



**Karndean**  
**Design**flooring

## ENVIRONMENTAL PRODUCT DECLARATION

### PRINTED LUXURY POLYVINYL CHLORIDE FLOOR COVERING



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**ENVIRONMENTAL PRODUCT DECLARATION - PROGRAMME RELATED INFORMATION**

EPD Program operator	The Australasian EPD® Programme c/o Enviro-Mark Solutions Level 14 / Prime Property Tower 86-90 Lambton Quay Wellington 6011 New Zealand <a href="http://www.epd-australasia.com">http://www.epd-australasia.com</a>	
Product Category Rules (PCR)	PCR 2012:01 International EPD system - Product Category Rule 2012:01 - Construction products and services V2.0. EN 15804:2012+A1:2013- Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products	
PCR review conducted by	Technical committee of the International EPD System - information available on <a href="http://epd-australasia.com/">http://epd-australasia.com/</a>	
Independent Verification according ISO 14025:2006	EPD verification <input checked="" type="checkbox"/> <input type="checkbox"/> internal <input checked="" type="checkbox"/> external EPD process verification <input type="checkbox"/>	
Approved third party verifier	Jane Anderson (Principal Consultant, Thinkstep) Email: <a href="mailto:jane.anderson@thinkstep.com">jane.anderson@thinkstep.com</a>	
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UN CPC code	36910 - floor covering of plastics in rolls or in the form of tiles	
ANZSIC code	1912 Rigid and semi-rigid polymer product manufacturing	
Geographic scope of application of the EPD	Australia, New Zealand	
Year taken as reference for the LCA calculation	2012	
Issue date	19/10/2016	
Valid to	18/10/2021	
Registration number	S-P00721	

## ENVIRONMENTAL PRODUCT DECLARATION

**1- Karndean Designflooring** - For over 40 years we have been creating stylish, high quality design flooring for the home and commercial projects. A global leader in flooring design with operations in the USA, Australia, New Zealand and Europe, we pride ourselves on environmental awareness in the supply and maintenance of our products worldwide. As a family-owned business, we remain true to our roots and are fiercely committed to our customers.

This EPD is conducted on the basis of ISO 14044, ISO 14025, EN 15804 and PCR 2012:01 International EPD system - Product Category Rule 2012:01 - Construction products and services V2.0. A related EPD exists for the North American and European markets.

Production sites:

The products are manufactured in three production sites which are certified ISO 9001 located in South Korea, Taiwan and China. These sites produce the same range of products. Two of them have Ecospecifier Global GreenTag certification to GreenStar Level 'A' requirements and the third is coming soon.

## 2 - Product description

### 2.1 - Product definition

This declaration for Luxury Vinyl Tile for the Australian and New Zealand market covers a range of 7 products of varying styles and colours.

Vinyl tile is made primarily from calcium carbonate (limestone), polyvinyl chloride, plasticizers, additives (i.e., pigments and stabilizers). It is structured with five layers: two PVC backing layers, one high definition photographic layer, one clear PVC embossed wear layer and a final PU protective layer.

**Diagram 1: Structure of the product**



Luxury vinyl tile is used in both commercial and residential interiors. It is commonly available in 2.0mm, 2.5 mm, 3.0 mm, 4.5 mm thicknesses. The weight of the reference product is 5.69 kg/m<sup>2</sup>.

Decorative applications and a PVC transparent wear layer are applied to the surface and a lacquer is used as finish on the wear layer.

Post-industrial materials are recycled back into the production of luxury vinyl tile.

The products included in this EPD are Art Select, Da Vinci, Van Gogh, Opus, Knight Tile, Michelangelo and HDC, in tile and plank format. The impact indicators are based on the reference product Van Gogh.

Luxury vinyl flooring is commonly used commercially in educational, healthcare, aged care, speciality retail and commercial, light commercial, and residential interiors where long lasting performance are preferred. The reference life span of the Karndean Designflooring luxury vinyl tile is 10 years.

## 2.2 - Product standards

The products considered in this EPD meet or exceed one of the following Technical Specifications:

- ASTM F 1700 - Standard Specification for Solid Vinyl Floor tiles : Class III, type B
  - ISO 10582 - Resilient floor coverings - Heterogeneous polyvinyl chloride floor covering - Specification :
- The products are classified from 23-31 to 34-43 according the references of the Luxury Vinyl Tiles

The ANZSIC code of the product is 1912 Rigid and semi-rigid polymer product manufacturing.

Fire Testing:

- Class 1 when tested in accordance with ASTM E 648/NFPA 253, Standard Test Method for Critical Radiant Flux.
- Meets 450 or less when tested in accordance with ASTM E 662/NFPA 258, Standard Test Method for Smoke Density if applicable.
- Tested according to AS ISO 9239.1: Reaction to fire tests for floorings. Determination of the burning behaviour using a radiant heat source
- FSCI-150; SD-150 when tested in accordance with CAN/ULC S102.2, Standard Test Method for Flame Spread Rating and Smoke Development if applicable.

## 2.3 - Product Characteristics

**Table 1 Products characteristics**

Characteristics	Representative product	Unit	Minimum value	Maximum value
Product thickness	0.12 (3.0)	in (mm)	0.08 (2.0)	0.18 (4.5)
Wear layer thickness	22 (0.55)	Mil (mm)	6 (0.15)	30 (0.7)
Product weight*	5.690 18.65	kg/m <sup>2</sup> oz/ft <sup>2</sup>	3.210 10.52	5.840 19.14
Product size	Tiles	in (mm)	12x12 (305x305)	36x36 (915x915)
	Planks	in (mm)	9x3 (229x76)	48x9 (1219x228)

\* The weight value is based on the actual volume of the best selling product (Van Gogh) in Australia and New Zealand.

VOC emissions test method: Compliant with California Department of Public Health Standard v1.1 2010 and certified by Floorscore flooring products Certification Program for Indoor Air Quality EC10.3-2014 and Indoor Air quality Certified to GreenStar IEQ VOC.

## 2.4 - Product range

**Table 2 Product range**

Products	Product thickness (mm)	Wear layer thickness (mm)	Product weight (kg/m <sup>2</sup> )	Product form	Classification ASTM 1700
Art Select	3 mm	0.7 mm	5.33 - 5.80	Tile & plank	Class III Type B
Da Vinci	3 mm	0.7 mm	5.56 - 5.84	Tile & plank	Class III Type B
Van Gogh	3 mm	0.55 mm	5.69	Plank	Class III Type B
Opus	2.5 mm	0.55 mm	4.83 - 4.98	Tile & plank	Class III Type B
Knight Tile	2 mm	0.3 mm	4.02	Tile & plank	Class III Type B
Michelangelo	2.5 mm	0.55 mm	4.63 - 4.74	Tile & plank	Class III Type B
HDC	2.5 mm	0.55 mm	5.51 - 5.62	Tile & plank	Class III Type B

## 3 - Declared unit

The declared unit is 1m<sup>2</sup> of installed luxury vinyl tile for the intended use.

## 4 - Reference service life

The reference service life of 10 years used as a RSL for the purpose of this EPD constitutes the minimum service life. It is the minimal warranty given by the manufacturer. The service life of resilient floor coverings depends on the correct installation taking into account the declared use classification, the intended use and the thickness of the product.

## 5- Material contents

**Table 3 : Material contents**

Components	Substances	Weight %
Polymer	Polyvinyl chloride	33.70
Filler	Limestone	49.99
Binder	Diisooctyl terephthalate Diisononyl phthalate	10.27
Binder	Epoxydized soybean oil	0.36
Stabilizer	Ca/Zn, Ba/Zn organic derivatives	1.28
PVC Lacquer	Polyurethane	0.22
Inks and pigments	Organic inks, carbon black	0.10
Recycled PVC external	Pre-consumer scraps	4.16

## 6 - Content declaration:

There are no substances listed in the "Candidate List of Substances of Very High Concern (SVHC) for authorisation" according to the Regulation (EC) No 1907/2006 of the European Parliament and of the council of the 18<sup>th</sup> of December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals

## 7 - System boundaries

It is a cradle to gate EPD with options according to EN 15804. The system boundary is based on the EN 15804 description.

Modules A1-A3 include processes that provide materials and energy input for the system, manufacturing and transport processes up to the factory gate, as well as waste processing.

Module A4 includes transport of the floor covering to the place of installation.

Module A5 includes the production of adhesive for the installation of the floor covering, the manufacture and the transport of the 5% extra product order for laying and land filling of these 5% off-cuts and recycling of packaging material.

Module B2 includes provision of cleaning agent, energy and water consumption for the cleaning of the floor covering. The LCA results in this EPD are declared for a one-year usage.

Module C1 considers manual operations without electricity use for the de-construction of the flooring.

Module C2 includes transportation of post-consumer waste to waste processing.

Module C4: end of life scenario is declared for 100% land filling of the used products

Module D, optional, is not considered in this study.

### 7.1 - Production and transport of main materials

#### Limestone

Limestone is calcium carbonate used as inert filler. It is an abundant mineral found in all part of the world. It can be ground to varying particle sizes and is widely used as filler in formulated flooring system.

#### Polyvinyl chloride

Commonly abbreviated to PVC and derived from fossil fuel and salt, this is the third-most widely produced polymer, after polyethylene and polypropylene. Petroleum or natural gas are processed to make ethylene. Salt electrolysis produces chlorine. Ethylene and chlorine react together to produce ethylene dichloride, which is further processed at high temperature into vinyl chloride monomer. Polymerization of vinyl chloride monomer converts it into a white, fine powder called vinyl resin.

#### Plasticizers

Plasticizers are colourless and odourless liquids commonly used in vinyl products to make them more flexible and/or durable. DOTP is manufactured from DMT (a common material for producing fizzy drink bottles) and 2-ethylhexanol. Some of our products may contain small amounts of DINP from recycled PVC. ESO is manufactured from soybean oil through an epoxidation process.

#### Additives

These products are used to make vinyl resistant to light and oxidation. They are viscous liquids consisting of alkaline earth metal (barium or calcium) and zinc salts of fatty acids.

#### Finish

The finish is a polyurethane UV cured lacquer.

#### Ink and Pigment

Inks are used to print the decorative patterns.

