European Communication Format – B2B

# Environmental Product Declaration

## POLYVINYLCHLORIDE (PVC-U) RAIN GUTTER SYSTEM

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 life-span of a rain gutter system.

With this framework in mind, TEPPFA has set up an LCA/EPD project with the Flemish Institute for Technological Research (VITO).

The present EPD outlines the various environmental aspects which accompany the Unplasticized Polyvinylchloride (PVC-U) gutter system, from the primary extraction of raw materials up to and including the end of life (EoL) treatment after its reference service life time.

## Name and address of manufacturers

**TEPPFA, Avenue de Cortenbergh, 71, B-1000 Brussels, Belgium**

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E-Mail: info@teppfa.eu
Website: **www.teppfa.eu**

## Polyvinylchloride (PVC-U) gutter system's use and functional unit

The EPD refers to a typical European Unplasticized Polyvinylchloride (PVC-U) rain gutter system installed onto a single family house, from the cradle to the grave, including raw material extraction, transportation to converters, converting process, transport to the single family house, construction, use and end-of-life treatment. Environmental indicators are expressed for the complete life cycle, from the cradle to the grave, so for a typical European PVC-U rain gutter system.

The functional unit is defined as "The collection and gravity withdrawal of rainwater from a typical gable roof (two sided with 0,3 m eaves) of a two storey 100 m2 family house (2 X 5m X 10m) by a PVC-U half-round gutter system of an average 120 mm opening with two diameter 80mm downpipes (one per side) and with a service life time of 50 years (aligned with the life time of the building until its first refurbishment), calculated per year".

## Product name

Polyvinylchloride (PVC-U) rain gutter system

## Description of the Polyvinylchloride (PVC-U) gutter system's components

The environmental burdens are calculated in relation to the functional unit, which resulted for the typical Polyvinylchloride (PVC-U) gutter system in the following basic pipe system components: PVC-U gutter, PVC-U downpipe, PVC-U fittings (stopends, stopend-, and central outlets, union pieces, bends, brackets) and EPDM seals.

The system consists of downpipes and gutters. Moreover the system contains stopends, stopend outlet, central outlet, gutter union and bends depending on the system components of the data provider companies. All necessary ancillary materials (brackets, screws, joints) are considered in the design. The brackets and screws are needed to fix the gutters and the pipes to the roof and the wall.

The rain gutter installation is representative for a 100 m² typical residential single family house consisting of 2-storeys and with a typical gable roof.

The EPD declares the average environmental performance for a Polyvinylchloride (PVC-U) rain gutter system, over its reference service life cycle of 50 years (being the estimated reference life time of the house until its first refurbishment).

## EPD programme and programme operator

The present EPD is in line with the EN15804:2012+A1:2013 and EN15942:2011 developed by CEN TC 350. A programme operator related to the CEN TC 350 has not been established yet.

## Date of declaration and validity

February, 2016
The EPD has a 5 year validity period (February, 2021)

## Comparability

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

## Typicial Europaen polyvinylchloride (PVC-U) rain gutter system EPD

he present EPD outlines the various environmental aspects which accompany a Polyvinylchloride (PVC-U) rain gutter system, from the primary extraction of raw materials up to and including the end of life (EoL) treatment after its reference service life time of 50 years (considering the service life time of the gutter system to be aligned with the 50 year service life time of the house until its first refurbishment).

## Group of manufacturers

The EPD for the Polyvinylchloride (PVC-U) rain gutter system is representative for an anticipated European PVC-U rain gutter system. A number of the Teppfa members are major players on the market for PVC gutters. For an overview of all members and national associations within TEPPFA we refer to pages 11 and 12 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 all 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

