European Communication Format – B2B

Environmental Product Declaration

POLYETHYLENE (PE) PIPE SYSTEM FOR COMBUSTIBLE GAS 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 2013 – foreground data remained the same, with only the datasets being updated to the latest available version (Ecoinvent 3.4 and Industry 2.0 replaced Ecoinvent 2 datasets).

It outlines the various environmental aspects, which accompany the polyethylene (PE) pipe system for combustible gas 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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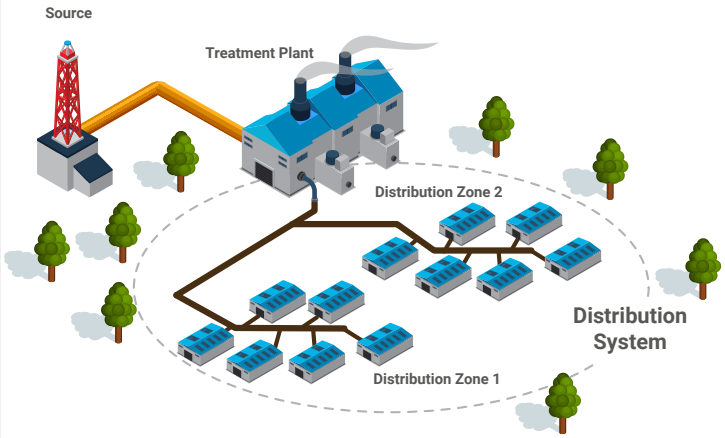
PE pipe system's use and functional unit

The EPD refers to a typical European Polyethylene (PE) pipe system for combustible gas 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 combustible gas, over a distance of 100 m (from the exit of the gas plant to the gas meter of the building), by a typical public European PE pipe gas distribution system (DN/OD 110 mm) over its complete life cycle of 100 years, calculated per year.".

Product name & graphic display of product

PE pipe system for combustible gas 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 combustible gas 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 system consists of PE pipe material made out of black PE100; with yellow stripes, with a pipe diameter of DN/OD 110 mm and wall thickness: of 6,47 mm (calculated as average size from actual sales across a market in sizes 20 mm to 315 mm). The nearest standard dimension ratio is SDR 17, so we selected the diameter 110 X 6,6 mm standard (EN 1555) pipe. Two types of fittings are considered (electrofusion and buttwelding). The popularity of fittings in the calculation towards the functional unit is calculated from actual sales data. The average weight of fittings is calculated at the same base. The reference service lifetime of the pipe system has been estimated to be 100 years. Calculations of the amounts of PE pipes, PE fittings, galvanised steel components and EPDM gaskets (needed per 100 meter of an average PE pipe system for gas distribution) are based on a consensus within the AG Utilities. Based on these calculations the mathematical average is made and this resulted in 217 kg of PE pipes, 15,84 kg of PE fittings, 19,5 kg of different components made out of galvanised steel, 0,15 kg of alloys (integrated at the production of the PE fittings phase), 0,88 kg of stainless steel (cutter) and 0,2 kg of EPDM gaskets.

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 1555-1, EN 1555-2, EN 1555-3, EN 1555-4, EN 12007-2and EN 1295-1.

EPD programme and programme operator

The present EPD is in line with the prEN15804 and prEN15942 (2009). A programme operator related to the CEN T350 has not been established yet.

Date of declaration and validity

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

Comparability

Please note that EPDs of construction products may not be comparable if they do not comply with the CEN TC 350 (prEN15804 and prEN15942) draft standards (2009).

Typical European PE pipe system EPD

The present EPD outlines various environmental aspects, which accompany a typical European PE pipe system for combustible gas 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 combustible gas 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 12-14 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

