ARDEX R50ES
Resina 100% sólidos, multiusos

Declaración de Ambiental de Producto (DAP) según Modelo EPD

FEICA (Asociación de la Industria Europea de Adhesivos y Selladores) ha desarrollado las denominadas Declaraciones Ambientales de Producto (Modelo EPD) y las ha verificado de forma independiente por el Instituto de Construcción y Medio Ambiente (IBU). Estos modelos de EPD verificados por IBU han sido puestos a disposición del público por FEICA e IBU. Los modelos de EPD representan la tecnología de producción actual en Europa. ARDEX CEMENTO, S.A., como miembro de la Asociación Española de Fabricantes de Colas y Adhesivos (ASEFCA), que es una asociación nacional miembro de FEICA, tiene derecho a declarar que un modelo específico de EPD de FEICA aplica al producto mencionado que se enumera a continuación. La conformidad de nuestros productos con los modelos de EPD se verifica sobre la base de nuestras formulaciones, mediante el uso de un procedimiento de guía aprobado por IBU. Por la presente declaramos que el producto

ARDEX R50ES, Resina 100% sólidos, multiusos

cumple los criterios del Modelo EPD adjunto

EPD-FEI-20150302-IBG1-EN para "Resinas reactivas a base de resina epoxi, rellenas y/o acuosas con bajo contenido de relleno"

Esto significa que los datos de evaluación del ciclo de vida y otros contenidos del Modelo de EPD se aplican a este tipo de productos y pueden usarse para la evaluación de la sostenibilidad de los productos de construcción y proyectos de construcción en los que se utilizan.

ARDEX CEMENTO, S.A.

ppa.

Joan Bo
Head of Technical Department

Apéndice:

EPD (DAP) con número de declaración: **EPD-FEI-20150302-IBG1-EN**

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ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	FEICA - Association of the European Adhesive and Sealant Industry
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-FEI-20150302-IBG1-EN
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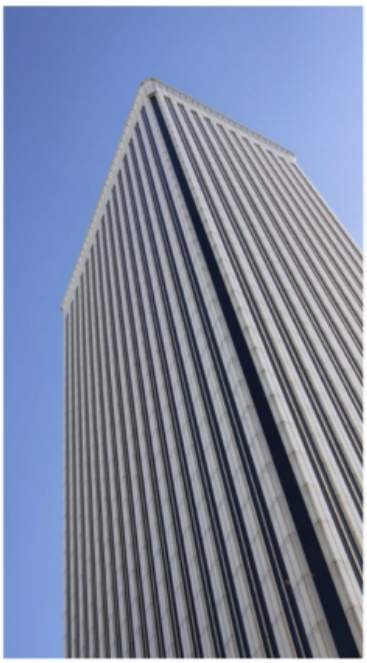
Issue date	14/12/2015
Valid to	13/06/2022

Reactive resins based on epoxy resin, filled and/or aqueous with low content of filler

FEICA - Association of the European Adhesive and Sealant Industry

www.bau-umwelt.com / https://epd-online.com



1. General Information

FEICA - Association of the European Adhesive and Sealant Industry

Reactive resins based on epoxy resin, filled and/or aqueous with low content of filler

Programme holder
IBU - Institut Bauen und Umwelt e.V.
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Germany

Owner of the Declaration
FEICA - Association of the European Adhesive and Sealant Industry
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1040 Brussels
Belgium

Declaration number
EPD-FEI-20150302-IBG1-EN

Declared product / Declared unit
1 kg reactive resin based on epoxy resin, filled and/or aqueous filled; density 1.1 - 2.5 g/cm³

This Declaration is based on the Product Category Rules:
Reaction resin products, 07.2014
(PCR tested and approved by the SVR)

Scope:
This validated Declaration entitles the holder to bear the symbol of the *Institut Bauen und Umwelt e.V.* It exclusively applies for products produced in Europe and for a period of five years from the date of issue. This EPD may be used by FEICA members and their members provided it has been proven that the respective product can be represented by this EPD. For this purpose a guideline is available at the FEICA secretariat. The members of FEICA are listed on its website. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Issue date
14/12/2015

Valid to
13/06/2022

Verification

The CEN Norm /EN 15804/ serves as the core PCR
Independent verification of the declaration according to /ISO 14025/
☐ internally ☒ externally

Prof. Dr.-Ing. Horst J. Bossenmayer
(President of Institut Bauen und Umwelt e.V.)

