methodological requirements.

This EPD is not registered in any specific EPD programme.

Date of declaration and validity

January, 2018
The EPD has a 5 year validity period (January, 2023)

Comparability

Please note that EPDs of construction products may not be comparable if they do not comply with the CEN TC 350 (EN15804 and EN15942) standards.

Typical European PE pipe system EPD

The present EPD outlines various environmental aspects, which accompany a typical European PE pipe system for water distribution, from the primary extraction of raw materials up to and including the end of life (EoL) treatment after its reference service lifetime of 100 years.

Group of manufacturers

The EPD for the PE pipe system is representative for an anticipated European typical PE pipe system for water distribution. The TEPPFA member companies represent more than 50% of the European market for extruded plastic pipes. For an overview of all members and national associations within TEPPFA we refer to pages 13-15 of this EPD.

Content of the product system

The product system does not contain materials or substances that can adversely affect human health and the environment in any stages of the life cycle.

Retrieve information

Explanatory material may be obtained by contacting TEPPFA **(http://www.teppfa.eu)**

2. DECLARATION OF THE MATERIAL CONTENT

The European Polyethylene (PE) pipe system for water distribution does not contain any substances as such or in concentration exceeding legal limits, which can adversely affect human health and the environment in any stages of its entire life cycle.

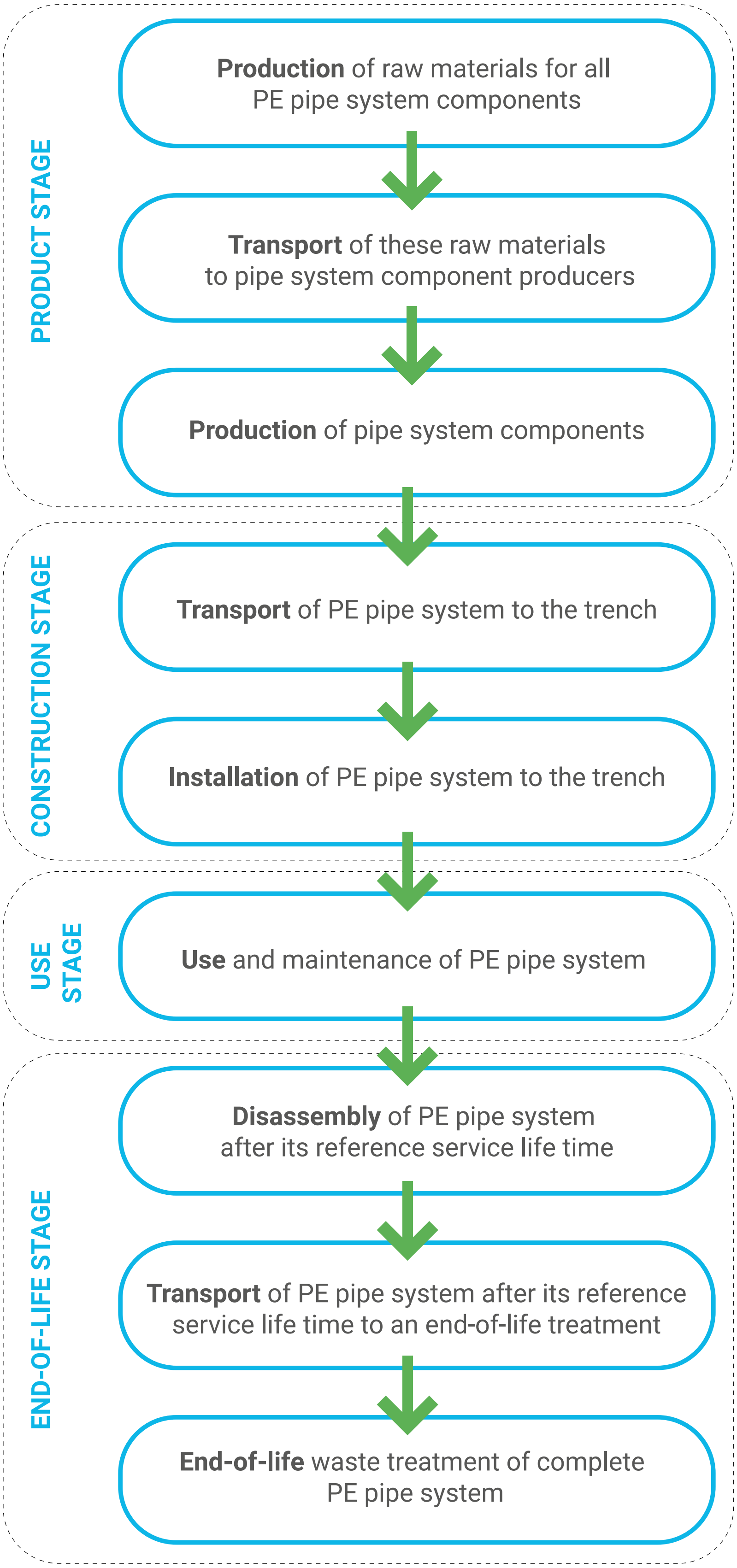
3. DECLARATION OF THE ENVIRONMENTAL PARAMETERS DERIVED FROM LCA

3.1 Life cycle flow diagram

The EPD refers to a typical European PE pipe system for water distribution, from the cradle to the grave, including product stage, transport to construction site and construction process stage, use stage and end of life stage.

- **Product stage:** raw material extraction and processing, recycling processes for recycled material input, transport to the manufacturer, manufacturing (including all energy provisions, waste management processes during the product stage up to waste for final disposal):
  - Production of raw materials for PE pipes, incl. additives
  - Transport of PE pipe raw materials to converter;
  - Converting process for PE pipes (extrusion), including packing of the pipes
  - Production of raw materials for PE fittings
  - Transport of PE fittings raw materials to converter
  - Converting process for PE fittings (injection moulding), including packing of the fittings
