Environmental Product Declaration

In accordance with ISO 14025 for

MAPEPLAN M & MAPEPLAN B

(PVC-P Waterproofing Membranes)

POLYGLASS SpA

Programme:	**The International EPD® System; www.environdec.com**
Programme operator:	**EPD International AB**
EPD registration number:	**S-P-00905**
Approval date:	**2016-06-28**
Valid until:	**2021-06-28**
Revision number:	**04**
Geographical scope:	***International***

1.Company description / Goal & Scope

The Company's headquarter is located in Ponte di Piave, Treviso (Italy). Over 90.000 m^2 of surface, 25.000 m^2 covered, 4 production lines of polymer-bitumen membranes, one production line of thermal and acoustic insulation systems and two production lines of synthetic PVC-P and TPO/FPO membranes.

Figure 1: Production equipment

In October 2008 Polyglass was taken over by the MAPEI Group, an international Company in the chemical industry for construction, with 67 production plants in 5 continents, in 32 countries.

Polyglass SpA is ISO 14001 certified since 2010 and ISO 9001 since 1995.

The goal of the study has been to provide necessary data and documentation to produce an EPD according to the requirements of PCR according to EN 15804:2014 and PCR Environdec, version 2.0, date 2015-03-03 and to have more comprehension about the environmental impacts related to Mapeplan M and Mapeplan B manufactured in Polyglass SpA located in Ponte di Piave (TV-Italy), including packaging of the finished products.

Target audiences of the study are customers and other parties with an interest in the environmental impacts of **Mapeplan M** and **Mapeplan B**.

This analysis shall not support comparative assertions intended to be disclosed to the public.

Figure 2: Polyglass S.p.A. headquarter

2. Product description

Mapeplan M (Broof t1-t3) is a synthetic roofing waterproofing membrane in PVC-P produced in one multiextrusion coating process, with high quality raw materials, reinforced with polyester net.
Mapeplan B is a synthetic roofing waterproofing membrane in PVC-P produced in one multi-extrusion coating process, with high quality raw materials, reinforced with glass mat.
The reference service life of the roofing membrane, according to Polyglass experience, is estimated at least 30 years, if professionally installed and properly used.
Both Mapeplan are compliant with EN 13956 (“Flexible sheets for waterproofing. Plastic and rubber sheets for roof waterproofing. Definitions and characteristics”), and are sold with different packaging, as follow:

PACKAGING

PALLET	14 rolls per pallet
LENGTH OF ROLLS	25 m 20 m 15 m (according to the thickness)
WIDTH OF ROLLS	2,10 m 1,60 m 1,05 m

Figure 3: MAPEPLAN M on fully exposed roof

3. Content declaration

The main components and ancillary materials of Mapeplan M and Mapeplan B synthetic waterproofing membranes are the following:

Table 1: Composition

Materials	Percentage (%)
Polyvinyl chloride (PVC)	50-70
Plasticizers	30-40
Pigments	0-5
Reinforcing material	5-15
Other additives	0-1

The formulations contain no hazardous substances. These products contain no substances of very high concern (SVHC) on the REACH Candidate List published by the European Chemicals Agency in a concentration more than 0,1 % (by unit weight).

4. Declared Unit and Reference Service Life:

The declared unit is 1m^2 of packaged finished product having a 1,5 mm thickness.

Packaging materials include:

- Wooden pallet
- Cardboard
- LDPE used as wrapping material

The reference service life of the roofing membrane, according to Polyglass experience, is estimated at least 30 years, if professionally installed and properly used.

5. System Boundaries & additional technical information:

The approach is a “cradle to gate” with options.

The following modules have been considered:

- A1-A3 (production stage): extraction and transport of raw materials, packaging included, production process

- A4-A5 (Construction process stage): transport of the finished product to final customers and installation into the building

- C1-C4 (End-of-life stage): de-construction, demolition (C1), transport to waste processing (C2), waste processing for reuse, recovery and/or recycling (C3), disposal (C4)

Table 2: System boundaries (X=included, MND= module not declared)

Product stage			Assemby stage		Use stage							End of life stage				
Upstream		core	Downstream													
Raw materials	Transport	Manufacturing	Transport	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	MND	MND	MND	MND	MND	X	X	X	X	MND