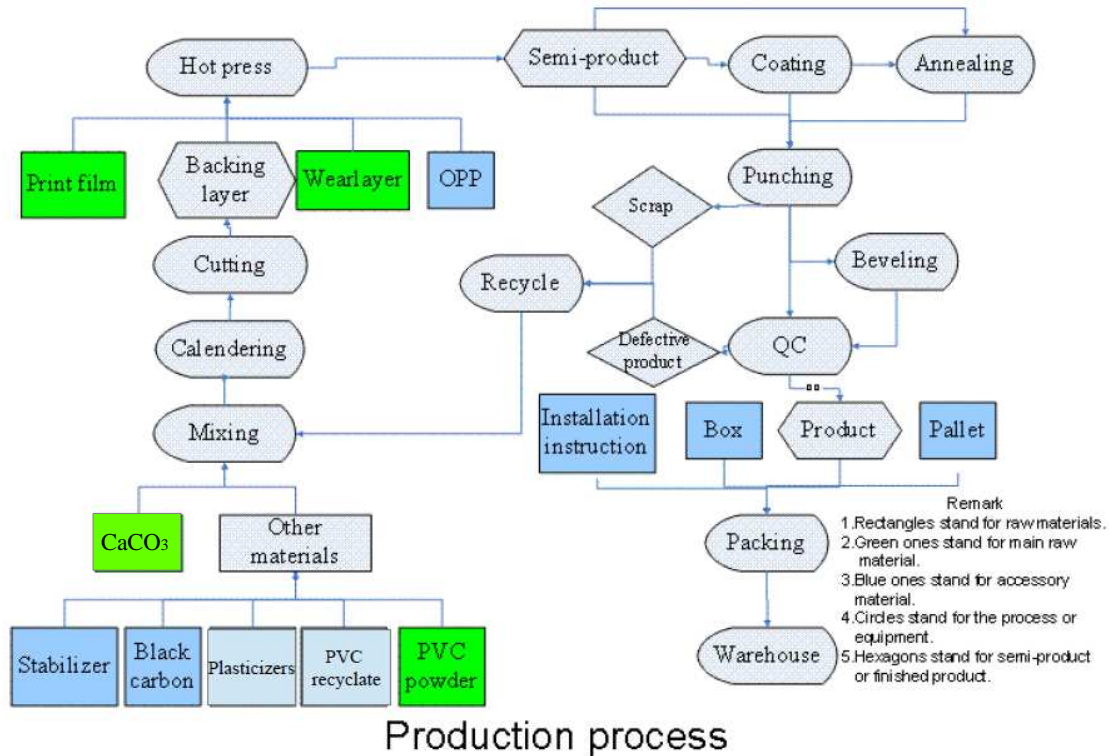
All these raw materials are produced in Asia and the transport to the manufacturing site is included.

### 7.2 - Production of the luxury vinyl tile

The products are manufactured in three Asian factories (China, Taiwan, South Korea) which are certified ISO 9001. Two of them have GreenStar certification to GreenTag level 'A' and the third is coming soon.

The production process is depicted below:

Diagram 2



Legend: print film: decorative pattern of the floor; wearlayer: transparent upper layer above the print film;  
OPP: accessory layer, only for processing; CaCO<sub>3</sub>: limestone

## 7.3 - Delivery and Installation of the floor covering

### 7.3.1 - Delivery

The delivery includes shipping from Asia to Australasia by transoceanic freight ship of the manufactured products and transport from port to warehouse, then to construction site by truck with an average distance of 2000 km.

### 7.3.2 - Installation

Installation requires adhesive: 250 g/m<sup>2</sup> are used. Water based acrylic VOC compliant adhesive is recommended. During installation, 5% of the total material is cut off as waste. The scrap is modelled as being disposed of in landfill, particularly if coated with adhesive and screed residues that prevent successful recycling. All emissions are allocated to installation.

Packaging: Products are packaged in cardboard boxes (with label and notice) on wood pallets and wrapped in polypropylene film.

**Table 4: Packaging**

Packaging	Quantity (kg)
Pallet	Wood : 0.0749 kg
Box	Paperboard: 0.045.8 kg
shrink wrap	PE film: 0.0022 kg
Label and instructions	Paper : 0.0016 kg

## 7.4 - Use Stage

The service lives of LVT vary according to the amount of floor traffic and the type of building and maintenance.

The release of volatile organic compounds conforms to the Floorscore - Indoor Air Quality Certified to SCS-EC10.3-2014 V1.1 and GreenStar IEQ Indoor Air Quality: VOC reduced exposure to pollutants.

### 7.4.1 - Cleaning and maintenance

As maintenance is dependent on the place where the floor is installed, we take an average maintenance based on typical installation.

The results of the maintenance phase impacts are scaled to 1 year's maintenance.

### 7.4.2 - Cleaning process

The average cleaning process is for commercial and residential use.

**Table 5: cleaning process**

Cleaning process	Cleaning frequency	Energy & resources
Dust mop	Daily	none
Damp mop / cleaner	Weekly	Hot water: 122 l/m <sup>2</sup> /y neutral detergent: 0.60 l/m <sup>2</sup> /y
Spray buff / restorer	Monthly	Floor finish: 0.06 l/m <sup>2</sup> /y Electricity: 0.248 kWh/m <sup>2</sup> /y

### 7.4.3 - Health during use stage

The Floor coverings supplied by Karndean are tested to the Floorscore Certification Programme and comply with the VOC requirements of the California Department of Public Health Standard Method v1.1 and Ecospecifier Global GreenStar IEQ (Indoor Environmental Air Quality: VOC reduced exposure to pollutants

Cleaning Materials with low VOCs are available for maintaining vinyl floors.

## 7.5 - End of Life

For this EPD, the floor covering is considered to be disposed of in landfill, particularly if coated with adhesive and screed residues that prevent successful recycling. It is the prerogative of the owner or specifier to determine the method of disposal of clean waste PVC floor coverings if recycling is an option.



## 8 - Life Cycle Assessment

The Life Cycle Inventory (LCI) and Life Cycle Impact Assessment (LCIA) were undertaken with guidelines from ISO 14040/ISO 14044, ISO 14025, EN 15804 and PCR 1201 v2.0.

The main purpose of EPDs is for use in business-to-business communication. As all EPDs are publicly available via the Program Operator and therefore are accessible to the end consumer, they can also be used in business-to consumer communication.

### 8.1-Declared Unit Description

The declaration refers to a declared unit of 1 m<sup>2</sup> installed floor covering for specified application and uses areas according ASTM F 1700.

This study is a cradle to gate with option EPD according to EN 15804. The optional modules included in this study are B2, C1, C2, C4.

### 8.2 - Cut-off Criteria

At a minimum, all raw materials representing 0.1% of input mass or greater were included. Materials below the cut-off criteria accounted for no more than 5% of total input mass. For manufacturing, the utilized thermal energy, the electrical energy, the required packaging materials, and all direct production waste were included in the analysis.

### 8.3 - Background Data

As a general rule, specific data derived from specific production processes or average data derived from specific production processes are preferred as the basis for calculating LCA results.

For life cycle modelling of the products, the software OpenLCA v1.4.0 is used to model the products system.

All background datasets including energy, transportation and materials were taken from Ecoinvent v3.1 database.

### 8.4 - Data quality

A variety of tests and checks were performed throughout the project to ensure high quality of the completed LCA.

Checks included an extensive review of project-specific LCA models and background data used.

### 8.5 - Temporal Coverage

Foreground data is based on 1 year averaged data for the year 2012.

Background data sets are all based on data from the last 3 years (since 2012), with the majority of datasets based on data from 2014.

### 8.6 - Technological Coverage

The raw material inputs in the calculation for this EPD are based on annual total purchases divided by annual production. Waste, emissions and energy use are based on measured data during the reference year.

### 8.7 - Geographical Coverage

In order to satisfy cut-off criteria, proxy datasets were used as needed for raw material inputs to address the lack of data for a specific material or for a specific geographical region. These proxy datasets were chosen for their representativeness of the actual product.

## 8.8 - System Boundaries

This is a cradle to gate with options EPD according to EN 15804. The stages are represented below. The system boundary of this EPD is described in the following pages.

The stages A1-A3 are mandatory. The optional modules included are: transport to customers (A4), installation (A5), maintenance (B2), deconstruction (C1), transport of waste (C2) and disposal (C4).

**Diagram 3 : System boundaries**

Product stage			construction stage		Use stage							end of life stage				Benefit Load
Raw material supply	Transport	Manufacturing	Transport	Construction – installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction Demolition	Transport	Waste processing	Disposal	Reuse, recovery or recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3/I	C4/L	D
X			X	X	NR	X	NR	NR	NR	NR	NR	X	X	X	X	MND

NR : module not relevant ; MND : Module not determined

**8.8.1 - The sourcing/extraction stage** is a mandatory stage and includes raw materials extraction and processing and transport to the manufacturer. Packaging materials is also considered in this stage This includes provision of all materials, products and energy, as well as emissions in air and water and waste processing up to the end-of waste state or disposal of final residues during the product stage.

**8.8.2 - The manufacturing stage** is a mandatory stage and includes manufacturing of the floor covering with the sourced raw materials. This includes provision of all materials, products and energy, as well as emissions in air and water and waste processing up to the end-of waste state or disposal of final residues during the product stage. Overheads and personnel related issues are not considered in this study.

**8.8.3 - The construction process stage** includes transport to the building site and installation into the building. Provision of all materials, products and energy, as well as waste processing up to the end-of-waste state or disposal of final residues during the construction process stage are also considered. This stage also includes all impacts and aspects related to any losses during this construction process stage (i.e. production, transport, and waste processing and disposal of the lost products and materials).

For this study, transport by ship from the suppliers to Melbourne and Auckland ports and by truck from ports to the warehouse then an average distance of 2000 km to installation site by truck and flooring installation in the building are included.

**8.8.4 - The use stage**, related to building flooring includes its cleaning and maintenance during its useful life as well as the extraction, manufacturing, and transport of all supporting materials, if relevant for the maintenance and above the cut-off levels. Provision and transport of all materials, products and related energy and water use, as well as emissions and waste processing up to the end-of-waste state or disposal of final residues are also considered during this part of the use stage. The cleaning processes considered in this EPD are daily dust mopping, weekly damp mopping and monthly spray buffing. The calculations of the impacts and resource uses and flows for this stage B2 are based on a period of one year use.

**8.8.5 - The end-of-life stage** includes de-construction, demolition, transport to waste processing or disposal. Transports, provision of all materials, products and related energy and water use are also considered. Materials are assumed transported 50km by truck to disposal.

## 8.9 - Allocation

### 8.9.1 - Co-product allocation

There is no co-product allocation.

The representative product is calculated according to the quantity of Van Gogh floor covering sold in the Australian and New Zealand market.

### 8.9.2 - Multi-input process allocation

No multi-input allocation occurs in the product system.

### 8.9.3 - Reuse, recycling, and recovery allocation

The cut-off allocation approach is adopted in the case of any pre-consumer recycled content, which is assumed to enter the system burden-free. Only environmental impacts from the point of recovery and forward (e.g. collection, sorting, processing, etc.) are considered.