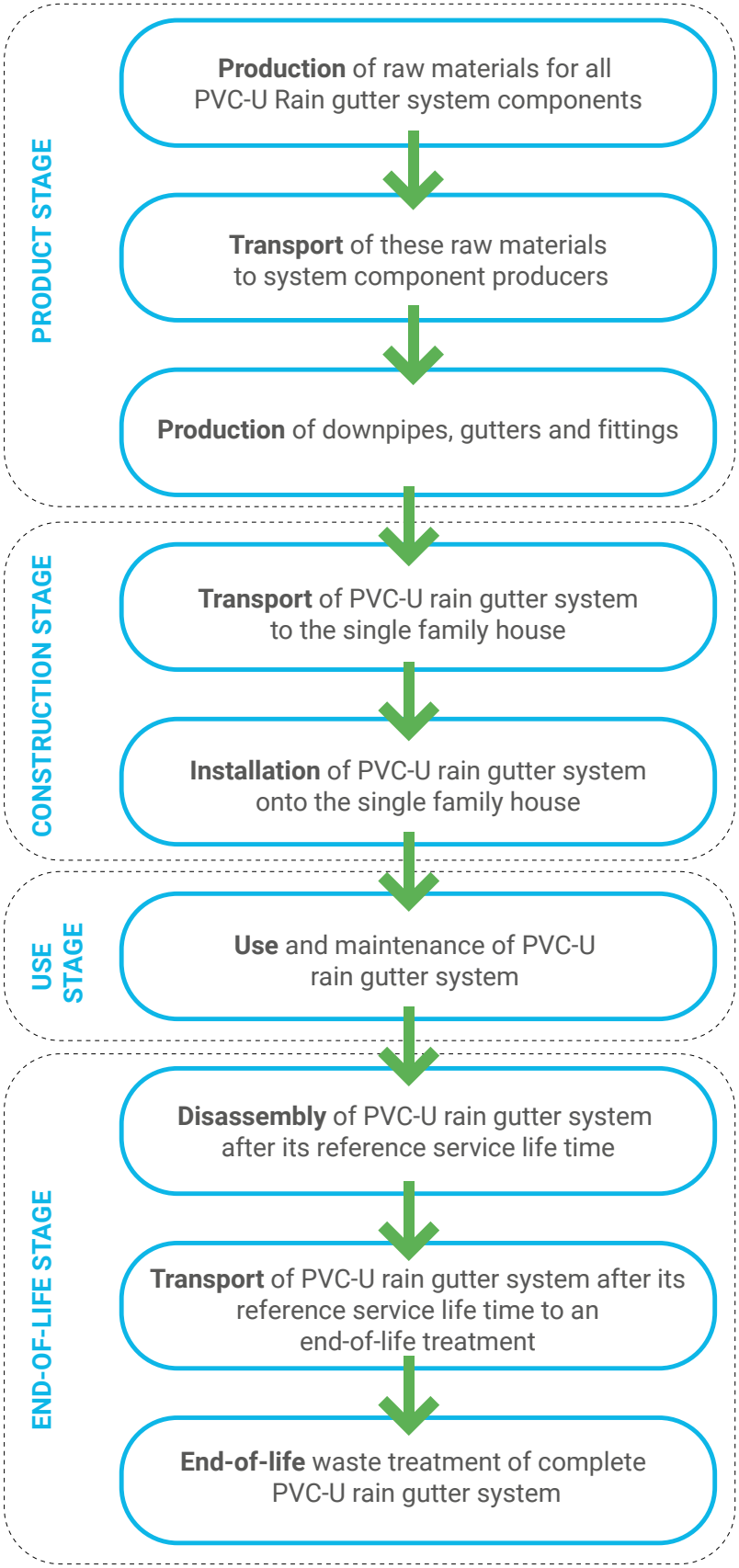
The Unplasticized Polyvinylchloride (PVC-U) gutter system does not contain any substances as such or in concentration exceeding legal limits, which can adversely affect human health and the environment in any stages of its entire life cycle.

## 3. DECLARATION OF THE ENVIRONMENTAL PARAMETERS DERIVED FROM LCA

### 3.1 Life cycle flow diagram

The EPD refers to a Unplasticized Polyvinylchloride (PVC-U) rain gutter system, from the cradle to the grave, including product stage, transport to construction site, 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 Polyvinylchloride PVC-U pipes;
  - Transport of the raw materials to downpipes converter;
  - Transport of the raw materials to gutters converter;
  - Transport of the raw materials to fittings producer;
  - Extrusion PVC-U downpipes;
  - Extrusion PVC-U gutters;
  - Injection moulding PVC-U fittings;
  - Printing PVC-U downpipes;
  - Printing PVC-U gutters
  - Packaging PVC-U downpipes;
  - Packaging PVC-U gutters;
  - Packaging PVC-U fittings;
- **Construction process stage:** including all energy provisions, waste management processes during the construction stage up to waste for final disposal
  - Transportation via customes to building site;
  - Installation of the PVC-U rain gutter system in the building.
- **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 PVC-U rain gutter system;
  - Maintenance is not relevant for the PVC-U rain gutter system.
- **End of life stage:** including transport and all energy provisions, waste management processes during the end-of-life (EOL) stage.
  - Disassembly of complete PVC-U gutter system;
  - Transport of complete PVC-U gutter system to EOL;
  - End-of-life treatment PVC-U gutter system.