Dr. Burkhart Lehmann
(Managing Director IBU)

Mr Olivier Muller
(Independent verifier appointed by SVR)

2. Product

2.1 Product description

Reactive resins based on epoxy resin, filled and/or aqueous filled

The reactive resins are manufactured in a two-component process using reactively-diluted epoxy resins and polyamines. The aqueous systems can be formulated as aqueous dispersions on the resin or hardening agent side.

They comply with multiple, often specific tasks in the construction, fitting and repair of structures. By using reactive resins based on epoxy resin, filled and/or aqueous filled, the fitness for use of structures is decisively improved and their life time extended.

The product displaying the highest environmental impacts was used as a representative product for calculating the Life Cycle Assessment results (worst case-approach).

2.2 Application

Reactive resins based on epoxy resin, filled and/or aqueous filled, are used in the following applications:

Module 1: *Reactive resins for protecting and repairing concrete structures*

Products for **surface protection of concrete**, for increasing the durability of concrete and reinforced concrete structures as well as for new concrete and for maintenance and repair work, products for **structural and non-structural repair** used for restoring the original condition of concrete structures and/or replacing faulty concrete and providing reinforcements with protection; products for **structural bonding** of strengthening materials to an existing concrete structure and **products for concrete injection** for filling cracks, voids and interstices in concrete.

Module 2: *Reactive resins for liquid applied roof waterproofing kits*

Reactive resins for waterproofing roof constructions which are applied on the construction site

Module 3: *Reactive resin primer for bridge waterproofing*

Primer for bridge waterproofing for use on bridges made of concrete

Module 4: *Reactive resins as adhesive for tiles*
Tile adhesives for internal and external tile installations on walls, floors and ceilings.
Module 5: *Reactive resins for watertight covering kits*
Watertight covering kits for wet room floors and/or walls inside buildings
Module 6:*Reactive resins for liquid applied waterproofings for buildings*
Liquid applied products for waterproofing of buildings
Module 7: *Screed material and floor screeds*
Products for screed / synthetic resin screed for use in floor constructions
Module 8: *Reactive resins for waterproofing components made of concrete or brickwork and for pre-treating mineral sub-surfaces such as screed or concrete flooring prior to flooring, parquet and tiling work*
Applications in accordance with the manufacturer's technical documentation / declaration of performance
Module 9: *Reactive resins for optical design of concrete components*
Products for usually coloured design of concrete accompanied by less-specified surface protection and improved durability of concrete and reinforced concrete surfaces. The same applies for other mineral sub-surfaces such as plaster, stone and brickwork.
On account of the susceptibility of epoxy resin layers to weathering factors (yellowing, whiting after extensive weathering), a final polyurethane-based coating is usually applied to epoxy layers in outdoor applications.

2.3 Technical Data

Module 1: *Reactive resins for protecting and repairing concrete structures*
The minimum requirements of /EN 1504/ apply. These are:
1.1 **Surface protection** systems for concrete – Requirements on performance characteristics for all intended uses in accordance with /EN 1504-2:2005-01/, Tables 1 and 5:
- Permeability to CO2 (/EN 1062-6:2002-10/)
- Water vapour permeability (/EN ISO 7783-1/-2:2012-02/)
- Capillary absorption and permeability to water (/EN 1062-3:2008-04/)
- Adhesive strength by pull off test (/EN 1542:1999-07/)

1.2 Products for **structural and non-structural repair** – Requirements on performance characteristics for all intended uses in accordance with /EN 1504-3/, Tables 1 and 3:
- Compressive strength (/EN 12190/)
- Chloride content (/EN 1015-17/)
- Adhesive strength by pull off test (/EN 1542:1999-07/)

1.3 Products for **structural bonding** – Performance characteristics for all intended uses in accordance with Tables 3.1 and 3.2 (manufacturer's declaration of performance)-
1.4 Products for **concrete injection** for filling cracks, voids and interstices in concrete– Requirements on performance characteristics for all intended uses in accordance with /EN 1504-5:2005-03/, Table 3:
- Injectability (/EN 1771:2004-11/)
- Viscosity (/EN ISO 3219:1994-10/)