Product and packaging waste is modelled as being disposed of in landfill. Plastic and other construction waste is assumed to be inert in landfills so no system expansion or allocation is necessary as landfill gas is not produced.

## 9 - Results

It is noted that results reported in the tables below represent the values corresponding to the reference product Van Gogh. This reference product is the most sold product in Australia and New Zealand.

The values of the impact categories are calculated by using the characterisation factors outlined in EN 15804 provided by CML - Leiden University. (CML baseline).

The optional biogenic carbon storage in products is not selected because the products are not involved in this type of environmental indicator.

Caution should be used when comparing the results presented in this EPD to the environmental performance of other vinyl tile products as the thickness, weight or assumed life time of floors will influence the environmental impacts.

EPD of construction products may not be comparable if they do not comply with EN 15804. EPD within the same product category, but from different programs may not be comparable.

### 9.1 - Life cycle impact assessment

The tables below present the results of the impact assessment for 1 m<sup>2</sup>. The results for stage B2 refer to a period of one year. For the calculation of the impact of B2 for a certain service life the values for B2 have to be multiplied by the estimated service life in years.

The 12 tables below are composed with 3 tables by table, each depicting the environmental impacts, the resource use and the wastes categories and other output flows of the representative product Van Gogh and of each other products.

### 9.1.1 Life cycle impact assessment of the representative product Van Gogh (5.69 gk/m<sup>2</sup>) - Table 6

Environmental Impacts			ADPE	ADPF	AP	ODP	GWP	EP	POCP
<b>Product stage</b>	Total Production	A1-A3	2.10E-05	1.20E+02	2.38E-02	1.36E-07	7.76E+00	5.77E-03	1.97E-03
<b>construction stage</b>	Transport	A4	5.46E-06	3.67E+01	1.89E-02	4.45E-07	2.51E+00	1.90E-03	7.31E-04
	Installation	A5	5.02E-06	1.20E+01	6.58E-03	1.09E-07	7.98E-01	1.98E-03	4.31E-04
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-
	Maintenance	B2	5.02E-06	1.50E+01	7.99E-03	1.42E-07	9.72E-01	2.43E-03	3.34E-04
	Repair	B3	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	5.34E-07	2.89E+00	7.73E-04	3.53E-08	1.92E-01	1.87E-04	3.24E-05
	Waste processing	C3	-	-	-	-	-	-	-
	Disposal	C4	8.21E-08	1.46E+00	4.57E-04	1.59E-08	3.71E-01	1.80E-02	8.21E-08
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-
<b>Caption</b>	ADPE : Abiotic depletion potential for non fossil resources, kg Sb equiv. ; ADPF: Abiotic depletion potential for fossil resources, MJ ; AP : Acidification potential of land and water sources, kg SO2 equiv. ; ODP : Depletion potential of the stratospheric ozone layer, kg CFC 11 equiv. ; GWP : Global warming potential, kg CO2 equiv. ; EP : Eutrophication potential, kg PO4 equiv. ; POCP : Formation potential of tropospheric ozone photo-chemical oxidants, kg Ethene equiv.								

Resource use			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
<b>Product stage</b>	Total Production	A1-A3	3.38E+00	3.23E+00	6.61E+00	1.27E+02	5.92E+01	1.86E+02	0.00E+00	0.00E+00	0.00E+00	3.36E-01
<b>construction stage</b>	Transport	A4	5.50E-01	0.00E+00	5.50E-01	3.82E+01	0.00E+00	3.82E+01	0.00E+00	0.00E+00	0.00E+00	9.90E-04
	Installation	A5	7.20E-01	0.00E+00	7.21E-01	1.38E+01	1.12E+00	1.49E+01	0.00E+00	0.00E+00	0.00E+00	7.60E-02
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-	-
	Maintenance	B2	7.17E-01	0.00E+00	7.17E-01	1.74E+01	2.50E-01	1.77E+01	0.00E+00	0.00E+00	0.00E+00	1.41E-01
	Repair	B3	-	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.72E-02	0.00E+00	3.72E-02	2.95E+00	0.00E+00	2.95E+00	0.00E+00	0.00E+00	0.00E+00	2.01E-04
	Waste processing	C3	-	-	-	-	-	-	-	-	-	-
	Disposal	C4	4.34E-02	0.00E+00	4.34E-02	1.54E+00	0.00E+00	1.54E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-03
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-	-
<b>Caption</b>	PERE : Use of renewable primary energy excluding renewable primary energy resources used as raw materials, MJ; PERM : Use of renewable primary energy resources used as raw materials, MJ; PERT : Total use of renewable primary energy resources, MJ; PENRE : Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials, MJ; PENRM : Use of non renewable primary energy resources used as raw materials, MJ; PENRT : Total use of non renewable primary energy resources, MJ; SM : Use of secondary material, kg; RSF : Use of renewable secondary fuels, MJ; NRSF : Use of non renewable secondary fuels, MJ; FW : Use of net fresh water, m3											

Wastes and others output flows			HW	NHW	RW	CFR	MFR	MER	EE	EEE	ETE
<b>Product stage</b>	Total Production	A1-A3	1.07E-01	2.13E+00	5.34E-04	0.00E+00	3.28E-01	6.40E-02	8.73E-01	3.63E-01	5.10E-01
<b>construction stage</b>	Transport	A4	1.44E-02	1.54E-01	2.79E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Installation	A5	1.91E-02	3.42E-01	5.00E-05	7.51E-02	2.29E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-
	Maintenance	B2	5.23E-03	2.76E-01	6.55E-05	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.86E-03	1.76E-02	2.03E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	-	-	-	-	-	-	-	-	-
	Disposal	C4	1.42E-03	6.31E+00	9.02E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-
<b>Caption</b>	HWD : Hazardous waste disposed, kg ; NHWD : Non hazardous waste disposed, kg ; RWD : Radioactive waste disposed, kg ; CRU : Components for re-use, kg ; MFR : Materials for recycling, kg ; MER : Materials for energy recovery, kg ; EE, exported energy, MJ ; EEE : Exported electrical energy, MJ ; ETE : Exported thermal energy, MJ										

### 9.1.2 Life cycle impact assessment of Knight Tile (4.02 kg/m<sup>2</sup>) - Table 7

Environmental Impacts			ADPE	ADPF	AP	ODP	GWP	EP	POCP
<b>Product stage</b>	Total Production	A1-A3	1.48E-05	8.49E+01	1.68E-02	9.61E-08	5.48E+00	4.08E-03	1.39E-03
<b>construction stage</b>	Transport	A4	3.86E-06	2.59E+01	1.34E-02	3.14E-07	1.77E+00	1.34E-03	5.16E-04
	Installation	A5	3.55E-06	8.49E+00	4.65E-03	7.70E-08	5.64E-01	1.40E-03	3.05E-04
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-
	Maintenance	B2	5.02E-06	1.50E+01	7.99E-03	1.42E-07	9.72E-01	2.43E-03	3.34E-04
	Repair	B3	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.77E-07	2.04E+00	5.46E-04	2.49E-08	1.36E-01	1.32E-04	2.29E-05
	Waste processing	C3	-	-	-	-	-	-	-
	Disposal	C4	5.80E-08	1.03E+00	3.23E-04	1.12E-08	2.62E-01	1.27E-02	5.80E-08
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-
<b>Caption</b>	ADPE : Abiotic depletion potential for non fossil resources, kg Sb equiv. ; ADPF: Abiotic depletion potential for fossil resources, MJ ; AP : Acidification potential of land and water sources, kg SO2 equiv. ; ODP : Depletion potential of the stratospheric ozone layer, kg CFC 11 equiv. ; GWP : Global warming potential, kg CO2 equiv. ; EP : Eutrophication potential, kg PO4 equiv. ; POCP : Formation potential of tropospheric ozone photo-chemical oxidants, kg Ethene equiv.								

Resource use			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
<b>Product stage</b>	Total Production	A1-A3	2.39E+00	2.28E+00	4.67E+00	8.99E+01	4.18E+01	1.32E+02	0.00E+00	0.00E+00	0.00E+00	2.37E-01
<b>construction stage</b>	Transport	A4	3.89E-01	0.00E+00	3.89E-01	2.70E+01	0.00E+00	2.70E+01	0.00E+00	0.00E+00	0.00E+00	6.99E-04
	Installation	A5	5.09E-01	0.00E+00	5.09E-01	9.71E+00	7.91E-01	1.05E+01	0.00E+00	0.00E+00	0.00E+00	5.37E-02
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-	-
	Maintenance	B2	7.17E-01	0.00E+00	7.17E-01	1.74E+01	2.50E-01	1.77E+01	0.00E+00	0.00E+00	0.00E+00	1.41E-01
	Repair	B3	-	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	2.63E-02	0.00E+00	2.63E-02	2.08E+00	0.00E+00	2.08E+00	0.00E+00	0.00E+00	0.00E+00	1.42E-04
	Waste processing	C3	-	-	-	-	-	-	-	-	-	-
	Disposal	C4	3.07E-02	0.00E+00	3.07E-02	1.09E+00	0.00E+00	1.09E+00	0.00E+00	0.00E+00	0.00E+00	9.68E-04
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-	-
<b>Caption</b>	PERE : Use of renewable primary energy excluding renewable primary energy resources used as raw materials, MJ; PERM : Use of renewable primary energy resources used as raw materials, MJ; PERT : Total use of renewable primary energy resources used as raw materials, MJ; PENRE : Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials, MJ; PENRM : Use of non renewable primary energy resources used as raw materials, MJ; PENRT : Total use of non renewable primary energy resources, MJ; SM : Use of secondary material, kg; RSF : Use of renewable secondary fuels, MJ; NRSF : Use of non renewable secondary fuels, MJ; FW : Use of net fresh water, m3											

Wastes and others output flows			HW	NHW	RW	CFR	MFR	MER	EE	EEE	ETE
<b>Product stage</b>	Total Production	A1-A3	7.56E-02	1.50E+00	3.77E-04	0.00E+00	2.32E-01	4.52E-02	6.17E-01	2.56E-01	3.60E-01
<b>construction stage</b>	Transport	A4	1.02E-02	1.09E-01	1.97E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Installation	A5	1.35E-02	2.42E-01	3.53E-05	5.31E-02	1.62E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-
	Maintenance	B2	5.23E-03	2.76E-01	6.55E-05	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.31E-03	1.24E-02	1.43E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	-	-	-	-	-	-	-	-	-
	Disposal	C4	1.00E-03	4.46E+00	6.37E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-
<b>Caption</b>	HWD : Hazardous waste disposed, kg ; NHWD : Non hazardous waste disposed, kg ; RWD : Radioactive waste disposed, kg ; CRU : Components for re-use, kg ; MFR : Materials for recycling, kg ; MER : Materials for energy recovery, kg ; EE, exported energy, MJ ; EEE : Exported electrical energy, MJ ; ETE : Exported thermal energy, MJ										