PRODUCT STAGE
Production of raw materials for all PVC-U Rain gutter system components
Transport of these raw materials to system component producers
Production of downpipes, gutters and fittings
CONSTRUCTION STAGE
Transport of PVC-U rain gutter system to the single family house
Installation of PVC-U rain gutter system onto the single family house
USE STAGE
Use and maintenance of PVC-U rain gutter system
END-OF-LIFE STAGE
Disassembly of PVC-U rain gutter system after its reference service life time
Transport of PVC-U rain gutter system after its reference service life time to an end-of-life treatment
End-of-life waste treatment of complete PVC-U rain gutter 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 | A1-3 | 6,39E-06 | 2,76E+01 | 3,62E-03 | 6,17E-04 | 1,24E+00 | 4,40E-07 | 3,64E-04 |
| Transport to installation | A4 | 7,19E-08 | 3,23E-01 | 6,96E-05 | 1,04E-05 | 2,00E-02 | 3,66E-09 | 6,31E-06 |
| Installation | A5 | 4,92E-07 | 2,63E-01 | 5,34E-05 | 6,20E-06 | 3,24E-02 | -8,41E-11 | 1,11E-05 |
| Use | B1-B7 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 |
| Disassembly | C1 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 |
| Transport to end-of-life treatment | C2 | 2,98E-07 | 7,86E-01 | 1,71E-04 | 2,50E-05 | 5,08E-02 | 8,76E-09 | 1,43E-06 |
| End-of-life treatment | C3-C4 | -8,44E-08 | -6,28E-01 | -1,32E-04 | -2,21E-06 | 1,89E-01 | -4,48E-09 | -2,67E-06 |
| **TOTAL** | | **7,17E-06** | **2,84E+01** | **3,78E-03** | **6,56E-04** | **1,53E+00** | **4,48E-07** | **3,93E-04** |

## 3.3 Parameters describing resource input

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

| Declaration of environmental paramaters derived from LCI | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameters describing resource use, primary energy | | | | | | | | |
| 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) |
| | | | MJ, net calorific value | MJ, net calorific value | MJ, net calorific value | MJ, net calorific value | MJ, net calorific value | MJ, net calorific value |
| Product stage | Total (of product stage) | A1-3 | na | na | 2,99E+00 | na | na | 3,10E+01 |
| Construction process stage | Transport | A4 | na | na | 4,46E-03 | na | na | 3,15E-01 |
| | Construction installation process | A5 | na | na | -3,65E-03 | na | na | -1,34E-02 |
| Use stage | Use | B1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Maintenance | B2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Repair | B3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Replacement | B4 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Refurbishment | B5 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Operational energy use | B6 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Operational water use | B7 | 0 | 0 | 0 | 0 | 0 | 0 |
| End of life | De-construction, demolition | C1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Transport | C2 | na | na | 1,09E-02 | na | na | 7,71E-01 |
| | Waste processing | C3 | na | na | -1,34E+01 | na | na | -1,43E+00 |
| | Disposal | C4 | na | na | 1,54E-03 | na | na | 5,67E-02 |

na: not available

| Declaration of environmental paramaters derived from LCI | | | | | | |
|---|---|---|---|---|---|---|
| Parameters describing resource use, secondary materials and fuels, and use of water | | | | | | |
| Environmental parameter | | | Use of secondary material* | Use of renewable secondary fuels* | Use of non renewable secondary fuels* | Net use of fresh water |
| | | | kg | MJ, net calorific value | MJ, net calorific value | m3 |
| Product stage | Total (of product stage) | A1-3 | 0 | 0 | 0 | 5,76E-02 |
| Construction process stage | Transport | A4 | na | na | na | 0,00E+00 |
| | Construction installation process | A5 | na | na | na | 3,50E-04 |
| Use stage | Use | B1 | 0 | 0 | 0 | 0 |
| | Maintenance | B2 | 0 | 0 | 0 | 0 |
| | Repair | B3 | 0 | 0 | 0 | 0 |
| | Replacement | B4 | 0 | 0 | 0 | 0 |
| | Refurbishment | B5 | 0 | 0 | 0 | 0 |
| | Operational energy use | B6 | 0 | 0 | 0 | 0 |
| | Operational water use | B7 | 0 | 0 | 0 | 0 |
| End of life | De-construction, demolition | C1 | 0 | 0 | 0 | 0 |
| | Transport | C2 | 0 | 0 | 0 | 0,00E+00 |
| | Waste processing | C3 | 0 | 0 | 0 | 1,03E-06 |
| | Disposal | C4 | 0 | 0 | 0 | 0,00E+00 |