Other performance characteristics in accordance with the manufacturer's technical documentation / declaration of performance
Module 2: *Reactive resins for liquid applied roof waterproofing kits*
The minimum requirements of /ETAG 005/ must be maintained.
The performance requirements must be indicated in accordance with the European Technical Assessment (ETA, no.).
Module 3: *Reactive resins for liquid-applied bridge deck waterproofing kits*
The minimum requirements of /ETAG 033/ apply.
The performance characteristics must be indicated in accordance with the European Technical Assessment (ETA, no.).
Module 4: *Reactive resins as adhesive for tiles*
The minimum requirements in accordance with /EN 12004:2012-09/ apply. These are:
- Initial shear adhesion strength (/EN 12003:2009-01/)
- Shear adhesion strength after water immersion (/EN 12003:2009-01/) Open time: tensile adhesion strength (/EN 1346:2007-11

Other performance characteristics in accordance with the manufacturer's technical documentation / Declaration of Performance
Module 5: *Reactive resins for watertight covering kits*
The minimum requirements of the /ETAG 022/ must be maintained.
The performance characteristics must be indicated in accordance with the European Technical Assessment (ETA, no.).
Module 6: *Reactive resins for liquid applied waterproofings for buildings*
Module 7: *Screed material and floor screeds*
The minimum requirements of /EN 13813:2003-01/ apply. For synthetic resin screeds, these are:
- Bond strength (/EN 13892-8:2003-02/)
- Reaction to fire (/EN 13501-1:2010-01/)

Performance characteristics in accordance with the manufacturer's technical documentation / declaration of performance
Module 8: *Reactive resins for waterproofing components made of concrete or brickwork and for pre-treating sub-surfaces such as screed or concrete flooring prior to flooring, parquet and tiling work*
At least the following requirements must be fulfilled:

Name	Value	Unit
Shore hardness A /ISO 7619-1,2/	> 50	
Shore hardness D /ISO 7619-1,2/	> 25	
Density /EN ISO 2811: 2011-06/	0,9 - 2	kg/dm³
Viscosity /EN ISO 3219: 1994-10/	< 200	Pa s

Other performance characteristics are in accordance with the manufacturer's technical documentation / declaration of performance
Module 9: *Reactive resins for optical design of concrete components*
Physical data on the coating material and/or coating must be indicated in accordance with the respective product standards; these can include, for example:
- Viscosity (/EN ISO 3219:1994-10/)
- Density (/EN ISO 2811:2011-06/)
- Pendulum damping (/ISO 1522:2007-04/)
- Reaction to fire (/EN 13501-1:2010-01/)
- Tensile strength (/EN 13892-8:2003-02/)

Other performance characteristics are in accordance with the manufacturer's technical documentation / declaration of performance.

2.4 Placing on the market / Application rules

For the placing on the market in the EU/EFTA (with the exception of Switzerland) products falling under the Regulation (EU) No 305/2011 need a Declaration of Performance taking into consideration either the relevant harmonised European standard or the European Technical Assessment and the CE-marking. For the application and use of the products the respective national provisions apply.

2.5 Delivery status

Liquid or pasty in containers made of tinplate or plastic appropriately prepared in separate or combi-containers for the practical mixing ratio. One kg of product in individual containers. Sealants in plastic cartridges and poly-tube bags made of foil compound materials. Typical container sizes contain 10 to 25 kg of material. For more extensive applications, vats containing approx. 200 kg or IBCs containing more than 1 tonne are also used.
A sheet steel container was modelled for the Life Cycle Assessment.