A brief description of production process, is the following:

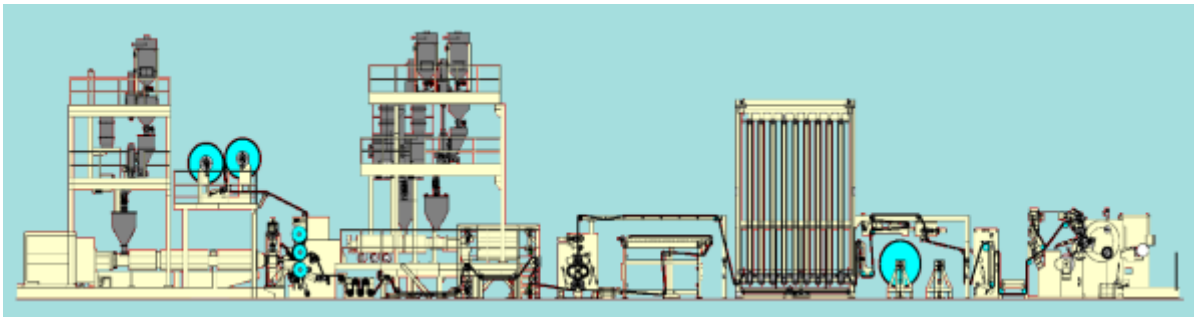


Figure 4: Production process detail

The production process of PVC-P roofing membranes is a multi-extrusion coating process. The production plant produces roofing membranes with an internal reinforcing material made of glass mat or polyester net.

PVC powders are mixed inside a turbomixer with other additives and liquid plasticizers. The mixture is stored under mixing, drained inside a hopper by a vacuum equipment, and finally sent to the extruders.

The hot melt compound comes out from the extruders where the reinforced material is combined and totally encapsulated.

The membrane is cooled and finally sent to the packaging area, ready to ship.

Table 3: Transport to the building site (A4)

Name	Value	Unit
Means of transport : truck euro 3 with 27 tons of payload		
Litres of fuel	0,002	l/100km
Transport distance	1000	km
Capacity utilisation (including empty runs)	85	%
Gross density of products transported	~ 1200	kg/m^3
Capacity utilisation volume factor	100	%

Table 4: Installation into the building (A5)

Name	Value	Unit
Auxiliary	-	kg
Water consumption	-	m^3
Other resources	-	kg
Electricity consumption	0,019	kWh/m^2
Other energy carriers	-	MJ
Material loss (membrane)	3	%
Overlaps (membrane)	5,5	%
Output substances following waste treatment on site	-	kg
Dust in the air	-	kg
VOC in the air	-	kg

Table 5: End of Life (C1-C4)

Name	Value	Unit
Collected separately	-	kg
Collected as mixed construction waste	-	kg
Reuse	-	kg
Transport to recycling /disposal facility	100	km
Energy recovery	-	kg
Landfilling	1,03	kg

6. Cut-off rules & allocation

Criteria for the exclusion of inputs and outputs (cut-off rules) in the LCA, information modules and any additional information are intended to support an efficient calculation procedure. They are not applied in order to hide data.

The following procedure is followed for the exclusion of inputs and outputs:

- All inputs and outputs to a unit process are included in the calculation, for which data are available.
- Less than 1 % of the total mass inputs / outputs of the unit process A1 and A3, are cut off (see Table 6).

Input flows are covered for over 99% of the formula.

Table 6: Cut-off criteria

Process excluded from study	Cut-off criteria	Quantified contribution from process
A1: raw materials	less than 0,5% by mass	less than 0,5% by mass
A3: production (auxiliary materials)	less than 10^{-5}Kg / Kg of finished product	less than 10^{-5}Kg / Kg of finished product
A3: production (particle emissions to air / not compliant finished product)	Less than 10^{-4} Kg / Kg of finished product	Less than 10^{-4} Kg / Kg of finished product

For the allocation procedure and principles, consider the following table (Table 7):