### 9.1.3 Life cycle impact assessment of Michelangelo (4.63 kg/m<sup>2</sup>) - Table 8

Environmental Impacts			ADPE	ADPF	AP	ODP	GWP	EP	POCP
<b>Product stage</b>	Total Production	A1-A3	1.71E-05	9.77E+01	1.94E-02	1.11E-07	6.31E+00	4.70E-03	1.60E-03
<b>construction stage</b>	Transport	A4	4.44E-06	2.99E+01	1.54E-02	3.62E-07	2.04E+00	1.55E-03	5.95E-04
	Installation	A5	4.08E-06	9.78E+00	5.35E-03	8.87E-08	6.49E-01	1.61E-03	3.51E-04
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-
	Maintenance	B2	5.02E-06	1.50E+01	7.99E-03	1.42E-07	9.72E-01	2.43E-03	3.34E-04
	Repair	B3	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	4.35E-07	2.35E+00	6.29E-04	2.87E-08	1.56E-01	1.52E-04	2.64E-05
	Waste processing	C3	-	-	-	-	-	-	-
	Disposal	C4	6.68E-08	1.19E+00	3.72E-04	1.29E-08	3.02E-01	1.46E-02	6.68E-08
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-
<b>Caption</b>	ADPE : Abiotic depletion potential for non fossil resources, kg Sb equiv. ; ADPF: Abiotic depletion potential for fossil resources, MJ ; AP : Acidification potential of land and water sources, kg SO2 equiv. ; ODP : Depletion potential of the stratospheric ozone layer, kg CFC 11 equiv. ; GWP : Global warming potential, kg CO2 equiv. ; EP : Eutrophication potential, kg PO4 equiv. ; POCP : Formation potential of tropospheric ozone photo-chemical oxidants, kg Ethene equiv.								

Resource use			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
<b>Product stage</b>	Total Production	A1-A3	2.75E+00	2.63E+00	5.38E+00	1.04E+02	4.82E+01	1.52E+02	0.00E+00	0.00E+00	0.00E+00	2.73E-01
<b>construction stage</b>	Transport	A4	4.48E-01	0.00E+00	4.48E-01	3.11E+01	0.00E+00	3.11E+01	0.00E+00	0.00E+00	0.00E+00	8.06E-04
	Installation	A5	5.86E-01	0.00E+00	5.87E-01	1.12E+01	9.11E-01	1.21E+01	0.00E+00	0.00E+00	0.00E+00	6.18E-02
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-	-
	Maintenance	B2	7.17E-01	0.00E+00	7.17E-01	1.74E+01	2.50E-01	1.77E+01	0.00E+00	0.00E+00	0.00E+00	1.41E-01
	Repair	B3	-	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.03E-02	0.00E+00	3.03E-02	2.40E+00	0.00E+00	2.40E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-04
	Waste processing	C3	-	-	-	-	-	-	-	-	-	-
	Disposal	C4	3.53E-02	0.00E+00	3.53E-02	1.25E+00	0.00E+00	1.25E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-03
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-	-
<b>Caption</b>	PERE : Use of renewable primary energy excluding renewable primary energy resources used as raw materials, MJ; PERM : Use of renewable primary energy resources used as raw materials, MJ; PERT : Total use of renewable primary energy resources, MJ; PENRE : Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials, MJ; PENRM : Use of non renewable primary energy resources used as raw materials, MJ; PENRT : Total use of non renewable primary energy resources, MJ; SM : Use of secondary material, kg; RSF : Use of renewable secondary fuels, MJ; NRSF : Use of non renewable secondary fuels, MJ; FW : Use of net fresh water, m3											

Wastes and others output flows			HW	NHW	RW	CFR	MFR	MER	EE	EEE	ETE
<b>Product stage</b>	Total Production	A1-A3	8.71E-02	1.73E+00	4.35E-04	0.00E+00	2.67E-01	5.21E-02	7.10E-01	2.95E-01	4.15E-01
<b>construction stage</b>	Transport	A4	1.17E-02	1.25E-01	2.27E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Installation	A5	1.55E-02	2.78E-01	4.07E-05	6.11E-02	1.86E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-
	Maintenance	B2	5.23E-03	2.76E-01	6.55E-05	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.51E-03	1.43E-02	1.65E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	-	-	-	-	-	-	-	-	-
	Disposal	C4	1.16E-03	5.13E+00	7.34E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-
<b>Caption</b>	HWD : Hazardous waste disposed, kg ; NHWD : Non hazardous waste disposed, kg ; RWD : Radioactive waste disposed, kg ; CRU : Components for re-use, kg ; MFR : Materials for recycling, kg ; MER : Materials for energy recovery, kg ; EE, exported energy, MJ ; EEE : Exported electrical energy, MJ ; ETE : Exported thermal energy, MJ										

### 9.1.4 Life cycle impact assessment of Michelangelo (4.74 kg/m<sup>2</sup>) - Table 9

Environmental Impacts			ADPE	ADPF	AP	ODP	GWP	EP	POCP
<b>Product stage</b>	Total Production	A1-A3	1.75E-05	1.00E+02	1.98E-02	1.13E-07	6.46E+00	4.81E-03	1.64E-03
<b>construction stage</b>	Transport	A4	4.55E-06	3.06E+01	1.57E-02	3.71E-07	2.09E+00	1.58E-03	6.09E-04
	Installation	A5	4.18E-06	1.00E+01	5.48E-03	9.08E-08	6.65E-01	1.65E-03	3.59E-04
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-
	Maintenance	B2	5.02E-06	1.50E+01	7.99E-03	1.42E-07	9.72E-01	2.43E-03	3.34E-04
	Repair	B3	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	4.45E-07	2.41E+00	6.44E-04	2.94E-08	1.60E-01	1.56E-04	2.70E-05
	Waste processing	C3	-	-	-	-	-	-	-
	Disposal	C4	6.84E-08	1.22E+00	3.81E-04	1.32E-08	3.09E-01	1.50E-02	6.84E-08
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-
<b>Caption</b>	ADPE : Abiotic depletion potential for non fossil resources, kg Sb equiv. ; ADPF: Abiotic depletion potential for fossil resources, MJ ; AP : Acidification potential of land and water sources, kg SO2 equiv. ; ODP : Depletion potential of the stratospheric ozone layer, kg CFC 11 equiv. ; GWP : Global warming potential, kg CO2 equiv. ; EP : Eutrophication potential, kg PO4 equiv. ; POCP : Formation potential of tropospheric ozone photo-chemical oxidants, kg Ethene equiv.								

Resource use			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
<b>Product stage</b>	Total Production	A1-A3	2.82E+00	2.69E+00	5.51E+00	1.06E+02	4.93E+01	1.55E+02	0.00E+00	0.00E+00	0.00E+00	2.80E-01
<b>construction stage</b>	Transport	A4	4.58E-01	0.00E+00	4.58E-01	3.18E+01	0.00E+00	3.18E+01	0.00E+00	0.00E+00	0.00E+00	8.25E-04
	Installation	A5	6.00E-01	0.00E+00	6.01E-01	1.15E+01	9.33E-01	1.24E+01	0.00E+00	0.00E+00	0.00E+00	6.33E-02
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-	-
	Maintenance	B2	7.17E-01	0.00E+00	7.17E-01	1.74E+01	2.50E-01	1.77E+01	0.00E+00	0.00E+00	0.00E+00	1.41E-01
	Repair	B3	-	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.10E-02	0.00E+00	3.10E-02	2.46E+00	0.00E+00	2.46E+00	0.00E+00	0.00E+00	0.00E+00	1.67E-04
	Waste processing	C3	-	-	-	-	-	-	-	-	-	-
	Disposal	C4	3.62E-02	0.00E+00	3.62E-02	1.28E+00	0.00E+00	1.28E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-03
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-	-
<b>Caption</b>	PERE : Use of renewable primary energy excluding renewable primary energy resources used as raw materials, MJ; PERM : Use of renewable primary energy resources used as raw materials, MJ; PERT : Total use of renewable primary energy resources, MJ; PENRE : Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials, MJ; PENRM : Use of non renewable primary energy resources used as raw materials, MJ; PENRT : Total use of non renewable primary energy resources, MJ; SM : Use of secondary material, kg; RSF : Use of renewable secondary fuels, MJ; NRSF : Use of non renewable secondary fuels, MJ; FW : Use of net fresh water, m3											

Wastes and others output flows			HW	NHW	RW	CFR	MFR	MER	EE	EEE	ETE
<b>Product stage</b>	Total Production	A1-A3	8.91E-02	1.77E+00	4.45E-04	0.00E+00	2.73E-01	5.33E-02	7.27E-01	3.02E-01	4.25E-01
<b>construction stage</b>	Transport	A4	1.20E-02	1.28E-01	2.32E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Installation	A5	1.59E-02	2.85E-01	4.17E-05	6.26E-02	1.91E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-
	Maintenance	B2	5.23E-03	2.76E-01	6.55E-05	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.55E-03	1.47E-02	1.69E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	-	-	-	-	-	-	-	-	-
	Disposal	C4	1.18E-03	5.26E+00	7.51E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-
<b>Caption</b>	HWD : Hazardous waste disposed, kg ; NHWD : Non hazardous waste disposed, kg ; RWD : Radioactive waste disposed, kg ; CRU : Components for re-use, kg ; MFR : Materials for recycling, kg ; MER : Materials for energy recovery, kg ; EE, exported energy, MJ ; EEE : Exported electrical energy, MJ ; ETE : Exported thermal energy, MJ										

### 9.1.5 Life cycle impact assessment of Opus (4.83 kg/m<sup>2</sup>) - Table 10

Environmental Impacts			ADPE	ADPF	AP	ODP	GWP	EP	POCP
<b>Product stage</b>	Total Production	A1-A3	1.78E-05	1.02E+02	2.02E-02	1.15E-07	6.59E+00	4.90E-03	1.67E-03
<b>construction stage</b>	Transport	A4	4.63E-06	3.12E+01	1.60E-02	3.78E-07	2.13E+00	1.61E-03	6.21E-04
	Installation	A5	4.26E-06	1.02E+01	5.59E-03	9.25E-08	6.77E-01	1.68E-03	3.66E-04
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-
	Maintenance	B2	5.02E-06	1.50E+01	7.99E-03	1.42E-07	9.72E-01	2.43E-03	3.34E-04
	Repair	B3	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	4.53E-07	2.45E+00	6.56E-04	3.00E-08	1.63E-01	1.59E-04	2.75E-05
	Waste processing	C3	-	-	-	-	-	-	-
	Disposal	C4	6.97E-08	1.24E+00	3.88E-04	1.35E-08	3.15E-01	1.53E-02	6.97E-08
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-
<b>Caption</b>	ADPE : Abiotic depletion potential for non fossil resources, kg Sb equiv. ; ADPF: Abiotic depletion potential for fossil resources, MJ ; AP : Acidification potential of land and water sources, kg SO2 equiv. ; ODP : Depletion potential of the stratospheric ozone layer, kg CFC 11 equiv. ; GWP : Global warming potential, kg CO2 equiv. ; EP : Eutrophication potential, kg PO4 equiv. ; POCP : Formation potential of tropospheric ozone photo-chemical oxidants, kg Ethene equiv.								