  - Production of galvanised steel components (raw materials + converting process)
  - Production of EPDM gaskets (raw materials + converting process)

- **Construction process stage:** including all energy provisions, waste management processes during the construction stage up to waste for final disposal
  - Transport of PE pipe system to the trench
  - Installation of PE pipe system in the trench
- **Use stage (maintenance and operational use):** including transport and all energy provisions, waste management processes up to waste for final disposal during this use stage
  - Operational use is not relevant for the PE pipe system for water distibution
  - Maintenance of the PE pipe system for water distribution during 100 years of reference service lifetime in the trench is not relevant
- **End of life stage:** including all energy provisions during the end of life stage
  - Disassembly of PE pipe system for water distribution after 100 years of reference service lifetime at the trench
  - Transport of PE pipe system after 100 years of reference service lifetime at the trench to an end-of-life treatment
  - End-of-life treatment of PE pipe system for water distribution


PRODUCT STAGE
Production of raw materials for all PE pipe system components
Transport of these raw materials to pipe system component producers
Production of pipe system components
CONSTRUCTION STAGE
Transport of PE pipe system to the trench
Installation of PE pipe system to the trench
USE STAGE
Use and maintenance of PE pipe system
END-OF-LIFE STAGE
Disassembly of PE pipe system after its reference service life time
Transport of PE pipe system after its reference service life time to an end-of-life treatment
End-of-life waste treatment of complete PE pipe system

3.2 Parameters describing environmental impacts

The following environmental parameters are expressed with the impact category parameters of the life cycle impact assessment (LCIA).

Impact category	Abiotic depletion	Abiotic depletion (fossil fuels)	Acidification	Eutrophication	Global warming	Ozone layer depletion	Photochemical oxidation
	kg Sb eq	MJ	kg SO2 eq	kg PO4--- eq	kg CO2 eq	kg CFC-11 eq	kg C2H4 eq
Product stage	4,33E-06	1,98E+02	1,72E-02	3,72E-03	5,78E+00	3,32E-07	2,00E-03
Construction process stage	4,09E-06	3,75E+01	1,60E-02	3,33E-03	2,45E+00	4,73E-07	4,95E-04
Use stage	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
End of life stage	4,00E-08	-2,50E-01	-8,05E-05	1,46E-05	1,49E-01	-7,75E-10	-7,38E-06
TOTAL	**8,45E-06**	**2,36E+02**	**3,31E-02**	**7,07E-03**	**8,38E+00**	**8,03E-07**	**2,48E-03**

3.3 Parameters describing resource input

The following environmental parameters apply data based on the life cycle inventory (LCI).