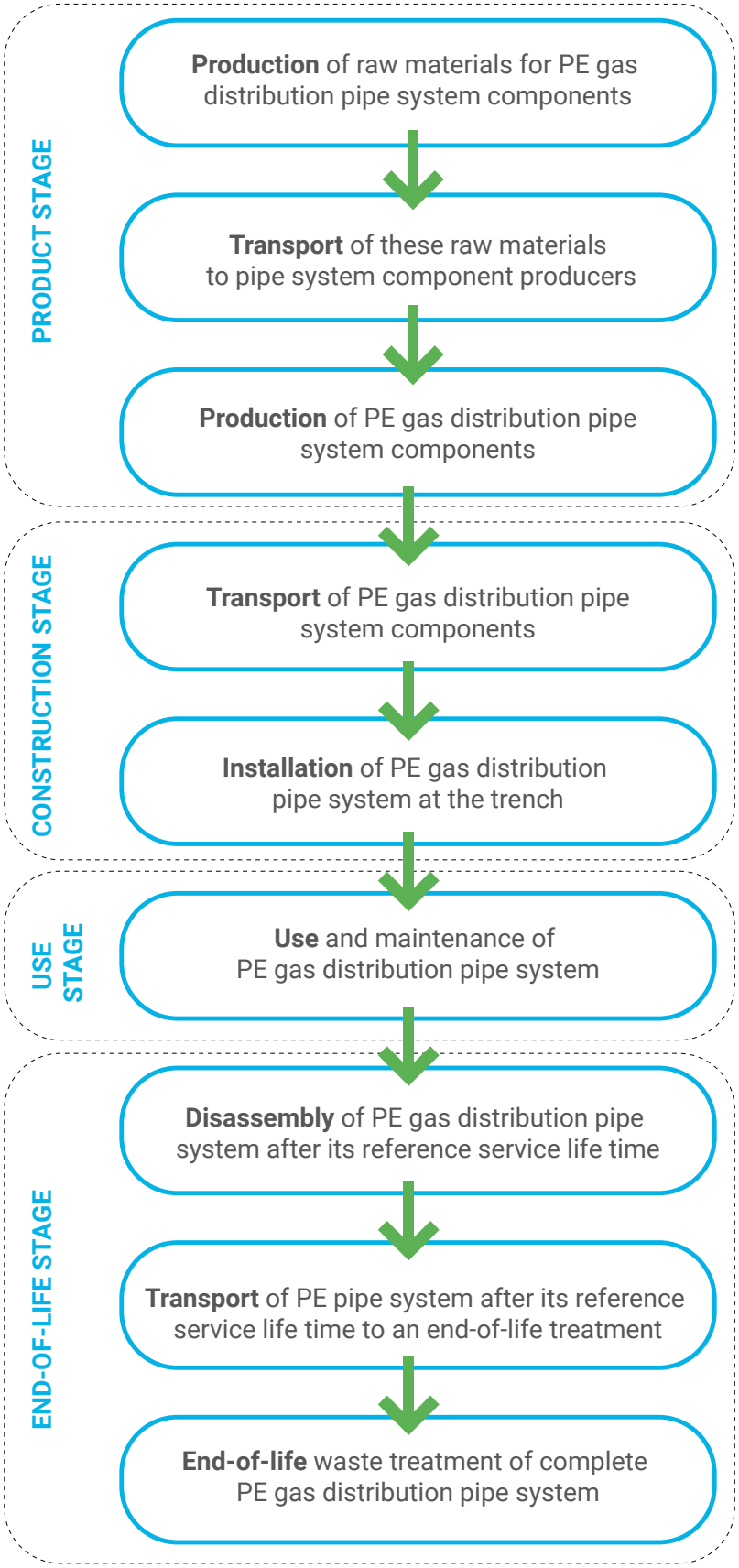
The European Polyethylene (PE) pipe system for combustible gas distribution does not contain any substances as such or in concentration exceeding legal limits, which can adversely affect human health and the environment in any stages of its entire life cycle.

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 combustible gas 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 combustible gas distribution
  - Maintenance of the PE pipe system for combustible gas 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 combustible gas 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 combustible gas distribution after its 100 years of reference service lifetime.


PRODUCT STAGE
Production of raw materials for PE gas distribution pipe system components
Transport of these raw materials to pipe system component producers
Production of PE gas distribution pipe system components
CONSTRUCTION STAGE
Transport of PE gas distribution pipe system components
Installation of PE gas distribution pipe system at the trench
USE STAGE
Use and maintenance of PE gas distribution pipe system
END-OF-LIFE STAGE
Disassembly of PE gas distribution 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 gas distribution 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 (non fossil)	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	4,37E-06	1,97E+02	1,70E-02	3,80E-03	5,67E+00	3,14E-07	1,96E-03
Construction process stage	4,16E-06	3,75E+01	1,61E-02	3,39E-03	2,47E+00	4,54E-07	4,88E-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	3,67E-08	-1,93E-01	-7,91E-05	7,46E-06	1,55E-01	-1,25E-10	-5,31E-06
TOTAL	**8,56E-06**	**2,35E+02**	**3,30E-02**	**7,21E-03**	**8,30E+00**	**7,68E-07**	**2,44E-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	5,32E+00	na	na	2,03E+02	na	na	na	1,09E-01
Construction process stage	na	na	1,84E+00	na	na	3,96E+01	na	na	na	3,40E-01
Use stage	na	na	na	na	na	na	na	na	na	na
End of life stage	na	na	-2,03E-01	na	na	-9,86E-01	na	na	na	-8,46E-04
TOTAL	**na**	**na**	**6,96E+00**	**na**	**na**	**2,42E+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	2,90E-01	1,67E-04
Construction stage	2,29E-05	7,73E-01	2,90E-04
Use stage	0,00E+00	0,00E+00	0,00E+00
End of life stage	-1,42E-06	2,51E+00	-5,12E-06
TOTAL	**2,23E-02**	**3,58E+00**	**4,52E-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 V3.4 datarecord “Transport, freight, lorry 16-32 metric ton, EURO5 {RER}| transport, freight, lorry 16-32 metric ton, EURO5	Cut-off, 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 m³ 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 V3.4 datarecord “Sand {CH}| gravel and quarry operation | Cut-off, U + Transport, freight, lorry >32 metric ton, EURO4 {RER}| transport, freight, lorry >32 metric ton, EURO4 | Cut-off, U”</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 V3.4 datarecord “Diesel, burned in building machine {GLO}| processing | Cut-off, 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 v3.4 datarecord “Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {RER}| transport, freight, lorry 3.5-7.5 metric ton, EURO4 | Cut-off, 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 m³ 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 v3.4 datarecord “Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {RER}| transport, freight, lorry 3.5-7.5 metric ton, EURO4 | Cut-off, 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 combustible gas distribution.