Table 7: Allocation procedure and principles

Module	Allocation Principle
A1; A2	All data are referred to 1m^2 of product • A1: electricity is allocated to the reference line production
A3; A4	All data are referred to 1m^2 of packaged product • A3-production: F-gas are taken into consideration and they are allocated for all production volumes from 2009 (first charge of refrigerating system) until 2015 (reference year of the present study). • A3-wastes: all data are allocated to the whole plant production
A5; C1; C2; C3, C4	All data are referred to 1m^2 of packaged product • A5: all wastes coming from packaging material are considered to be disposed in a landfill (100%) • C3 - C4: according to *"European Commission DG ENV Final Report Task 2 – Management of C&D waste",* 46% is to be considered as recycle/reuse and remaining percentage is to be considered as disposed in a landfill NOTE: **No benefits coming from recycling waste treatment process have been considered in this study**

7. Environmental performance & interpretation

Following tables show environmental impacts for the products considered according to CML methodology (2010 - Apr2013, version 4.2).

Table 8: Mapeplan M Environmental categories

System boundary	Modules	GWP_{100} (Kg CO2 eq.)	ADPe (element) (Kg Sb eq.)	EP (Kg PO34- eq.)	AP (Kg SO2 eq.)	POCP (Kg ethylene eq.)	ODP (Kg R-11 eq.)	ADPf (fossil) (MJ)
Upstream + core	A1-A3	5,00E+00	3,35E-03	6,26E-03	2,46E-02	4,33E-03	1,43E-07	1,19E+02
Downstream	A4	9,92E-02	3,86E-09	1,11E-04	4,38E-04	-1,47E-04	4,05E-13	1,36E+00
	A5	1,07E-01	3,00E-09	3,12E-05	7,98E-05	3,74E-05	6,99E-12	2,06E-01
	C1	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	C2	1,53E-02	5,94E-10	1,62E-05	6,40E-05	-2,09E-05	6,22E-14	2,09E-01
	C3	2,46E-03	4,11E-09	4,25E-06	1,70E-05	2,42E-06	3,74E-14	4,55E-02
	C4	1,71E-02	6,40E-09	1,43E-05	1,05E-04	9,81E-06	2,76E-13	2,25E-01

GWP100: Global Warming Potential; **ADPe**: Abiotic Depletion Potential (elements); **EP**: Eutrophication Potential; **AP**: Acidification Potential; **POCP**: Photochemical Ozone Creation Potential; **ODP**: Ozone Depletion Potential; **ADPf**: Abiotic Depletion Potential (fossil)

Table 9: Mapeplan M other environmental indicators

System boundary		Ustream + core	Downstream					
Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
RPEE	MJ	6,06E+00	7,60E-02	3,99E-02	0,00E+00	1,17E-02	3,29E-03	2,31E-02
RPEM	MJ	-	-	-	-	-	-	-
TPE	MJ	6,06E+00	7,60E-02	3,99E-02	0,00E+00	1,17E-02	3,29E-03	2,31E-02
NRPE	MJ	1,34E+02	1,36E+00	2,71E-01	0,00E+00	2,09E-01	4,68E-02	2,34E-01
NRPM	MJ	-	-	-	-	-	-	-
TRPE	MJ	1,34E+02	1,36E+00	2,71E-01	0,00E+00	2,09E-01	4,68E-02	2,34E-01
SM	kg	1,60E-02	-	-	-	-	-	-
RSF	MJ	-	-	-	-	-	-	-
NRSF	MJ	-	-	-	-	-	-	-
W	m^3	9,43E-03	2,62E-03	1,48E-04	0,00E+00	4,03E-04	6,17E-05	1,81E-04

RPEE Renewable primary energy as energy carrier; **RPEM** Renewable primary energy as material utilisation; **TPE** Total use of renewable primary energy sources; **NRPE** Non-renewable primary energy as energy carrier; **NRPM** Non-renewable primary energy as material utilization; **TRPE** Total use of non-renewable primary energy sources; **SM** Use of secondary materials; **RSF** Renewable secondary fuels; **NRSF** Non-renewable secondary fuels; **W** Net use of fresh water

Table 10: Mapeplan M waste production & other output flows

System boundary		Ustream + core	Downstream					
Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
NHW	Kg	1,96E-03	-	-	-	-	-	-
HW	Kg	1,12E-02	-	-	-	-	-	-
RW	Kg	0,00E+00	-	-	-	-	-	-
Components for re-use	Kg	-	-	-	-	-	-	-
Materials for recycling	Kg	-	-	-	-	-	9,1E-01	-
Materials for energy recovery	Kg	-	-	-	-	-	-	-
Exported energy	MJ	-	-	-	-	-	-	-