*only for foreground process from which LCI data are made available by TEPPFA - the number does not include processes and materials modelled by means of background data, eg transportation, electricity, ancillary materials...

## 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

| Declaration of environmental paramaters derived from LCI | | | | | |
|---|---|---|---|---|---|
| Other environmental information describing waste categories | | | | | |
| Environmental parameter | | | Hazardous waste | Non-hazardous waste | Radioactive waste |
| | | | kg | kg | kg |
| Product stage | Total (of product stage) | A1-3 | 31,86E-01 | 1,02E-01 | 3,73E-05 |
| Construction process stage | Transport | A4 | 2,00E-07 | 2,15E-02 | 2,08E-06 |
| | Construction installation process | A5 | 2,15E-06 | 1,60E-02 | -5,96E-07 |
| Use stage | Use | B1 | 0 | 0 | 0 |
| | Maintenance | B2 | 0 | 0 | 0 |
| | Repair | B3 | 0 | 0 | 0 |
| | Replacement | B4 | 0 | 0 | 0 |
| | Refurbishment | B5 | 0 | 0 | 0 |
| | Operational energy use | B6 | 0 | 0 | 0 |
| | Operational water use | B7 | 0 | 0 | 0 |
| End of life | De-construction, demolition | C1 | 0 | 0 | 0 |
| | Transport | C2 | 5,92E-07 | 2,25E-02 | 4,95E-06 |
| | Waste processing | C3 | -1,28E-06 | 2,55E-01 | -7,24E-06 |
| | Disposal | C4 | 4,15E-08 | 2,11E-01 | 3,38E-07 |

### Parameters describing further output material flows

| Other environmental information describing output flows | |
|---|---|
| Components for re-use* | 0,00E+00 kg |
| Materials for recycling* | 9,17E-01 kg |
| Materials for energy recovery** | 0,00E+00 kg |
| Exported energy** | 0,00E+00 MJ per energy carrier |

*only for foreground process from which LCI data are made available by TEPPFA - the number does not include processes and materials modelled by means of background data, eg transportation, electricity, ancillary materials...
**the benefits from waste incineration are accounted for within the system boundaries. Therefore no energy nor materials for energy recovery are leaving the system boundaries

# 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 PVC-U rain gutter system is transported over an average distance of 311 km with a large truck (>16 ton) to a wholesaler and over an average distance of 30 km (by means of a van < 3,5 ton) from the wholesaler to the single family house.<br>Environmental burdens associated with this kind of transport are calculated by means of the Ecoinvent V3.3 datarecords “Transport, freight, lorry >32 metric ton, EURO5 {RER}| transport, freight, lorry >32 metric ton, EURO5 | Alloc Rec, U” and “Transport, freight, lorry 3.5-7.5 metric ton, EURO5 {RER}| transport, freight, lorry 3.5-7.5 metric ton, EURO5 | 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 construction site)