4.3 End of life

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

- Estimated reference service lifetime of 100 years 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)

<table>
<tr><th>Processes</th><th>Parameter unit expressed per functional unit</th></tr>
<tr><td>Collection process</td><td>After a reference service lifetime of 100 years the PE pipe system for combustible gas 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).
<table>
<tr><th>EOL scenario PE pipes</th><th>Present</th></tr>
<tr><td>Mechanical recycling</td><td>2,5%</td></tr>
<tr><td>Incineration</td><td>2,5%</td></tr>
<tr><td>Left in ground</td><td>95%</td></tr>
</table>
So for the functional unit 2,536 kg of pipe system components are available at the trench, of which 0,2038 kg is transported over an average distance of 50 km to a metal recycling plant and 2,3304 kg is treated according to the PE pipes EOL scenario: 2,5% (0,064 kg) is transported over an average distance of 600 km to a recycling plant, 2,5% (0,064 kg) is transported over an average distance of 150 km to an incinerator, and the remaining 95% (2,408 kg) is left in the ground. Environmental burdens associated with transportation are calculated by means of the following Ecoinvent v3.4 datarecord “Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {RER}| transport, freight, lorry 3.5-7.5 metric ton, EURO4 | Cut-off, U”</td></tr>
</table>

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

Emissions to indoor air:

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

Emissions to soil and water:

Despite there is no approved European measurement method available, we can confirm that the PE pipe system for combustible gas distribution does not contain any substances mentioned on the REACH-list.

6. OTHER ADDITIONAL INFORMATION

Product certification, conformity, marking

EN 1555-1, Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Part 1: General

EN 1555-2, Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Part 2: Pipes

EN 1555-3, Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Part 3: Fittings

EN 1555-4, Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Part 4: Valves

EN 12007-2, Gas supply systems - Pipelines for maximum operating pressure up to and including 16 bar - Part 2: Specific functional recommendations for polyethylene (MOP up to and including 10 bar)

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

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

Ecoinvent, 2016. Ecoinvent database v3.4, Swiss Centre for Life Cycle Inventories, Switzerland. From: www.ecoinvent.org

EN 1555-1: Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Part 1: General

EN 1555-2: Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Part 2: Pipes

EN 1555-3: Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Part 3: Fittings

EN 1555-4: Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Part 4: Valves

EN 12007-2: Gas supply systems - Pipelines for maximum operating pressure up to and including 16 bar - Part 2: Specific functional recommendations for polyethylene (MOP up to and including 10 bar)

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

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: 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

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

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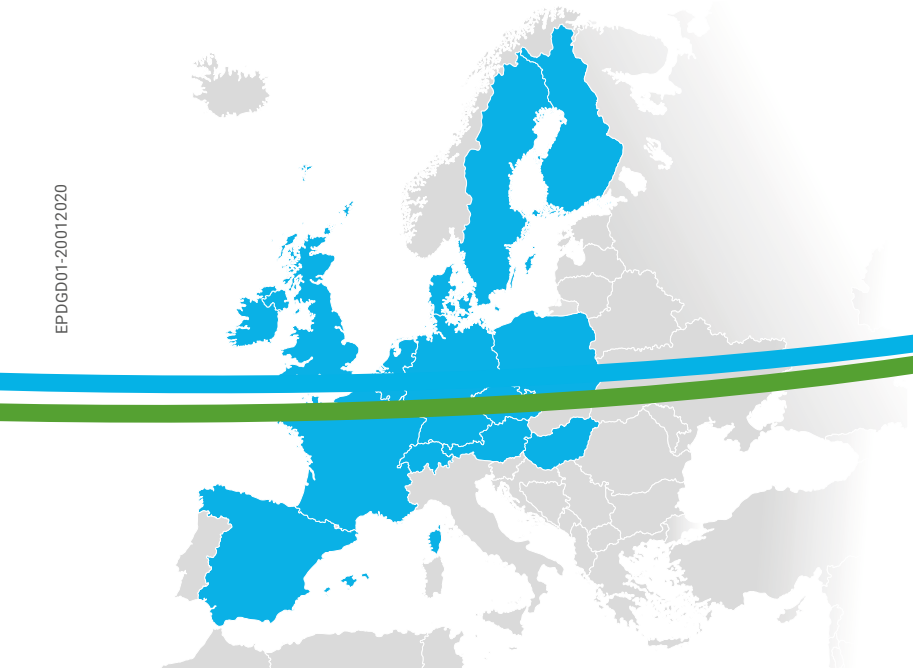

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