HW Hazardous waste disposed; **NHW** Non Hazardous waste disposed; **RW** Radioactive waste disposed

Table 11: Mapeplan B Environmental categories

System boundary	Modules	GWP_{100} (Kg CO2 eq.)	ADPe (element) (Kg Sb eq.)	EP (Kg PO34- eq.)	AP (Kg SO2 eq.)	POCP (Kg ethylene eq.)	ODP (Kg R-11 eq.)	ADPf (fossil) (MJ)
Upstream + core	A1-A3	4,67E+00	1,87E-05	3,20E-03	2,27E-02	3,93E-03	1,30E-07	1,12E+02
Downstream	A4	9,27E-02	3,61E-09	1,04E-04	4,09E-04	-1,37E-04	3,78E-13	1,27E+00
	A5	1,01E-01	2,84E-09	2,96E-05	7,57E-05	3,55E-05	6,62E-12	1,96E-01
	C1	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	C2	1,43E-02	5,54E-10	1,51E-05	5,98E-05	-1,96E-05	5,81E-14	1,95E-01
	C3	2,29E-03	3,84E-09	3,96E-06	1,59E-05	2,26E-06	3,49E-14	4,25E-02
	C4	1,60E-02	5,98E-09	1,34E-05	9,76E-05	9,16E-06	2,57E-13	2,10E-01

GWP100: Global Warming Potential; **ADPe**: Abiotic Depletion Potential (elements); **EP**: Eutrophication Potential; **AP**: Acidification Potential; **POCP**: Photochemical Ozone Creation Potential; **ODP**: Ozone Depletion Potential; **ADPf**: Abiotic Depletion Potential (fossil)

Table 12: Mapeplan B other environmental indicators

System boundary		Ustream + core	Downstream					
Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
RPEE	MJ	5,54E+00	7,10E-02	3,78E-02	0,00E+00	1,09E-02	3,07E-03	2,15E-02
RPEM	MJ	-	-	-	-	-	-	-
TPE	MJ	5,54E+00	7,10E-02	3,78E-02	0,00E+00	1,09E-02	3,07E-03	2,15E-02
NRPE	MJ	1,26E+02	1,27E+00	2,57E-01	0,00E+00	1,95E-01	4,37E-02	2,19E-01
NRPM	MJ	-	-	-	-	-	-	-
TRPE	MJ	1,26E+02	1,27E+00	2,57E-01	0,00E+00	1,95E-01	4,37E-02	2,19E-01
SM	kg	1,60E-02	-	-	-	-	-	-
RSF	MJ	-	-	-	-	-	-	-
NRSF	MJ	-	-	-	-	-	-	-
W	m^3	8,00E-03	2,45E-03	1,41E-04	0,0E+00	3,76E-04	5,76E-05	1,69E-04

RPEE Renewable primary energy as energy carrier; **RPEM** Renewable primary energy as material utilisation; **TPE** Total use of renewable primary energy sources; **NRPE** Non-renewable primary energy as energy carrier; **NRPM** Non-renewable primary energy as material utilization; **TRPE** Total use of non-renewable primary energy sources; **SM** Use of secondary materials; **RSF** Renewable secondary fuels; **NRSF** Non-renewable secondary fuels; **W** Net use of fresh water

Table 13: Mapeplan B waste production & other output flows

System boundary		Ustream + core	Downstream					
Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4
NHW	Kg	2,03E-03	-	-	-	-	-	-
HW	Kg	1,12E-02	-	-	-	-	-	-
RW	Kg	0,00E+00	-	-	-	-	-	-
Components for re-use	Kg	-	-	-	-	-	-	-
Materials for recycling	Kg	-	-	-	-	-	9,1E-01	-
Materials for energy recovery	Kg	-	-	-	-	-	-	-
Exported energy	MJ	-	-	-	-	-	-	-

HW Hazardous waste disposed; **NHW** Non Hazardous waste disposed; **RW** Radioactive waste disposed

To calculate results for different thicknesses (1,2, 1,8 and 2,0 mm), please use following multiplicative coefficients for the environmental indicators considered (EI_x):