Resource use			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
<b>Product stage</b>	Total Production	A1-A3	2.87E+00	2.74E+00	5.61E+00	1.08E+02	5.03E+01	1.58E+02	0.00E+00	0.00E+00	0.00E+00	2.85E-01
<b>construction stage</b>	Transport	A4	4.67E-01	0.00E+00	4.67E-01	3.24E+01	0.00E+00	3.24E+01	0.00E+00	0.00E+00	0.00E+00	8.40E-04
	Installation	A5	6.11E-01	0.00E+00	6.12E-01	1.17E+01	9.51E-01	1.26E+01	0.00E+00	0.00E+00	0.00E+00	6.45E-02
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-	-
	Maintenance	B2	7.17E-01	0.00E+00	7.17E-01	1.74E+01	2.50E-01	1.77E+01	0.00E+00	0.00E+00	0.00E+00	1.41E-01
	Repair	B3	-	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.16E-02	0.00E+00	3.16E-02	2.50E+00	0.00E+00	2.50E+00	0.00E+00	0.00E+00	0.00E+00	1.71E-04
	Waste processing	C3	-	-	-	-	-	-	-	-	-	-
	Disposal	C4	3.68E-02	0.00E+00	3.68E-02	1.31E+00	0.00E+00	1.31E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-03
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-	-
<b>Caption</b>	PERE : Use of renewable primary energy excluding renewable primary energy resources used as raw materials, MJ; PERM : Use of renewable primary energy resources used as raw materials, MJ; PERT : Total use of renewable primary energy resources, MJ; PENRE : Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials, MJ; PENRM : Use of non renewable primary energy resources used as raw materials, MJ; PENRT : Total use of non renewable primary energy resources, MJ; SM : Use of secondary material, kg; RSF : Use of renewable secondary fuels, MJ; NRSF : Use of non renewable secondary fuels, MJ; FW : Use of net fresh water, m3											

Wastes and others output flows			HW	NHW	RW	CFR	MFR	MER	EE	EEE	ETE
<b>Product stage</b>	Total Production	A1-A3	9.08E-02	1.81E+00	4.53E-04	0.00E+00	2.78E-01	5.43E-02	7.41E-01	3.08E-01	4.33E-01
<b>construction stage</b>	Transport	A4	1.22E-02	1.31E-01	2.37E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Installation	A5	1.62E-02	2.90E-01	4.24E-05	6.37E-02	1.94E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-
	Maintenance	B2	5.23E-03	2.76E-01	6.55E-05	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.58E-03	1.49E-02	1.72E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	-	-	-	-	-	-	-	-	-
	Disposal	C4	1.21E-03	5.36E+00	7.66E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-
<b>Caption</b>	HWD : Hazardous waste disposed, kg ; NHWD : Non hazardous waste disposed, kg ; RWD : Radioactive waste disposed, kg ; CRU : Components for re-use, kg ; MFR : Materials for recycling, kg ; MER : Materials for energy recovery, kg ; EE, exported energy, MJ ; EEE : Exported electrical energy, MJ ; ETE : Exported thermal energy, MJ										



### 9.1.6 Life cycle impact assessment of Opus (4.98 kg/m<sup>2</sup>) - Table 11

Environmental Impacts			ADPE	ADPF	AP	ODP	GWP	EP	POCP
<b>Product stage</b>	Total Production	A1-A3	1.84E-05	1.05E+02	2.08E-02	1.19E-07	6.79E+00	5.05E-03	1.72E-03
<b>construction stage</b>	Transport	A4	4.78E-06	3.21E+01	1.65E-02	3.89E-07	2.20E+00	1.66E-03	6.40E-04
	Installation	A5	4.39E-06	1.05E+01	5.76E-03	9.54E-08	6.98E-01	1.73E-03	3.77E-04
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-
	Maintenance	B2	5.02E-06	1.50E+01	7.99E-03	1.42E-07	9.72E-01	2.43E-03	3.34E-04
	Repair	B3	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	4.67E-07	2.53E+00	6.77E-04	3.09E-08	1.68E-01	1.64E-04	2.84E-05
	Waste processing	C3	-	-	-	-	-	-	-
	Disposal	C4	7.19E-08	1.28E+00	4.00E-04	1.39E-08	3.25E-01	1.58E-02	7.19E-08
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-
<b>Caption</b>	ADPE : Abiotic depletion potential for non fossil resources, kg Sb equiv. ; ADPF: Abiotic depletion potential for fossil resources, MJ ; AP : Acidification potential of land and water sources, kg SO2 equiv. ; ODP : Depletion potential of the stratospheric ozone layer, kg CFC 11 equiv. ; GWP : Global warming potential, kg CO2 equiv. ; EP : Eutrophication potential, kg PO4 equiv. ; POCP : Formation potential of tropospheric ozone photo-chemical oxidants, kg Ethene equiv.								

Resource use			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
<b>Product stage</b>	Total Production	A1-A3	2.96E+00	2.83E+00	5.79E+00	1.11E+02	5.18E+01	1.63E+02	0.00E+00	0.00E+00	0.00E+00	2.94E-01
<b>construction stage</b>	Transport	A4	4.81E-01	0.00E+00	4.81E-01	3.34E+01	0.00E+00	3.34E+01	0.00E+00	0.00E+00	0.00E+00	8.66E-04
	Installation	A5	6.30E-01	0.00E+00	6.31E-01	1.20E+01	9.80E-01	1.30E+01	0.00E+00	0.00E+00	0.00E+00	6.65E-02
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-	-
	Maintenance	B2	7.17E-01	0.00E+00	7.17E-01	1.74E+01	2.50E-01	1.77E+01	0.00E+00	0.00E+00	0.00E+00	1.41E-01
	Repair	B3	-	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.26E-02	0.00E+00	3.26E-02	2.58E+00	0.00E+00	2.58E+00	0.00E+00	0.00E+00	0.00E+00	1.76E-04
	Waste processing	C3	-	-	-	-	-	-	-	-	-	-
	Disposal	C4	3.80E-02	0.00E+00	3.80E-02	1.35E+00	0.00E+00	1.35E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-03
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-	-
<b>Caption</b>	PERE : Use of renewable primary energy excluding renewable primary energy resources used as raw materials, MJ; PERM : Use of renewable primary energy resources used as raw materials, MJ; PERT : Total use of renewable primary energy resources, MJ; PENRE : Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials, MJ; PENRM : Use of non renewable primary energy resources used as raw materials, MJ; PENRT : Total use of non renewable primary energy resources, MJ; SM : Use of secondary material, kg; RSF : Use of renewable secondary fuels, MJ; NRSF : Use of non renewable secondary fuels, MJ; FW : Use of net fresh water, m3											

Wastes and others output flows			HW	NHW	RW	CFR	MFR	MER	EE	EEE	ETE
<b>Product stage</b>	Total Production	A1-A3	9.36E-02	1.86E+00	4.67E-04	0.00E+00	2.87E-01	5.60E-02	7.64E-01	3.18E-01	4.46E-01
<b>construction stage</b>	Transport	A4	1.26E-02	1.35E-01	2.44E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Installation	A5	1.67E-02	2.99E-01	4.38E-05	6.57E-02	2.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-
	Maintenance	B2	5.23E-03	2.76E-01	6.55E-05	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.63E-03	1.54E-02	1.78E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	-	-	-	-	-	-	-	-	-
	Disposal	C4	1.24E-03	5.52E+00	7.89E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-
<b>Caption</b>	HWD : Hazardous waste disposed, kg ; NHWD : Non hazardous waste disposed, kg ; RWD : Radioactive waste disposed, kg ; CRU : Components for re-use, kg ; MFR : Materials for recycling, kg ; MER : Materials for energy recovery, kg ; EE, exported energy, MJ ; EEE : Exported electrical energy, MJ ; ETE : Exported thermal energy, MJ										

### 9.1.7 Life cycle impact assessment of Art Select (5.33 kg/m<sup>2</sup>) - Table 12

Environmental Impacts			ADPE	ADPF	AP	ODP	GWP	EP	POCP
<b>Product stage</b>	Total Production	A1-A3	1.97E-05	1.13E+02	2.23E-02	1.27E-07	7.27E+00	5.40E-03	1.85E-03
<b>construction stage</b>	Transport	A4	5.11E-06	3.44E+01	1.77E-02	4.17E-07	2.35E+00	1.78E-03	6.85E-04
	Installation	A5	4.70E-06	1.13E+01	6.16E-03	1.02E-07	7.48E-01	1.85E-03	4.04E-04
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-
	Maintenance	B2	5.02E-06	1.50E+01	7.99E-03	1.42E-07	9.72E-01	2.43E-03	3.34E-04
	Repair	B3	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	5.00E-07	2.71E+00	7.24E-04	3.31E-08	1.80E-01	1.75E-04	3.04E-05
	Waste processing	C3	-	-	-	-	-	-	-
	Disposal	C4	7.69E-08	1.37E+00	4.28E-04	1.49E-08	3.48E-01	1.69E-02	7.69E-08
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-
<b>Caption</b>	ADPE : Abiotic depletion potential for non fossil resources, kg Sb equiv. ; ADPF: Abiotic depletion potential for fossil resources, MJ ; AP : Acidification potential of land and water sources, kg SO <sub>2</sub> equiv. ; ODP : Depletion potential of the stratospheric ozone layer, kg CFC 11 equiv. ; GWP : Global warming potential, kg CO <sub>2</sub> equiv. ; EP : Eutrophication potential, kg PO <sub>4</sub> equiv. ; POCP : Formation potential of tropospheric ozone photo-chemical oxidants, kg Ethene equiv.								