Environmental parameter	Use of renewable primary energy excluding renewable primary energy resources used as raw materials	Use of renewable primary energy resources used as raw materials	Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	Use of non renewable primary energy resources used as raw materials	Total use of non renewable primary energy resources (primary energy and primary energy resources used as raw materials)	Use of secondary material	Use of renewable secondary fuels	Use of non renewable secondary fuels	Net use of fresh water
	MJ, net calorific value	MJ, net calorific value	MJ, net calorific value	MJ, net calorific value	MJ, net calorific value	MJ, net calorific value	kg	MJ, net calorific value	MJ, net calorific value	m3
Product stage	na	na	5,17E+00	na	na	2,04E+02	na	na	na	1,10E-01
Construction process stage	na	na	1,52E+00	na	na	4,07E+01	na	na	na	3,39E-01
Use stage	na	na	na	na	na	na	na	na	na	na
End of life stage	na	na	-1,87E-01	na	na	-1,02E+00	na	na	na	-8,68E-04
TOTAL	**na**	**na**	**-6,50E+00**	**na**	**na**	**2,44E+02**	**na**	**na**	**na**	**4,48E-01**

3.4 Parameters describing different waste categories and further output material flows

The parameters describing waste categories and other material flows are output flows derived from the life cycle inventory (LCI):

Parameters describing different waste categories

Environmental parameter	Hazardous waste	Non-hazardous waste	Nuclear waste
	kg	kg	kg
Product stage	2,23E-02	2,51E-01	1,72E-04
Construction stage	2,34E-05	7,71E-01	3,15E-04
Use stage	0,00E+00	0,00E+00	0,00E+00
End of life stage	-1,14E-06	2,52E+00	-4,94E-06
TOTAL	**2,23E-02**	**3,54E+00**	**4,83E-04**

Parameters describing further output material flows

Parameter	Parameter unit expressed per functional unit
Components for re-use	2,214 kg
Materials for recycling	0,264 kg
Materials for energy recovery	0,065 kg

4. SCENARIOS AND TECHNICAL INFORMATION

4.1 Construction process stage

Transport from the production gate to the construction site (trench)

Parameter	Parameter unit expressed per functional unit
Fuel type consumption of vehicle or vehicle type used for transport e.g. long distance truck, boat etc.	The PE pipe system is transported over an average distance of 460 km by means of a truck from the producers of the different pipe system components to the trench. The average loading capacity is 13% with an average actual load of 7 tons. The loading factor for PE pipes is limited by volume. Environmental burdens associated with this kind of transport are calculated by means of the Ecoinvent V3.3 datarecord “Transport, freight, lorry 16-32 metric ton, EURO4 {RER}| transport, freight, lorry 16-32 metric ton, EURO4 | Alloc Rec, U”.
Capacity utilisation (including empty returns)	
Bulk density	
Volume capacity utilisation factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaged products)	

Construction (installation at trench)

<table>
<tr><th>Parameter</th><th>Parameter unit expressed per functional unit</th></tr>
<tr><td>Ancillary materials for installation</td><td>0,1392 m^3 of backfilling sand trucked to trench over an average distance of 10 km. Environmental burdens associated with this kind of energy are calculated by means of the Ecoinvent V3.3 datarecord “Sand {CH}| gravel and quarry operation | Alloc Rec, U + Transport, freight, lorry >32 metric ton, EURO4 {RER}| transport, freight, lorry >32 metric ton, EURO4 | Alloc Rec, U”
Building hall is excluded from the background dataset for sand due to irregularities related to the impact on abiotic depletion non-fossil.</td></tr>
<tr><td>Other resource consumption</td><td>Not relevant</td></tr>
<tr><td>Quantitative description of energy type (regional mix) and consumption during the installation process</td><td>15 MJ of mechanical energy is needed for excavating the soil (dig up), for excavating the backfilling soil and sand, for the stamping process (compaction next pipe) and for the vibration plate (compaction top). Environmental burdens associated with this kind of energy are calculated by means of the Ecoinvent V3.3 datarecord “Diesel, burned in building machine {GLO}| processing | Alloc Rec, U”</td></tr>
<tr><td>Waste on the building site, generated by the product’s installation</td><td rowspan="2">0,0434 kg of PE pipe left over during installation: 80% to landfill, 15% to incineration and 5% to mechanical recycling. Transportation of PE pipe left over to waste management treatment facilities is included: 600 km to recycling plant, 150 km to incineration with energy recovery and 50 km to landfill.
Environmental burdens are calculated by means of the Ecoinvent V3.3 datarecord “Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {RER}| transport, freight, lorry 3.5-7.5 metric ton, EURO4 | Alloc Rec, U”.
0,035 kg of packaging waste: treated according to European average packaging waste scenarios (EU27, 2006):
<table>
<tr><th></th><th>Recycling</th><th>Energy Recovery</th><th>Landfill</th></tr>
<tr><td>Plastic</td><td>27%</td><td>26%</td><td>47%</td></tr>
<tr><td>Paper and board</td><td>75%</td><td>10%</td><td>15%</td></tr>
<tr><td>Wood</td><td>38%</td><td>23%</td><td>39%</td></tr>
<tr><td>Metals</td><td>66%</td><td></td><td>34%</td></tr>
<tr><td>Total</td><td>57%</td><td>12%</td><td>31%</td></tr>
</table>
0,1488 m^3 of soil: that has to be transported over an average distance of 5 km to the nearest depot. Environmental burdens are calculated by means of the Ecoinvent V3.3 datarecord “Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {RER}| transport, freight, lorry 3.5-7.5 metric ton, EURO4 | Alloc Rec, U”.</td></tr>
<tr><td>Output materials as result of waste management processes at the building site e.g. of collection for recycling, for energy recovery, final disposal</td></tr>
<tr><td>Emissions to ambient air, soil and water</td><td>No direct emissions at the trench. Emissions are related to the upstream processes (mining of sand, transportation processes and mechanical energy) and downstream processes (waste management and treatment) and are included in the Ecoinvent datarecords that are used for modelling the environmental impacts.</td></tr>
</table>