Table 14: Calculation rules for Environmental Categories of different thickness

	1,2 mm thickness	1,5 mm thickness	1,8 mm thickness	2,0 mm thickness
Mapeplan M	$EI_{1,5}$***0,83**	$EI_{1,5}$*1	$EI_{1,5}$ ***1,22**	$EI_{1,5}$***1,39**
Mapeplan B	-	$EI_{1,5}$*1	$EI_{1,5}$***1,22**	$EI_{1,5}$***1,39**

$EI_{1,5}$: Environmental Indicator for Mapeplan with 1,5 mm thickness

Tables above show absolute results for each of environmental impact categories. They clearly indicate that module **A1** has the highest contribution for each of them and accounts for up to 95% of the total impact in the whole system boundary.

In particular, PVC compounds, plasticizers and reinforcing materials, which are some of the main components in Mapeplan formulations, carry a significant impact for all environmental categories.

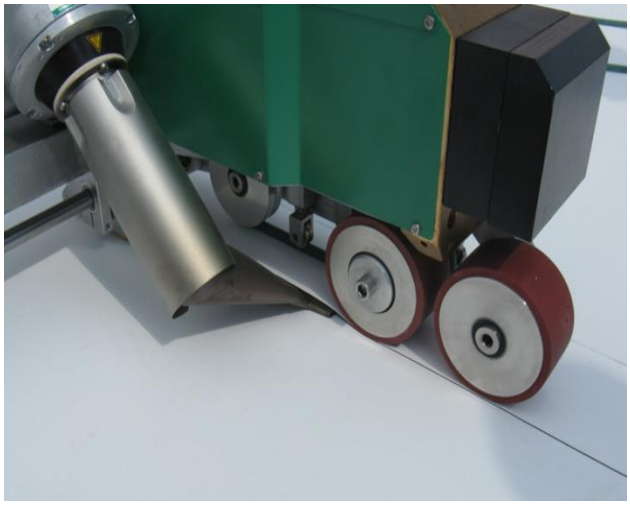


Figure 5: Installation process detail

Electricity consumption and F-gas included into the refrigerating system in the production process (module **A3**), considerably affects the GWP100, ADP (fossil) and ODP values.

In terms of GWP100, module **A5** gives an important contribution too, considering that, during the installation phase it's necessary to take into account a membranes overlap between 5% and 6%.

Transportation modules (**A2, A4**), have both relevant importance while **C2** module doesn't give a very high contribution.

Only for transportation modules **A2** and **A4**, POCP shows a negative contribution, due to nitrogen dioxide and monoxide emission factors as reported in CML v.4.2 methodology.

Figure above shows the hot air welding of Mapeplan by an automatic machine (rif. Leister Varimat V2).

Figure on the right shows the Mapeplan installed on roof with gravel ballast.