Resource use			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
<b>Product stage</b>	Total Production	A1-A3	3.17E+00	3.03E+00	6.19E+00	1.19E+02	5.55E+01	1.74E+02	0.00E+00	0.00E+00	0.00E+00	3.15E-01
<b>construction stage</b>	Transport	A4	5.15E-01	0.00E+00	5.15E-01	3.58E+01	0.00E+00	3.58E+01	0.00E+00	0.00E+00	0.00E+00	9.27E-04
	Installation	A5	6.74E-01	0.00E+00	6.75E-01	1.29E+01	1.05E+00	1.39E+01	0.00E+00	0.00E+00	0.00E+00	7.12E-02
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-	-
	Maintenance	B2	7.17E-01	0.00E+00	7.17E-01	1.74E+01	2.50E-01	1.77E+01	0.00E+00	0.00E+00	0.00E+00	1.41E-01
	Repair	B3	-	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.48E-02	0.00E+00	3.48E-02	2.76E+00	0.00E+00	2.76E+00	0.00E+00	0.00E+00	0.00E+00	1.88E-04
	Waste processing	C3	-	-	-	-	-	-	-	-	-	-
	Disposal	C4	4.07E-02	0.00E+00	4.07E-02	1.44E+00	0.00E+00	1.44E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-03
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-	-
<b>Caption</b>	PERE : Use of renewable primary energy excluding renewable primary energy resources used as raw materials, MJ; PERM : Use of renewable primary energy resources used as raw materials, MJ; PERT : Total use of renewable primary energy resources, MJ; PENRE : Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials, MJ; PENRM : Use of non renewable primary energy resources used as raw materials, MJ; PENRT : Total use of non renewable primary energy resources, MJ; SM : Use of secondary material, kg; RSF : Use of renewable secondary fuels, MJ; NRSF : Use of non renewable secondary fuels, MJ; FW : Use of net fresh water, m <sup>3</sup>											

Wastes and others output flows			HW	NHW	RW	CFR	MFR	MER	EE	EEE	ETE
<b>Product stage</b>	Total Production	A1-A3	1.00E-01	2.00E+00	5.00E-04	0.00E+00	3.07E-01	6.00E-02	8.18E-01	3.40E-01	4.78E-01
<b>construction stage</b>	Transport	A4	1.35E-02	1.44E-01	2.61E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Installation	A5	1.79E-02	3.20E-01	4.68E-05	7.03E-02	2.15E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-
	Maintenance	B2	5.23E-03	2.76E-01	6.55E-05	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.74E-03	1.65E-02	1.90E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	-	-	-	-	-	-	-	-	-
	Disposal	C4	1.33E-03	5.91E+00	8.45E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-
<b>Caption</b>	HWD : Hazardous waste disposed, kg ; NHWD : Non hazardous waste disposed, kg ; RWD : Radioactive waste disposed, kg ; CRU : Components for re-use, kg ; MFR : Materials for recycling, kg ; MER : Materials for energy recovery, kg ; EE, exported energy, MJ ; EEE : Exported electrical energy, MJ ; ETE : Exported thermal energy, MJ										

### 9.1.8 Life cycle impact assessment of Art Select (5.80 kg/m<sup>2</sup>) - Table 13

Environmental Impacts			ADPE	ADPF	AP	ODP	GWP	EP	POCP
<b>Product stage</b>	Total Production	A1-A3	2.14E-05	1.22E+02	2.43E-02	1.39E-07	7.91E+00	5.88E-03	2.01E-03
<b>construction stage</b>	Transport	A4	5.57E-06	3.74E+01	1.93E-02	4.54E-07	2.56E+00	1.94E-03	7.45E-04
	Installation	A5	5.12E-06	1.23E+01	6.71E-03	1.11E-07	8.13E-01	2.02E-03	4.39E-04
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-
	Maintenance	B2	5.02E-06	1.50E+01	7.99E-03	1.42E-07	9.72E-01	2.43E-03	3.34E-04
	Repair	B3	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	5.44E-07	2.95E+00	7.88E-04	3.60E-08	1.96E-01	1.91E-04	3.30E-05
	Waste processing	C3	-	-	-	-	-	-	-
	Disposal	C4	8.37E-08	1.49E+00	4.66E-04	1.62E-08	3.78E-01	1.83E-02	8.37E-08
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-
<b>Caption</b>	ADPE : Abiotic depletion potential for non fossil resources, kg Sb equiv. ; ADPF: Abiotic depletion potential for fossil resources, MJ ; AP : Acidification potential of land and water sources, kg SO2 equiv. ; ODP : Depletion potential of the stratospheric ozone layer, kg CFC 11 equiv. ; GWP : Global warming potential, kg CO2 equiv. ; EP : Eutrophication potential, kg PO4 equiv. ; POCP : Formation potential of tropospheric ozone photo-chemical oxidants, kg Ethene equiv.								

Resource use			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
<b>Product stage</b>	Total Production	A1-A3	3.45E+00	3.29E+00	6.74E+00	1.30E+02	6.03E+01	1.90E+02	0.00E+00	0.00E+00	0.00E+00	3.42E-01
<b>construction stage</b>	Transport	A4	5.61E-01	0.00E+00	5.61E-01	3.89E+01	0.00E+00	3.89E+01	0.00E+00	0.00E+00	0.00E+00	1.01E-03
	Installation	A5	7.34E-01	0.00E+00	7.35E-01	1.40E+01	1.14E+00	1.52E+01	0.00E+00	0.00E+00	0.00E+00	7.75E-02
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-	-
	Maintenance	B2	7.17E-01	0.00E+00	7.17E-01	1.74E+01	2.50E-01	1.77E+01	0.00E+00	0.00E+00	0.00E+00	1.41E-01
	Repair	B3	-	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.79E-02	0.00E+00	3.79E-02	3.01E+00	0.00E+00	3.01E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-04
	Waste processing	C3	-	-	-	-	-	-	-	-	-	-
	Disposal	C4	4.42E-02	0.00E+00	4.42E-02	1.57E+00	0.00E+00	1.57E+00	0.00E+00	0.00E+00	0.00E+00	1.40E-03
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-	-
<b>Caption</b>	PERE : Use of renewable primary energy excluding renewable primary energy resources used as raw materials, MJ; PERM : Use of renewable primary energy resources used as raw materials, MJ; PERT : Total use of renewable primary energy resources, MJ; PENRE : Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials, MJ; PENRM : Use of non renewable primary energy resources used as raw materials, MJ; PENRT : Total use of non renewable primary energy resources, MJ; SM : Use of secondary material, kg; RSF : Use of renewable secondary fuels, MJ; NRSF : Use of non renewable secondary fuels, MJ; FW : Use of net fresh water, m3											

Wastes and others output flows			HW	NHW	RW	CFR	MFR	MER	EE	EEE	ETE
<b>Product stage</b>	Total Production	A1-A3	1.09E-01	2.17E+00	5.44E-04	0.00E+00	3.34E-01	6.52E-02	8.90E-01	3.70E-01	5.20E-01
<b>construction stage</b>	Transport	A4	1.47E-02	1.57E-01	2.84E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Installation	A5	1.95E-02	3.49E-01	5.10E-05	7.66E-02	2.33E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-
	Maintenance	B2	5.23E-03	2.76E-01	6.55E-05	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.90E-03	1.79E-02	2.07E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	-	-	-	-	-	-	-	-	-
	Disposal	C4	1.45E-03	6.43E+00	9.19E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-
<b>Caption</b>	HWD : Hazardous waste disposed, kg ; NHWD : Non hazardous waste disposed, kg ; RWD : Radioactive waste disposed, kg ; CRU : Components for re-use, kg ; MFR : Materials for recycling, kg ; MER : Materials for energy recovery, kg ; EE, exported energy, MJ ; EEE : Exported electrical energy, MJ ; ETE : Exported thermal energy, MJ										

### 9.1.9 Life cycle impact assessment of HDC (5.51 kg/m<sup>2</sup>) - Table 14

Environmental Impacts			ADPE	ADPF	AP	ODP	GWP	EP	POCP
<b>Product stage</b>	Total Production	A1-A3	2.03E-05	1.16E+02	2.30E-02	1.32E-07	7.51E+00	5.59E-03	1.91E-03
<b>construction stage</b>	Transport	A4	5.29E-06	3.55E+01	1.83E-02	4.31E-07	2.43E+00	1.84E-03	7.08E-04
	Installation	A5	4.86E-06	1.16E+01	6.37E-03	1.06E-07	7.73E-01	1.92E-03	4.17E-04
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-
	Maintenance	B2	5.02E-06	1.50E+01	7.99E-03	1.42E-07	9.72E-01	2.43E-03	3.34E-04
	Repair	B3	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	5.17E-07	2.80E+00	7.49E-04	3.42E-08	1.86E-01	1.81E-04	3.14E-05
	Waste processing	C3	-	-	-	-	-	-	-
	Disposal	C4	7.95E-08	1.41E+00	4.43E-04	1.54E-08	3.59E-01	1.74E-02	7.95E-08
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-
<b>Caption</b>	ADPE : Abiotic depletion potential for non fossil resources, kg Sb equiv. ; ADPF: Abiotic depletion potential for fossil resources, MJ ; AP : Acidification potential of land and water sources, kg SO2 equiv. ; ODP : Depletion potential of the stratospheric ozone layer, kg CFC 11 equiv. ; GWP : Global warming potential, kg CO2 equiv. ; EP : Eutrophication potential, kg PO4 equiv. ; POCP : Formation potential of tropospheric ozone photo-chemical oxidants, kg Ethene equiv.								