2.6 Base materials / Ancillary materials

Reactive resins based on epoxy resin, filled and/or aqueous filled, comprise resin and crosslinking agent components. Aqueous, filled systems can be formulated as aqueous dispersions on the resin or crosslinking agent side.
The resin component contains low-molecular epoxy resins based on Bisphenol-A and Bisphenol-F Diglycidether. Reactive diluting agents (Glycidether) based on aliphatic alcohol are used for viscosity adjustment. Crosslinking occurs when installed on site with the amine component. Polyamines and polyamine adducts based on IPDA, MXDA, TMDA and TEPA are used for this purpose. The components can contain accelerators, catalysts, wetting agents, foam regulators, inert diluting agents (no solvents) for fine adjustment of the product properties as auxiliaries (restrictions governing application or placing on the market must be observed).
The mixing ratio for resin and crosslinker is adjusted in accordance with the stoichiometric requirements. Product crosslinking starts immediately after mixing the components.
On average, the products covered by this EPD contain the following range of base materials and auxiliaries:
Resin component: ~ 45-65%
Crosslinker component: ~ 10-15%
Reactive diluting agent: ~ 15-30%
Filler material: 5-15%
Other: ~ <1.5%
The ranges referred to above are average values and the composition of products complying with the EPD can deviate from the concentration volumes referred to in individual cases. Deviations are possible. More detailed information is provided by the respective manufacturer (e.g. product data sheets).
In individual cases, it is possible that substances on the list of particularly harmful substances for inclusion in Annex XIV of the /REACH/ Ordinance are included in concentrations of more than 0.1%. If this is the case, this information can be found in the respective safety data sheet.

2.7 Manufacture

The product components formulated are usually mixed from the ingredients in batch mode and packaged for delivery, whereby quality and environmental standards in accordance with /ISO 9001:2008-12/ and the provisions outlined in the relevant regulations such as the Industrial Safety Regulation and Federal Pollution Control Act are adhered to.

2.8 Environment and health during manufacturing

As a general rule, no other environmental protection measures other than those specified by law are necessary.

2.9 Product processing/Installation

Reactive resins based on epoxy resin (filled and/or water-filled)
are processed by trowelling/knife-coating or rolling, pouring, spraying or injection, whereby health and safety measures (hand and eye protection, ventilation, respiratory equipment) are to be taken and consistently adhered to in accordance with the information on the safety data sheet and conditions on site. VOC-Emissions may occur.

2.10 Packaging

A detailed description of packaging is provided in section 2.5. Empty containers and clean foils can be recycled.

2.11 Condition of use

During the use phase, reactive resins based on epoxy, unfilled/solvent-free, are crosslinked and essentially comprise an inert, three-dimensional network.
They are long-lasting products which protect our buildings in the form of primer, coatings or sealings and make a significant contribution towards retaining their function and long-term value

2.12 Environment and health during use

Option 1 – Products for applications outside indoor areas with permanent stays by people
During use, reactive resins based on epoxy, filled and/or aqueous filled, lose their reactivity and react inert.
No risks are known for water, air and soil if the products are used as designated.
Option 2 – Products for applications inside indoor areas with permanent stays by people
When used in indoor areas with permanent stays by people, evidence of the emission performance of construction products in contact with indoor air must be submitted according to national requirements. No further influences on the environment and health by emanating substances are known.

2.13 Reference service life

Reactive resins based on epoxy resin, aqueous (unfilled), comply with various, often specific tasks associated with the construction or refurbishment of building structures. Use thereof decisively improves the usability of building structures and significantly extends their Reference Service Life.
The anticipated Reference Service Life depends on the specific installation situation and associated product exposure. It can be influenced by weather factors as well as by mechanical or chemical loads.

2.14 Extraordinary effects

Fire
Even without any special fire safety fittings, the reactive resins based on epoxy, unfilled/solvent-free, comply with the minimum requirements of /EN 13501-

1/ for fire class E and Efl. In terms of the volumes used, they only have a subordinate effect on the fire characteristics of a building in which they are installed. As cross-linked epoxy resins involve a duroplastic material, it does not melt or drip with the result that the resins do not contribute to fire spread, whereas the combustibility of cross-linked epoxy resins is greater than that of other duroplastics. Among other substances, formaldehyde and phenol can be formed in the event of a fire.

Water
The reactive resins based on epoxy, unfilled/solvent-free, are chemically inert and water-insoluble. They are often used for protecting building structures from harmful water ingress / the effects of flooding.

Mechanical destruction
Mechanical destruction of reactive resins based on epoxy resin does not lead to any decomposition products which are harmful to the environment or health.