<table>
<tr><th>Parameter</th><th>Parameter unit expressed per functional unit</th></tr>
<tr><td>Ancillary materials for installation</td><td>0,000093 kg solvent cement, modelled using the records: PVC (suspension polymerisation) E (database: Industry data 2.0), Ethyl acetate {RER}| production | Alloc Rec, U (database Ecoinvent V3.3 (2014)), Methyl ethyl ketone {RER}| production | Alloc Rec, U (database ecoinvent 3.1) and Acetone, liquid {RER}| production | Alloc Rec, U<br>Environmental burdens associated with these ancillary materialsare calculated by means of the Ecoinvent V3.5 datarecord “Tap water {RER}| market group for | Cut-off, U” “Activated bentonite {DE}| production | Cut-off, U” (database ecoinvent 3.1)<br>0,00009 kg of cleaning agent, modelled using the record: Methyl ethyl ketone {RER}| production | Alloc Rec, U (database ecoinvent 3.1)<br>0,00848 kg of galvanized steel screws, calculated using the records: Steel hot dip galvanized (ILCD), blast furnace route, production mix, at plant, 1kg, typical thickness between 0.3 - 3 mm. typical width between 600 - 2100 mm. GLO S (database ELCD) and Metal working, average for steel product manufacturing {RER}| processing | Alloc Rec, U (database: ecoinvent 3.1)</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>0,00025 kWh electrical energy for the screw driver, calculated by means fo the record Electricity, low voltage {ENTSO-E}| electricity voltage transformation from medium to low voltage | Alloc Rec, U_created based on ecoinvent information. This record is not standard available in the SimaPro database, but has been created based on information published on the ecoinvent website</td></tr>
<tr><td>Waste on the building site, generated by the product’s installation<br><br>Output materials as result of waste management processes at the building site e.g. of collection for recycling, for energy recovery, final disposal</td><td>0,00383 kg of Polyvinylchloride (PVC-U) pipe left over during installation: 80% to landfill, 15% to incineration and 5% to mechanical recycling. Transportation of Polyvinylchloride (PVC-U) pipe left over to waste management treatment facilities is included: 600 km for mechanical recycling, 150 km to incineration with energy recovery and 50 km to landfill. Environmental burdens are calculated by means of the Ecoinvent V3.3 data record “Transport, freight, lorry 3.5-7.5 metric ton, EURO5 {RER}| transport, freight, lorry 3.5-7.5 metric ton, EURO5 | Alloc Rec, U”.<br>0,04142 kg of packaging waste: treated according to European average packaging waste scenarios (Eurostat, 2011):<br><br>
<table>
<tr><th></th><th>Recycling</th><th>Energy Recovery</th><th>Landfill</th></tr>
<tr><td>Plastic</td><td>34,3%</td><td>29,1%</td><td>36,6%</td></tr>
<tr><td>Paper and board</td><td>83%</td><td>8,5%</td><td>8,5%</td></tr>
<tr><td>Wood</td><td>37,7%</td><td>29,9%</td><td>32,4%</td></tr>
<tr><td>Metals</td><td>72,3%</td><td>0,6%</td><td>27,7%</td></tr>
</table>
(Source: Eurostat)</td></tr>
<tr><td>Emissions to ambient air, soil and water</td><td>No direct emissions at the building site. Emissions are related to the upstream processes. Emissions are related to the upstream processes (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 is not relevant for the EPD (gravity discharge). If maintenance is necessary, it will be done manually (using only a brush).

## 4.3 End of life

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

- Estimated reference service lifetime of 50 years being the service life time of the single family house until the first refurbishment
- EoL approach for recycling, landfill and 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)

| Process | Parameter unit expressed per functional unit |
|---|---|
| Collection process | The After a service life time of 50 years the single family house (containing a PVC-U rain gutter pipe system) might be refurbished and certain elements are stripped for recoverable materials and products. The remaining construction is subsequently refurbished. The PVC-U rain gutter system is demolished together with the total construction. So for the functional unit 0,48342 kg of rain gutter system components are available at the single family house.<br>The PVC-U parts of the system (0,47394 kg) follow the following scenario: 36,2% (0,17157 kg) is transported over an average distance of 150 km to an incinerator, 43,8% (0,20759 kg) is transported over an average distance of 50 km to landfill and 20% (0,09479 kg) is transported over an average distance of 600 km for mechanical recycling.<br>The EPDM sealing rings (0,00099 kg) are for 45,25% incinerated (0,00045 kg is transported over average distance of 150 km) and for 45,75% disposed to landfill (0,00054 kg transported over average distance of 50 km).<br>The galvanized steel screws (0,00848 kg) are for 75% recycled (0,00636 kg is transported over average distance of 600 km) and for 25% disposed to landfill (0,00212 kg transported over average distance of 50 km). |
| Recycling system | |
| Final deposition | |

| EOL scenario PVC-U parts | | EOL EPDM sealing rings | | EOL metal parts | |
|---|---|---|---|---|---|
| Mechanical recycling | 20,00% | - | - | Recycling | 75,00% |
| Incineration | 36,20% | Incineration | 45,25% | - | - |
| Landfill | 43,80% | Landfill | 54,75% | Landfill | 25,00% |

Environmental burdens associated with transportation are calculated by means of the following Ecoinvent V3.3 data record “Transport, freight, lorry 3.5-7.5 metric ton, EURO5 {RER}| transport, freight, lorry 3.5-7.5 metric ton, EURO5 | Alloc Rec, U”.