Resource use			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
<b>Product stage</b>	Total Production	A1-A3	3.27E+00	3.13E+00	6.40E+00	1.23E+02	5.73E+01	1.80E+02	0.00E+00	0.00E+00	0.00E+00	3.25E-01
<b>construction stage</b>	Transport	A4	5.33E-01	0.00E+00	5.33E-01	3.70E+01	0.00E+00	3.70E+01	0.00E+00	0.00E+00	0.00E+00	9.59E-04
	Installation	A5	6.97E-01	0.00E+00	6.98E-01	1.33E+01	1.08E+00	1.44E+01	0.00E+00	0.00E+00	0.00E+00	7.36E-02
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-	-
	Maintenance	B2	7.17E-01	0.00E+00	7.17E-01	1.74E+01	2.50E-01	1.77E+01	0.00E+00	0.00E+00	0.00E+00	1.41E-01
	Repair	B3	-	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.60E-02	0.00E+00	3.60E-02	2.86E+00	0.00E+00	2.86E+00	0.00E+00	0.00E+00	0.00E+00	1.95E-04
	Waste processing	C3	-	-	-	-	-	-	-	-	-	-
	Disposal	C4	4.20E-02	0.00E+00	4.20E-02	1.49E+00	0.00E+00	1.49E+00	0.00E+00	0.00E+00	0.00E+00	1.33E-03
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-	-
<b>Caption</b>	PERE : Use of renewable primary energy excluding renewable primary energy resources used as raw materials, MJ; PERM : Use of renewable primary energy resources used as raw materials, MJ; PERT : Total use of renewable primary energy resources, MJ; PENRE : Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials, MJ; PENRM : Use of non renewable primary energy resources used as raw materials, MJ; PENRT : Total use of non renewable primary energy resources, MJ; SM : Use of secondary material, kg; RSF : Use of renewable secondary fuels, MJ; NRSF : Use of non renewable secondary fuels, MJ; FW : Use of net fresh water, m3											

Wastes and others output flows			HW	NHW	RW	CFR	MFR	MER	EE	EEE	ETE
<b>Product stage</b>	Total Production	A1-A3	1.04E-01	2.06E+00	5.17E-04	0.00E+00	3.18E-01	6.20E-02	8.45E-01	3.52E-01	4.94E-01
<b>construction stage</b>	Transport	A4	1.39E-02	1.49E-01	2.70E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Installation	A5	1.85E-02	3.31E-01	4.84E-05	7.27E-02	2.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-
	Maintenance	B2	5.23E-03	2.76E-01	6.55E-05	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.80E-03	1.70E-02	1.97E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	-	-	-	-	-	-	-	-	-
	Disposal	C4	1.38E-03	6.11E+00	8.73E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-
<b>Caption</b>	HWD : Hazardous waste disposed, kg ; NHWD : Non hazardous waste disposed, kg ; RWD : Radioactive waste disposed, kg ; CRU : Components for re-use, kg ; MFR : Materials for recycling, kg ; MER : Materials for energy recovery, kg ; EE, exported energy, MJ ; EEE : Exported electrical energy, MJ ; ETE : Exported thermal energy, MJ										

### 9.1.10 Life cycle impact assessment of HDC (5.62 kg/m<sup>2</sup>) - Table 15

Environmental Impacts			ADPE	ADPF	AP	ODP	GWP	EP	POCP
<b>Product stage</b>	Total Production	A1-A3	2.07E-05	1.19E+02	2.35E-02	1.34E-07	7.66E+00	5.70E-03	1.95E-03
<b>construction stage</b>	Transport	A4	5.39E-06	3.62E+01	1.87E-02	4.40E-07	2.48E+00	1.88E-03	7.22E-04
	Installation	A5	4.96E-06	1.19E+01	6.50E-03	1.08E-07	7.88E-01	1.96E-03	4.26E-04
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-
	Maintenance	B2	5.02E-06	1.50E+01	7.99E-03	1.42E-07	9.72E-01	2.43E-03	3.34E-04
	Repair	B3	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	5.27E-07	2.85E+00	7.63E-04	3.49E-08	1.90E-01	1.85E-04	3.20E-05
	Waste processing	C3	-	-	-	-	-	-	-
	Disposal	C4	8.11E-08	1.44E+00	4.51E-04	1.57E-08	3.66E-01	1.78E-02	8.11E-08
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-
<b>Caption</b>	ADPE : Abiotic depletion potential for non fossil resources, kg Sb equiv. ; ADPF: Abiotic depletion potential for fossil resources, MJ ; AP : Acidification potential of land and water sources, kg SO2 equiv. ; ODP : Depletion potential of the stratospheric ozone layer, kg CFC 11 equiv. ; GWP : Global warming potential, kg CO2 equiv. ; EP : Eutrophication potential, kg PO4 equiv. ; POCP : Formation potential of tropospheric ozone photo-chemical oxidants, kg Ethene equiv.								

Resource use			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
<b>Product stage</b>	Total Production	A1-A3	3.34E+00	3.19E+00	6.53E+00	1.26E+02	5.85E+01	1.84E+02	0.00E+00	0.00E+00	0.00E+00	3.32E-01
<b>construction stage</b>	Transport	A4	5.43E-01	0.00E+00	5.43E-01	3.77E+01	0.00E+00	3.77E+01	0.00E+00	0.00E+00	0.00E+00	9.78E-04
	Installation	A5	7.11E-01	0.00E+00	7.12E-01	1.36E+01	1.11E+00	1.47E+01	0.00E+00	0.00E+00	0.00E+00	7.51E-02
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-	-
	Maintenance	B2	7.17E-01	0.00E+00	7.17E-01	1.74E+01	2.50E-01	1.77E+01	0.00E+00	0.00E+00	0.00E+00	1.41E-01
	Repair	B3	-	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.67E-02	0.00E+00	3.67E-02	2.91E+00	0.00E+00	2.91E+00	0.00E+00	0.00E+00	0.00E+00	1.99E-04
	Waste processing	C3	-	-	-	-	-	-	-	-	-	-
	Disposal	C4	4.29E-02	0.00E+00	4.29E-02	1.52E+00	0.00E+00	1.52E+00	0.00E+00	0.00E+00	0.00E+00	1.35E-03
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-	-
<b>Caption</b>	PERE : Use of renewable primary energy excluding renewable primary energy resources used as raw materials, MJ; PERM : Use of renewable primary energy resources used as raw materials, MJ; PERT : Total use of renewable primary energy resources, MJ; PENRE : Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials, MJ; PENRM : Use of non renewable primary energy resources used as raw materials, MJ; PENRT : Total use of non renewable primary energy resources, MJ; SM : Use of secondary material, kg; RSF : Use of renewable secondary fuels, MJ; NRSF : Use of non renewable secondary fuels, MJ; FW : Use of net fresh water, m3											

Wastes and others output flows			HW	NHW	RW	CFR	MFR	MER	EE	EEE	ETE
<b>Product stage</b>	Total Production	A1-A3	1.06E-01	2.10E+00	5.27E-04	0.00E+00	3.24E-01	6.32E-02	8.62E-01	3.59E-01	5.04E-01
<b>construction stage</b>	Transport	A4	1.42E-02	1.52E-01	2.76E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Installation	A5	1.89E-02	3.38E-01	4.94E-05	7.42E-02	2.26E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-
	Maintenance	B2	5.23E-03	2.76E-01	6.55E-05	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.84E-03	1.74E-02	2.01E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	-	-	-	-	-	-	-	-	-
	Disposal	C4	1.40E-03	6.23E+00	8.91E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-
<b>Caption</b>	HWD : Hazardous waste disposed, kg ; NHWD : Non hazardous waste disposed, kg ; RWD : Radioactive waste disposed, kg ; CRU : Components for re-use, kg ; MFR : Materials for recycling, kg ; MER : Materials for energy recovery, kg ; EE, exported energy, MJ ; EEE : Exported electrical energy, MJ ; ETE : Exported thermal energy, MJ										

### 9.1.11 Life cycle impact assessment of Da Vinci (5.56 kg/m<sup>2</sup>) - Table 16

Environmental Impacts			ADPE	ADPF	AP	ODP	GWP	EP	POCP
<b>Product stage</b>	Total Production	A1-A3	2.05E-05	1.17E+02	2.33E-02	1.33E-07	7.58E+00	5.64E-03	1.92E-03
<b>construction stage</b>	Transport	A4	5.34E-06	3.59E+01	1.85E-02	4.35E-07	2.45E+00	1.86E-03	7.14E-04
	Installation	A5	4.91E-06	1.17E+01	6.43E-03	1.07E-07	7.80E-01	1.93E-03	4.21E-04
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-
	Maintenance	B2	5.02E-06	1.50E+01	7.99E-03	1.42E-07	9.72E-01	2.43E-03	3.34E-04
	Repair	B3	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-
<b>end of life</b>	Operational water use	B7	-	-	-	-	-	-	-
	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	5.22E-07	2.82E+00	7.55E-04	3.45E-08	1.88E-01	1.83E-04	3.17E-05
	Waste processing	C3	-	-	-	-	-	-	-
Potential benefits and loads beyond the system boundaries	Disposal	C4	8.02E-08	1.43E+00	4.47E-04	1.55E-08	3.63E-01	1.76E-02	8.02E-08
		D	-	-	-	-	-	-	-
<b>Caption</b>	ADPE : Abiotic depletion potential for non fossil resources, kg Sb equiv. ; ADPF: Abiotic depletion potential for fossil resources, MJ ; AP : Acidification potential of land and water sources, kg SO2 equiv. ; ODP : Depletion potential of the stratospheric ozone layer, kg CFC 11 equiv. ; GWP : Global warming potential, kg CO2 equiv. ; EP : Eutrophication potential, kg PO4 equiv. ; POCP : Formation potential of tropospheric ozone photo-chemical oxidants, kg Ethene equiv.								

Resource use			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
<b>Product stage</b>	Total Production	A1-A3	3.30E+00	3.16E+00	6.46E+00	1.24E+02	5.78E+01	1.82E+02	0.00E+00	0.00E+00	0.00E+00	3.28E-01
<b>construction stage</b>	Transport	A4	5.37E-01	0.00E+00	5.37E-01	3.73E+01	0.00E+00	3.73E+01	0.00E+00	0.00E+00	0.00E+00	9.67E-04
	Installation	A5	7.04E-01	0.00E+00	7.05E-01	1.34E+01	1.09E+00	1.45E+01	0.00E+00	0.00E+00	0.00E+00	7.43E-02
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-	-
	Maintenance	B2	7.17E-01	0.00E+00	7.17E-01	1.74E+01	2.50E-01	1.77E+01	0.00E+00	0.00E+00	0.00E+00	1.41E-01
	Repair	B3	-	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-	-
<b>end of life</b>	Operational water use	B7	-	-	-	-	-	-	-	-	-	-
	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.64E-02	0.00E+00	3.64E-02	2.88E+00	0.00E+00	2.88E+00	0.00E+00	0.00E+00	0.00E+00	1.96E-04
	Waste processing	C3	-	-	-	-	-	-	-	-	-	-
Potential benefits and loads beyond the system boundaries	Disposal	C4	4.24E-02	0.00E+00	4.24E-02	1.50E+00	0.00E+00	1.50E+00	0.00E+00	0.00E+00	0.00E+00	1.34E-03
		D	-	-	-	-	-	-	-	-	-	-
<b>Caption</b>	PERE : Use of renewable primary energy excluding renewable primary energy resources used as raw materials, MJ; PERM : Use of renewable primary energy resources used as raw materials, MJ; PERT : Total use of renewable primary energy resources, MJ; PENRE : Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials, MJ; PENRM : Use of non renewable primary energy resources used as raw materials, MJ; PENRT : Total use of non renewable primary energy resources, MJ; SM : Use of secondary material, kg; RSF : Use of renewable secondary fuels, MJ; NRSF : Use of non renewable secondary fuels, MJ; FW : Use of net fresh water, m3											