2.15 Re-use phase
According to present knowledge, no environmentally-harmful effects are generally anticipated in landfilling, for example, as a result of de-construction and recycling of building materials to which crosslinked epoxy resin products are adherent.
If epoxy systems can be removed from construction products without any noticeable effort, thermal utilisation is a practical recycling variant on account of their energy content.
Minor adhesion is not taken into consideration during disposal. It does not interfere with disposal/recycling of the remaining components / building materials.

2.16 Disposal
Individual components which can no longer be recycled must be combined at a specified ratio and hardened.
Hardened product residue is not special waste.
Non-hardened product residue is special waste.
Empty, dried containers (free of drops and scraped clean) are directed to the recycling process. Residue must be directed to proper waste disposal taking consideration of local guidelines.
The following European Waste Codes waste (EWC) codes can apply:
Hardened product residue:
/EWC 2000/532/EC 080112/ with the exception of those covered by /EWC 2000/532/EC08 01 11/
/EWC 2000/532/EC 080410/ with the exception of those covered by /EWC 2000/532/EC 08 04 09/

2.17 Further information
More information is available in the manufacturer's product or safety data sheets and is available on the manufacturer's Web sites or on request. Valuable technical information is also available on the associations' Web sites.

3. LCA: Calculation rules

3.1 Declared Unit
This EPD refers to the declared unit of 1 kg reactive resin based on epoxy resin, filled and/or aqueous filled of density 1.1 - 2.5 g/cm³ in the mixing ratio required for processing both components in accordance with the PCR Part B for Reactive resin products.
Consumption per unit area of the products to be applied extensively can range between only a few hundred grams and more than 1 kg per square metre.
In the case of products, which are injected, the application volume depends on the component to be injected.
The results of the Life Cycle Assessment provided in this declaration have been calculated from the product with the highest environmental impact (worst-case scenario).

Declared unit

Name	Value	Unit
Declared unit	1	kg
Conversion factor to 1 kg	1	-

3.2 System boundary
Modules A1-A3, A4, A5 and D are taken into consideration in the LCA:

- A1 Production of preliminary products
- A2 Transport to plant
- A3 Production incl. provision of energy, production of packaging as well as auxiliaries and consumables, waste treatment)
- A4 Transport to site
- A5 Installation (disposal of packaging & installation losses and emissions during installation)
- D Credits from incineration of packaging materials & installation losses and recycling the metal container

The declaration is therefore from "cradle to gate - with options".

3.3 Estimates and assumptions
Where no specific /GaBi/ processes were available, the individual recipe ingredients of formulation were estimated on the basis of information provided by the manufacturer or literary sources.

3.4 Cut-off criteria
All raw materials submitted for the formulations and production data were taken into consideration.
The manufacture of machinery, plants and other infrastructure required for production of the products under review was not taken into consideration in the LCA.
Transport of packaging materials is also excluded.

3.5 Background data
Data from the /GaBi 6/ database was used as background data. Where no background data was available, it was complemented by manufacturer information and literary research.

3.6 Data quality
Representative products were applied for this EPD and the product in a group displaying the highest environmental impact was selected for calculating the LCA results. The datasets are less than 5 years old. Production data and packaging are based on details

provided by the manufacturer. The formulation used for evaluation refers to a specific product.

3.7 Period under review

Representative formulations were accepted by FEICA Ltd and collected in 2011.

3.8 Allocation

No allocations were applied for production. A multi-input allocation with a credit for electricity and thermal energy was used for incineration of production residues and packaging materials. The credits achieved through packaging disposal are declared in Module D.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account. In this case, 1 kg reactive resin was selected as the declared unit. Depending on the application, a corresponding conversion factor such as the specific unit area must be taken into consideration.

4. LCA: Scenarios and additional technical information

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

Transport to the building site (A4)

Name	Value	Unit
Litres of fuel	0.0016	l/100km
Transport distance	1000	km
Capacity utilisation (including empty runs)	85	%
Gross density of products transported	1100 - 2500	kg/m^3
Capacity utilisation volume factor	1	-

Installation into the building (A5)

Name	Value	Unit
Material loss	0.01	kg
VOC in the air (NMVOC)	0.02	kg

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	X	X	MND	MND	MNR	MNR	MNR	MND	MND	MND	MND	MND	MND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 kg reactive resin based on epoxy resin, filled and/or aqueous filled