4.2 Use stage: operation and maintenance

Operation and maintenance:

Operational use (pumping energy) is not relevant for the EPD, since it falls outside the system boundaries of the LCA project. Maintenance is not needed for the PE pipe system for water distribution.

4.3 End of life

The following end of life scenarios have been taken into account:

- Estimated reference service lifetime of 100 years (Ulrich Schulte and Joachim Hessel, 2006)
- EoL approach for landfill, incineration with energy recovery (impacts and credits are assigned to the life cycle that generates the waste flows)
- Recycled content approach for recycling and use of recyclates (= impact of recycling and credits for recyclates, because less virgin materials are needed is assigned to the life cycle that uses the recyclates)

Processes	Parameter unit expressed per functional unit
Collection process	After a reference service lifetime of 100 years the PE pipe system for water distribution might be replaced. In most cases (95%) the pipe system will be left in the ground. In some cases (5%) the pipe system is taken out and treated (landfilled or incinerated).

EOL scenario PE pipes	
Mechanical recycling	2,5%
Incineration	2,5%
Left in ground	95%

The transportation distance of the PE pipe system from the trench to a waste treatment facility depends on the treatment option. For mechanical recycling we assumed an average transportation distance of 600 km and for incineration an average distance of 150 km. Environmental burdens associated with transportation are calculated by means of the following Ecoinvent V3.3 datarecord “Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {RER}| transport, freight, lorry 3.5-7.5 metric ton, EURO4 | Alloc Rec, U”

5. ADDITIONAL INFORMATION ON EMISSIONS TO INDOOR AIR, SOIL AND WATER DURING USE STAGE

Emissions to indoor air:

Since the PE pipe system for water distribution is a buried system (in trench) we can confirm that emissions to indoor air are not relevant.

Emissions to soil and water:

The PE pipe system for water distribution does not contain any substances mentioned on the REACH-list.

6. OTHER ADDITIONAL INFORMATION

Product certification, conformity, marking

EN 12201-1, Plastics piping systems for water supply. Polyethylene (PE). Part 1: General

EN 12201-2, Plastics piping systems for water supply. Polyethylene (PE). Part 2: Pipes

EN 12201-3, Plastics piping systems for water supply. Polyethylene (PE). Part 3 Fittings

EN 12201-4, Plastics piping systems for water supply. Polyethylene (PE). Part 4: Valves

EN 805, Water supply. Requirements for systems and components outside buildings

EN 1295-1, Structural design of buried pipelines under various conditions of loading. Part 1: General requirements

EN 1610, Construction and testing of drains and sewers

In compliance with European Construction Products Directive (89/106/EEC)

Other technical product performances

For the full overview of the environmental benefits of plastic pipe systems please refer to the TEPPFA website: **http://www.teppfa.eu**

List of names and logos of TEPPFA member companies

	Aliaxis
	DYKA
	Geberit International
	Georg Fischer Piping Systems
	LK
	Nupi
	Pipelife International
	Polypipe
	Rehau
	Radius Systems
	Uponor
	Wavin