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

**Emissions to indoor air:**

Despite there is no approved European measurement method available, we can confirm that the Polyvinylchloride (PVC-U) rain gutter system does not contain any substances mentioned on the REACH-list.

**Emissions to soil and water:**

Since the Polyvinylchloride (PVC-U) rain gutter system is installed in the builing we can confirm that emissions to soil and water are not relevant.

## 6. OTHER ADDITIONAL INFORMATION

### Product certification, conformity, marking

**EN 12056-3,** Gravity drainage systems inside buildings – Part 3: Roof drainage, layout and calculation

### 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 15804:2012+A1:2013,** Sustainability of construction works – Environmental product declarations – core rules for the product category of construction products.

**EN 15942: 2011,** Sustainability of construction works – Environmental product declarations – Communication format – Business to Business.

**CML. 2013. CML – Institute of Environmental Sciences:** Impact assessment characterisation factors, version 4.1. CML, Leiden, April, 2013. Available online: http://www.leidenuniv.nl/interfac/cml/ssp/index.html

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

**ISO 14025. 2006:** Environmental labels and declarations -- General principles

**ISO 14040. 2006:** Environmental management – Life cycle assessment – Principles and framework.

**ISO 14044. 2006:** Environmental management – Life cycle assessment – Requirements and guidelines.

**EN 12056-3 Gravity drainage systems inside buildings - Part 3:** Roof drainage, layout and calculations.

**Eurostat, 2011. Packaging waste scenarios (EU27, 2011)**: http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/data/wastestreams/packaging_waste

**PlasticsEurope, 2015. The association of plastics manufacturers**: http://www.plasticseurope.org/plastics-sustainability/eco-profiles.aspx

**SimaPro, 2015**. SimaPro LCA Software v.8.0.5., PRé consultants bv, Amersfoort, The Netherlands

**TNO report, 2008**. Quality of PVC sewage pipes in the Netherlands

**MT-RAP-2008-01066/mso / 2;** Author(s) J. Breen - Assignor BureauLeiding

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

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vision on technology

## External critical review of underlying LCA by

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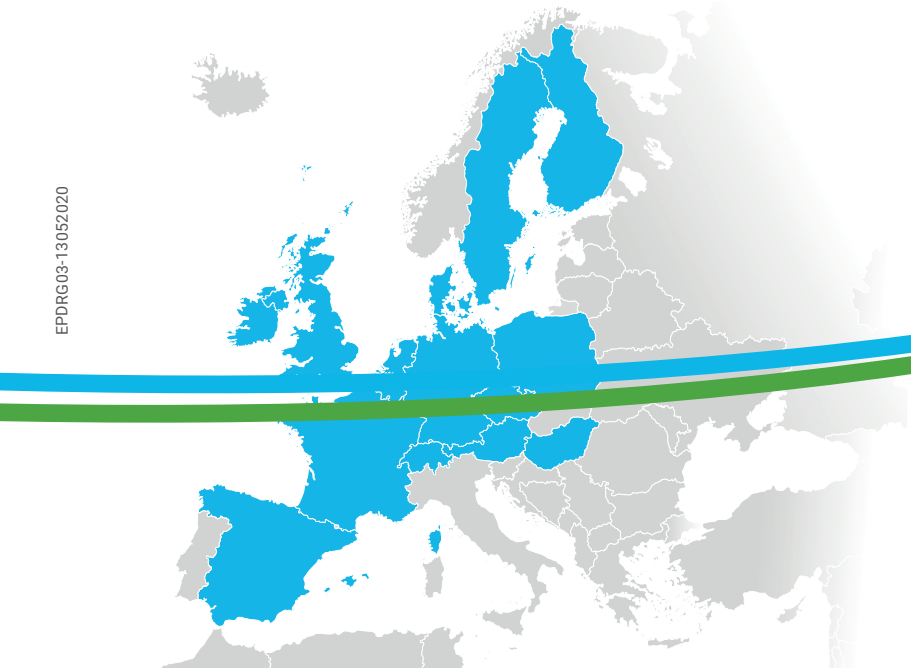
denkstatt
create sustainable value

**Visit our website**
www.teppfa.eu



EPDRG03-13052020

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