Parameter	Unit	A1-A3	A4	A5	D
Global warming potential	[kg CO_2-Eq.]	5.90E+0	4.91E-2	9.15E-2	-1.50E-1
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	6.05E-10	2.02E-13	3.84E-13	-1.01E-11
Acidification potential of land and water	[kg SO_2-Eq.]	1.20E-2	1.26E-4	1.39E-5	-5.43E-4
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	1.56E-3	3.11E-5	2.58E-6	-4.40E-5
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	2.29E-3	-3.41E-5	7.22E-3	-7.46E-5
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	2.52E-5	1.93E-9	1.10E-9	-4.53E-9
Abiotic depletion potential for fossil resources	[MJ]	1.16E+2	6.76E-1	2.01E-2	-1.55E+0

RESULTS OF THE LCA - RESOURCE USE: 1 kg reactive resin based on epoxy resin, filled and/or aqueous filled

Parameter	Unit	A1-A3	A4	A5	D
Renewable primary energy as energy carrier	[MJ]	3.76E+0	IND	IND	IND
Renewable primary energy resources as material utilization	[MJ]	7.30E-1	IND	IND	IND
Total use of renewable primary energy resources	[MJ]	4.49E+0	3.79E-2	2.25E-3	-2.27E-2
Non-renewable primary energy as energy carrier	[MJ]	9.86E+1	IND	IND	IND
Non-renewable primary energy as material utilization	[MJ]	2.34E+1	IND	IND	IND
Total use of non-renewable primary energy resources	[MJ]	1.22E+2	6.79E-1	2.38E-2	-1.60E+0
Use of secondary material	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	[m^3]	3.29E-2	6.65E-5	2.35E-4	-1.91E-4

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 kg reactive resin based on epoxy resin, filled and/or aqueous filled

Parameter	Unit	A1-A3	A4	A5	D
Hazardous waste disposed	[kg]	1.28E-3	3.22E-7	6.99E-9	-6.38E-9
Non-hazardous waste disposed	[kg]	4.08E-2	9.66E-5	1.38E-3	1.76E-3
Radioactive waste disposed	[kg]	2.58E-3	9.27E-7	1.47E-6	-1.80E-5
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for energy recovery	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	1.14E-1	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	2.67E-1	0.00E+0

6. LCA: Interpretation

All impacts are associated with the production phase (A1-A3). The most significant contribution to the production phase impacts is the upstream production of raw materials as main driver. Another relevant contributor in the production phase, in the category of Abiotic Depletion Potential Elements (**ADPE**), is the steel sheet used as a packaging material.
The majority of life cycle energy consumption takes place during the production phase (A1-A3). Significant contributions to Primary Energy Demand – Non-renewable (**PENRT**) derive from the energy resources used in the production of raw materials. The largest contributor to Primary Energy Demand – Renewable (**PERT**) is the consumption of renewable energy resources required for the generation and supply of electricity. During manufacturing (A1-A3) some influence also arises due to the wooden pallets used as packaging that need solar energy for photosynthesis. It should be noted that Primary Energy Demand – Renewable (**PERT**) generally represents a small percentage of the production phase primary energy demand with the bulk of the demand coming from non-renewable energy resources.
Transportation to the construction site (A4) and the installation process (A5) make a negligible contribution to almost all impacts. The only exception is the photochemical ozone creation potential (**POCP**) that is significantly influenced by the installation of the product due to emissions of benzyl alcohol of maximum 2%. This leads to a contribution of the installation phase of

up to 80% on the overall life cycle of the product. Emissions associated with the manufacturing of products (A3) only have a minor influence on POCP. In module A4, transport to construction site, values for POCP are negative due to emission profile modelled for the selected transportation process and of the characterisation method used in CML 2001 for the calculation of the POCP.

Scrap burdens and energy credit from incineration of packaging material reported in module D are not important (contribution <2.5% for most results). CO_2 is the most important contributor to Global Warming Potential (GWP). For the Acidification Potential (AP), NO_x and SO_2 contribute to the largest share.

7. Requisite evidence

VOC

Special tests and evidence have not been carried out or provided within the framework of drawing up this Model EPD. Some member states require special documentation on VOC emissions into indoor air for specific areas of application. This documentation, as well as documentation for voluntary VOC labelling, has to be provided separately and is specific for products in question.