Figure 6: Membrane MAPEPLAN B on ballasted roof

Table 15: Environmental Impact as percentage of Mapeplan M

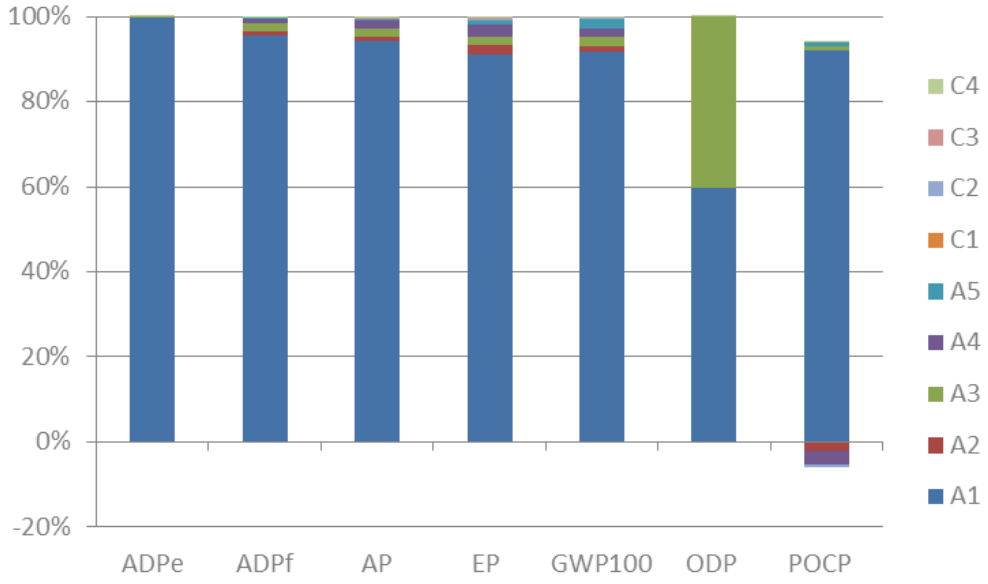
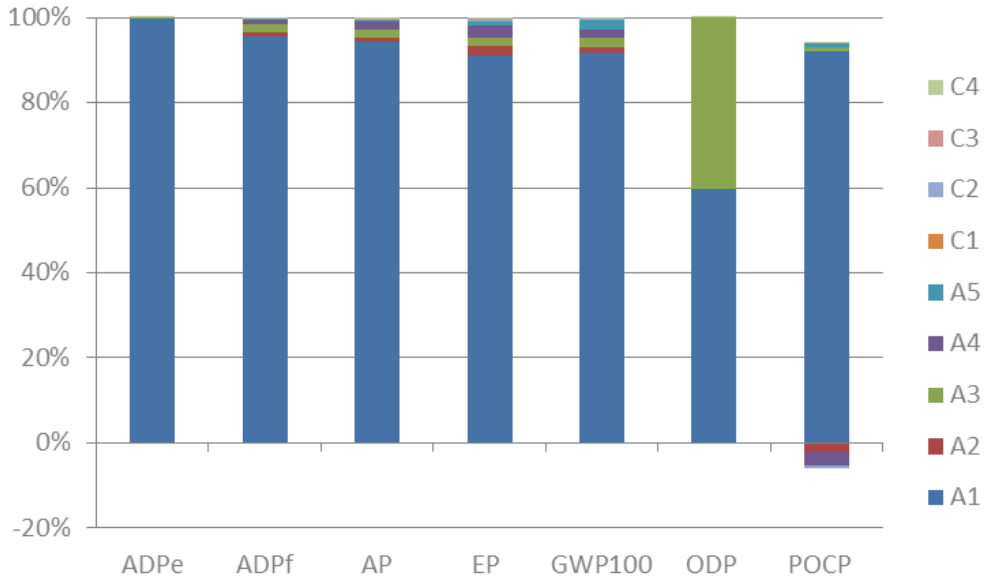


Table 16: Environmental Impact as percentage of Mapeplan B



More details about electrical mix used in this EPD (Italian grid mix – 2011), is shown below:

Data source	Amount	Unit
GaBi (v6) database	0,490	Kg CO_2-eqv/kWh

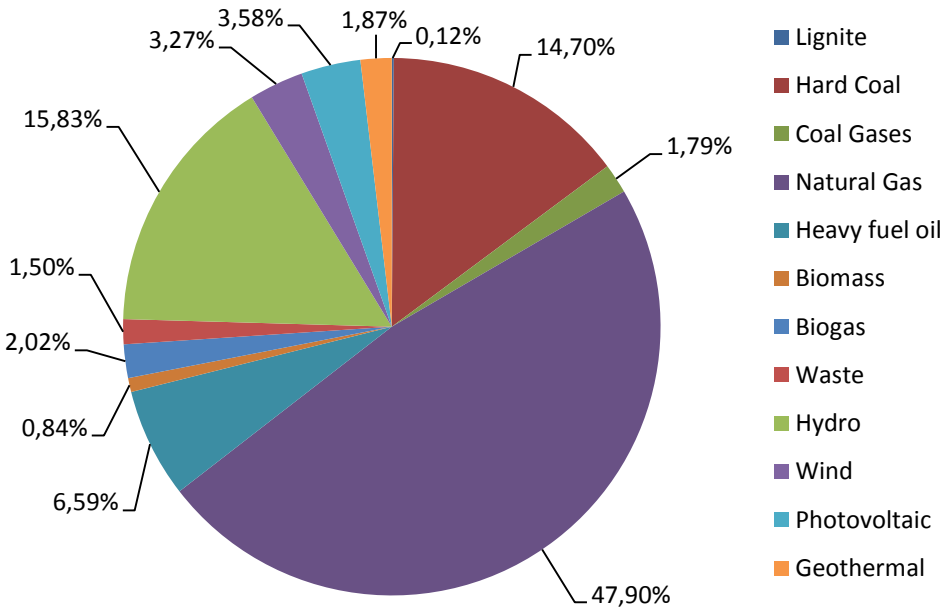


Figure 7: Electricity Mix - Italy - 2011

This data represents the average country specific electricity supply for final consumers, including electricity own consumption, transmission/distribution losses and electricity imports from neighbouring countries. The national energy carrier mixes used for electricity production, the power plant efficiency data, shares on direct to combined heat and power generation (CHP), as well as transmission/distribution losses and own consumption are taken from official statistics (International Energy Agency) for the corresponding reference year.

8. Data Quality

Table 17: Data quality

Dataset & Geographical reference	Database (source)	Temporary reference
A1		
PVC Compound	Ecoinvent 3.1 Database	2015
Reinforcing materials	Ecoinvent 3.1 Database	2013
Additives	GaBi & Ecoinvent 3.1	2015
Electricity grid mix (IT)	GaBi Database	2011
Thermal energy from natural gas (IT)	GaBi Database	2011
A2-A4 (Transport)		
Truck transport (27ton payload – GLO)	GaBi Database	2012
Rail transport (GLO)	GaBi Database	2013
Electricity mix (EU)	GaBi Database	2011
Diesel for transport (EU)	GaBi Database	2011
A3 (production)		
Wastes (EU & DE)	GaBi Database& PlasticEurope	2005-2013
Packaging (EU)	GaBi Database& PlasticEurope	2005-2013
Diesel mix (EU)	GaBi Database& PlasticEurope	2011
Waste water treatment (EU)	GaBi Database& PlasticEurope	2010
Landfill for plastic waste (EU)	GaBi Database& PlasticEurope	2013
Landfill for inert matter (EU)	GaBi Database& PlasticEurope	2013
A4 (Transport)		
Truck transport (27ton payload – GLO)	GaBi Database	2012
Rail transport (GLO)	GaBi Database	2013
Electricity mix (EU)	GaBi Database	2011
Diesel for transport (EU)	GaBi Database	2011
A5 (Installation)		
Electricity grid mix (EU)	GaBi Database	2011
Landfill for plastic waste (EU)	GaBi Database	2013
Landfill for wood waste (EU)	GaBi Database	2013
Landfill for paper waste (EU)	GaBi Database	2013
Landfill for metal waste (EU)	GaBi Database	2013
C1-C4 (End of Life)		
Truck transport (9,3ton payload – GLO)	GaBi Database	2013
Electricity grid mix (EU)	GaBi Database	2011
Landfill for inert matter (EU)	GaBi Database	2013
Construction waste treatment (DE)	GaBi Database	2013

Transport datasets have a global or European representativeness.

All dataset are not more than 10 years old (according to EN 15804 § 6.3.7 *"data quality requirements"*).

Primary data are collected during 2015 and representative for the entire annual production.

9. Verification and Registration

EPD of construction products may not be comparable if they do not comply with EN 15804

“Environmental product declarations within the same product category from different programs may not be comparable

CEN standard EN15804 served as the core PCR	
PCR:	PCR 2012:01 Construction products and Construction services, Version 2.01, 2016-03-09
PCR review was conducted by:	The Technical Committee of the International EPD® System. Chair:Massimo Marino Contact via info@environdec.com
Independent verification of the declaration and data, according to ISO 14025	☒ EPD Process Certification (Internal) ☐ EPD Verification (external)
Third party verifier:	Certiquality S.r.l. Number of accreditation: 003H rev14
Accredited or approved by:	Accredia

10. References

- General Programme Instructions of the International EPD® System. Version 2.5.
- PCR 2012:01; “PRODUCT GROUP CLASSIFICATION: MULTIPLE UN CPC CODES CONSTRUCTION PRODUCTS AND CONSTRUCTION SERVICES”; Version 2.01
- PCR 2014:12 FLEXIBLE SHEETS FOR WATERPROOFING - BITUMEN , PLASTIC OR RUBBER SHEETS FOR ROOF WATERPROOFING

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