List of National Associations of TEPPFA

ADPP	Czech Republic plastic pipes association
ASETUB	Asociación Española de Fabricantes de Tubos y Accesorios Plásticos
BPF	Plastic Pipes Group
BureauLeiding	Dutch Plastic Pipes Association
DPF	Danish Plastics Federation
FCIO	Fachverband der Chemischen Industrie Österreich
Essenscia PolyMatters	Belgian Federation for Chemistry and Life Sciences industries
FIPIF	Finnish Plastics Industries Federation
IPPMA	Irish Plastic Pipe Manufacturers Association
KRV	Kunstoffrohrverband e.V.- Fachverband der Kunstoffrohr-Industrie
MCsSz	Műanyag Csőgyártók Szövetsége
NPG Sweden	Swedish Plastic Pipe Association
PRIK	Polish Association of Pipes and Fittings
STR	Syndicat des Tubes et Raccords
VKR	Verband Kunststoffrohre und Rohrleitungstelle

List of names and logos of TEPPFA Associated Members

Borealis

ECVM

LyondellBasell

Lubrizol

Molecor

List of names and logos of TEPPFA Supporting Members

Rollepaal

7. REFERENCES

EN 12201-1, Plastics piping systems for water supply. Polyethylene (PE). Part 1: General

EN 12201-2, Plastics piping systems for water supply. Polyethylene (PE). Part 2: Pipes

EN 12201-3, Plastics piping systems for water supply. Polyethylene (PE). Part 3 Fittings

EN 12201-4, Plastics piping systems for water supply. Polyethylene (PE). Part 4: Valves

EN 805, Water supply. Requirements for systems and components outside buildings

EN 1295-1, Structural design of buried pipelines under various conditions of loading. Part 1: General requirements

EN 1610, Construction and testing of drains and sewers

Eurostat, 2006, Packaging waste scenarios (EU27, 2006)

ISO 14025: Environmental Labels and Declarations Type III

ISO 14040: Environmental management – Life cycle assessment – Principles and framework

ISO 14044: Environmental management – Life cycle assessment – Requirements and guidelines

EN 15804: Sustainability of construction works – Environmental product declarations – core rules for the product category of construction products (draft, 2008)

EN 15804:2012+A1:2013: Sustainability of construction works – Environmental product declarations – core rules for the product category of construction products (2013)

EN 15942: Sustainability of construction works – Environmental product declarations – Communication format – Business to Business

Ulrich Schulte and Joachim Hessel, 2006 -Remaining service life of plastic pipes after 41 years in service – Fachberichte - 3R International (45), Heft 9/2006 (5 pages)

Ecoinvent, 2016. Ecoinvent database v3.3, Swiss Centre for Life Cycle Inventories, Switzerland. From: www.ecoinvent.org

Background LCA report (ISO 14040 and ISO 14044) prepared by

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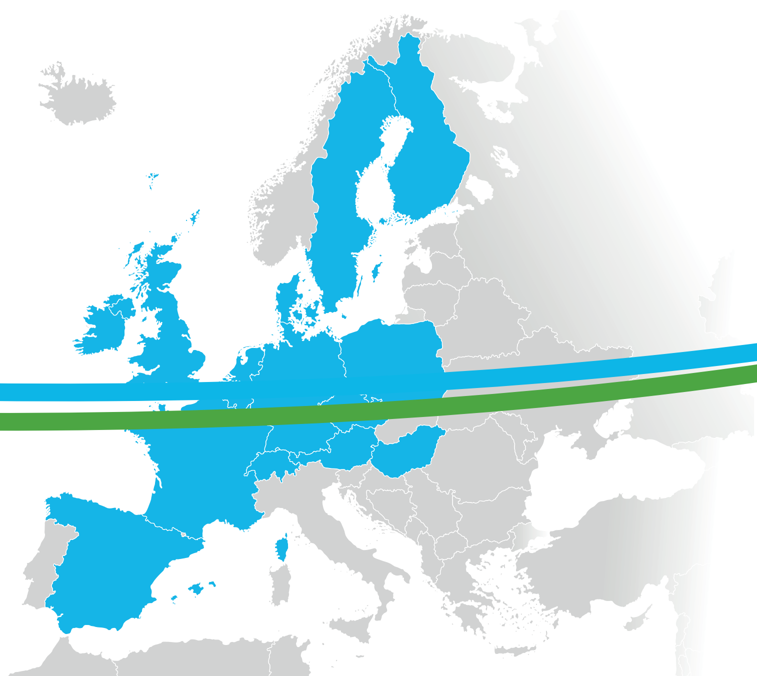

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