Evidence pertaining to VOC emissions shall show
- either an attestation of compliance with,
- or documentation of test data that are required in,

any of the existing regulations or in any of the existing voluntary labeling programs for low-emitting products, as far as these

(1) include limits for the parameters TVOC, TSVOC, carcinogens, formaldehyde, acetaldehyde, LCI limits for individual substances (including but not limited to the European list of harmonized LCIs), and the R value;

(2) base their test methods on /CEN/TS 16516/ (or /EN 16516/, after the on-going revision of /CEN/TS 16516/);

(3) perform testing and apply the limits after 28 days storage in a ventilated test chamber, under the conditions specified in /CEN/TS 16516/; some regulations and programs also have limits after 3 days, on top of the 28 days limits;

(4) express the test results as air concentrations in the European Reference Room, as specified in /CEN/TS 16516/.

Examples of such regulations are the Belgian /Royal Decree C-2014/24239/, or the German /AgBB/. Examples of such voluntary labeling programs are EMICODE, Blue Angel or Indoor Air Comfort.

Relevant test results shall be produced either by an /ISO 17025/ accredited commercial test lab, or by a qualified internal test lab of the manufacturer. Examples for the applied limits after 28 days storage in a ventilated test chamber are:
- TVOC: 1000 µg/m³
- TSVOC: 100 µg/m³
- Each carcinogen: 1 µg/m³
- Formaldehyde: 100 µg/m³
- LCI: different per substance involved
- R value: 1 (meaning that, in total, 100% of the combined LCI values must not be exceeded).

Informative Annexes (2 tables):
The table shown below is an overview of the most relevant regulations and specifications as of April 2015, as regards requirements after 3 days storage in a ventilated test chamber.

	TVOC [µg/m³]	Sum of carcinogens. C1A,CA2 [µg/m³]	Formal-dehyde [µg/m³]	Acet-aldehyde [µg/m³]	Sum of Form- and Acet-aldehyde
German DIBt/AgBB regulation	10 000	10	-/-	-/-	-/-
draft Lithuanian regulation	10 000	10	-/-	-/-	-/-
EMICODE EC1	1 000	10	50	50	50 ppb
EMICODE EC1 *PLUS*	750	10	50	50	50 ppb

The table above provides an overview of the most relevant regulations and specifications as of April 2015, as regards requirements after 28 days storage in a ventilated test chamber. Some details may be missing in the table due to lack of space. Values given represent maximum values/limits.

	TVOC [µg/m³]	TSVOC [µg/m³]	Each carcinogen C1A,CA2 [µg/m³]	Formaldehyde [µg/m³]	Acetaldehyde [µg/m³]	LCI	R value	Specials	Sum non-LCI & non-identified [µg/m³]
Belgian regulation	1000	100	1	100	200	Belgian list	1	Toluene 300 µg/m³	-/-
French regulations class A+	1000	-/-	-/-	10	200	-/-	-/-	List of 8 VOCs, 4 CMR	-/-
French regulations class A	1500	-/-	-/-	60	300	-/-	-/-	List of 8 VOCs, 4 CMR	-/-
French regulations class B	2000	-/-	-/-	120	400	-/-	-/-	List of 8 VOCs, 4 CMR	-/-
French regulations class C	>2000	-/-	-/-	>120	>400	-/-	-/-	List of 8 VOCs, 4 CMR	-/-
German DIBt/AgBB regulation	1000	100	1	100	1200	German AgBB list	1	-/-	100
draft Lithuanian regulation	1000	100	1	product type specific	-/-	Lithua-nian list	1	-/-	-/-
EMICODE EC1	100	50	1	(after 3 days)	(after 3 days)	-/-	-/-	-/-	-/-
EMICODE EC1 *PLUS*	60	40	1	(after 3 days)	(after 3 days)	German AgBB list	1	-/-	40
Finnish M1, sealants	20	-/-	1	10	-/-	-/-	-/-	Ammonia, odour	-/-
Finnish M1, adhesives	200 µg/m²h	-/-	5 µg/m²h	50 µg/m²h	-/-	-/-	-/-	Ammonia, odour	-/-

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