Wastes and others output flows			HW	NHW	RW	CFR	MFR	MER	EE	EEE	ETE
<b>Product stage</b>	Total Production	A1-A3	1.05E-01	2.08E+00	5.22E-04	0.00E+00	3.21E-01	6.25E-02	8.53E-01	3.55E-01	4.98E-01
<b>construction stage</b>	Transport	A4	1.41E-02	1.50E-01	2.73E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Installation	A5	1.87E-02	3.34E-01	4.89E-05	7.34E-02	2.24E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-
	Maintenance	B2	5.23E-03	2.76E-01	6.55E-05	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-
<b>end of life</b>	Operational water use	B7	-	-	-	-	-	-	-	-	-
	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.82E-03	1.72E-02	1.98E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	-	-	-	-	-	-	-	-	-
Potential benefits and loads beyond the system boundaries	Disposal	C4	1.39E-03	6.17E+00	8.81E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		D	-	-	-	-	-	-	-	-	-
<b>Caption</b>	HWD : Hazardous waste disposed, kg ; NHWD : Non hazardous waste disposed, kg ; RW : Radioactive waste disposed, kg ; CRU : Components for re-use, kg ; MFR : Materials for recycling, kg ; MER : Materials for energy recovery, kg ; EE, exported energy, MJ ; EEE : Exported electrical energy, MJ ; ETE : Exported thermal energy, MJ										

### 9.1.12 Life cycle impact assessment of Da Vinci (5.80 kg/m<sup>2</sup>) - Table 17

Environmental Impacts			ADPE	ADPF	AP	ODP	GWP	EP	POCP
<b>Product stage</b>	Total Production	A1-A3	2.14E-05	1.22E+02	2.43E-02	1.39E-07	7.91E+00	5.88E-03	2.01E-03
<b>construction stage</b>	Transport	A4	5.57E-06	3.74E+01	1.93E-02	4.54E-07	2.56E+00	1.94E-03	7.45E-04
	Installation	A5	5.12E-06	1.23E+01	6.71E-03	1.11E-07	8.13E-01	2.02E-03	4.39E-04
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-
	Maintenance	B2	5.02E-06	1.50E+01	7.99E-03	1.42E-07	9.72E-01	2.43E-03	3.34E-04
	Repair	B3	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	5.44E-07	2.95E+00	7.88E-04	3.60E-08	1.96E-01	1.91E-04	3.30E-05
	Waste processing	C3	-	-	-	-	-	-	-
	Disposal	C4	8.37E-08	1.49E+00	4.66E-04	1.62E-08	3.78E-01	1.83E-02	8.37E-08
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-
<b>Caption</b>	ADPE : Abiotic depletion potential for non fossil resources, kg Sb equiv. ; ADPF: Abiotic depletion potential for fossil resources, MJ ; AP : Acidification potential of land and water sources, kg SO2 equiv. ; ODP : Depletion potential of the stratospheric ozone layer, kg CFC 11 equiv. ; GWP : Global warming potential, kg CO2 equiv. ; EP : Eutrophication potential, kg PO4 equiv. ; POCP : Formation potential of tropospheric ozone photo-chemical oxidants, kg Ethene equiv.								

Resource use			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
<b>Product stage</b>	Total Production	A1-A3	3.45E+00	3.29E+00	6.74E+00	1.30E+02	6.03E+01	1.90E+02	0.00E+00	0.00E+00	0.00E+00	3.42E-01
<b>construction stage</b>	Transport	A4	5.61E-01	0.00E+00	5.61E-01	3.89E+01	0.00E+00	3.89E+01	0.00E+00	0.00E+00	0.00E+00	1.01E-03
	Installation	A5	7.34E-01	0.00E+00	7.35E-01	1.40E+01	1.14E+00	1.52E+01	0.00E+00	0.00E+00	0.00E+00	7.75E-02
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-	-
	Maintenance	B2	7.17E-01	0.00E+00	7.17E-01	1.74E+01	2.50E-01	1.77E+01	0.00E+00	0.00E+00	0.00E+00	1.41E-01
	Repair	B3	-	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.79E-02	0.00E+00	3.79E-02	3.01E+00	0.00E+00	3.01E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-04
	Waste processing	C3	-	-	-	-	-	-	-	-	-	-
	Disposal	C4	4.42E-02	0.00E+00	4.42E-02	1.57E+00	0.00E+00	1.57E+00	0.00E+00	0.00E+00	0.00E+00	1.40E-03
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-	-
<b>Caption</b>	PERE : Use of renewable primary energy excluding renewable primary energy resources used as raw materials, MJ; PERM : Use of renewable primary energy resources used as raw materials, MJ; PERT : Total use of renewable primary energy resources, MJ; PENRE : Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials, MJ; PENRM : Use of non renewable primary energy resources used as raw materials, MJ; PENRT : Total use of non renewable primary energy resources, MJ; SM : Use of secondary material, kg; RSF : Use of renewable secondary fuels, MJ; NRSF : Use of non renewable secondary fuels, MJ; FW : Use of net fresh water, m3											

Wastes and others output flows			HW	NHW	RW	CFR	MFR	MER	EE	EEE	ETE
<b>Product stage</b>	Total Production	A1-A3	1.09E-01	2.17E+00	5.44E-04	0.00E+00	3.34E-01	6.52E-02	8.90E-01	3.70E-01	5.20E-01
<b>construction stage</b>	Transport	A4	1.47E-02	1.57E-01	2.84E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Installation	A5	1.95E-02	3.49E-01	5.10E-05	7.66E-02	2.33E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>use stage</b>	Use	B1	-	-	-	-	-	-	-	-	-
	Maintenance	B2	5.23E-03	2.76E-01	6.55E-05	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	-	-	-	-	-	-	-	-	-
	Replacement	B4	-	-	-	-	-	-	-	-	-
	Refurbishment	B5	-	-	-	-	-	-	-	-	-
	Operational energy use	B6	-	-	-	-	-	-	-	-	-
	Operational water use	B7	-	-	-	-	-	-	-	-	-
<b>end of life</b>	De-construction	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.90E-03	1.79E-02	2.07E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	-	-	-	-	-	-	-	-	-
	Disposal	C4	1.45E-03	6.43E+00	9.19E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries			D	-	-	-	-	-	-	-	-
<b>Caption</b>	HWD : Hazardous waste disposed, kg ; NHWD : Non hazardous waste disposed, kg ; RWD : Radioactive waste disposed, kg ; CRU : Components for re-use, kg ; MFR : Materials for recycling, kg ; MER : Materials for energy recovery, kg ; EE, exported energy, MJ ; EEE : Exported electrical energy, MJ ; ETE : Exported thermal energy, MJ										

## 10 - Life cycle interpretation

### Energy

PVC floor covering life cycle uses mainly non-renewable energy (261 MJ, 97% of total energy). 71% (186 MJ) of the total non-renewable primary energy (PENRT) is at the production stage where sourcing represents 136 MJ (52%). This non-renewable energy is for a large part for energy use (201 MJ, 77%) and also in primary materials (61 MJ), mainly in PVC (41.5 MJ, 68%) and plasticizer (19 MJ).

The total renewable and non-renewable energy for materials and energy use for A1-A3 is 193 MJ. The total renewable and non-renewable energy for energy use for A1-A3 is 130 MJ where electricity at A3 stage represents 8.96 MJ. Using a delivered to primary ratio of 3, this will give 23.9 MJ primary energy from electricity use in A3, corresponding to 12% of the total primary energy.

Transport from manufacturing site to AUS/NZ market is the second contributor PENRT consumption (38 MJ, 15%). The main contributor is the transport by road of the product in Australia (30.4 MJ 80%) while sea transport freight represents 22% (8.6 MJ).

The third contributor is maintenance (18MJ, 7%) where cleaning product manufacturing represents 30% (5.4 MJ) of the non renewable energy, then transport by road of the auxiliaries in AUS-NZ represents 23 % (4.1 MJ with 2.9 MJ (72%) from the transport in Australia) and by sea 14% (2.4 MJ). Electricity for cleaning process is only 1.2 MJ (7%).

### Net Fresh water (Total :0.555 m<sup>3</sup>)

FW is mainly used at A1 stage (0.336 m<sup>3</sup>, 61%) for the PVC production (0.152 m<sup>3</sup>, 28%). The use stage is the second contributor (0.141 m<sup>3</sup>/FU/year, 25%). In other hand, the net fresh water consumption reaches to 2.529 m<sup>3</sup> for a life of 15 years where the use stage represents 84%.

### Global warming potential (GWP)

Total GWP is 12.6 kg CO<sub>2</sub>eq and follows the same way as PENRT.

Within the production stage, sourcing stage A1 is the main contributor of GWP with 4.9 kg CO<sub>2</sub>eq (39%) where PVC and plasticizer are the main components with 3.6 CO<sub>2</sub>eq(73%) and 1.3 CO<sub>2</sub>eq (27%) respectively. Manufacturing stage A3 is the second contributor with 2.7 kg CO<sub>2</sub>eq (20%) shared between CN and KR facility, with 1.6 and 1.1 kg CO<sub>2</sub>eq respectively and 52% (1.4 kg CO<sub>2</sub>eq) of these emissions are the Chinese electricity production for manufacturing because of the use of coal while the KR electricity emission are 1.1 kg CO<sub>2</sub>eq.

Transport of the products from manufacturing site to the AUS-NZ market is also the second contributor where transport by road and by sea represent 1.2 and 0.6 kg CO<sub>2</sub>eq respectively.

### Eutrophication potential (EP) (total EP: 1.92 E-2 kg PO<sub>4</sub><sup>3-</sup> eq)

The end of life and mainly, the land filling of the used product is the main contributor of EP with 1.82 kg PO<sub>4</sub><sup>3-</sup> eq (94%) and 1.80 kg PO<sub>4</sub><sup>3-</sup> eq (93%) respectively.

### Acidification potential (AP)

The total AP is 5.85E-2 SO<sub>2</sub> kg eq. The main contributor is the production stage with 2.38E-2 kg SO<sub>2</sub> (41%) and the sourcing represents 1.32E-2 kg SO<sub>2</sub> (23%). The second contributor is transport with 1.89E-2 kg SO<sub>2</sub> (32%) where the transport by sea emits 1.24E-2 kg SO<sub>2</sub> (21%).

### Ozone depletion potential (ODP)

The total ODP is 8.83E-7 kg CFC11eq. The transport of the product the main contributor 4.45E-7 kg CFC11 (50%). Transport by road in AUS/NZ is the main contributor of this stage with a value of 3.47E-7 kg CFC11 (39%).



## Waste

Hazardous wastes (HW - Total: 0.149 kg) are mainly supplied by the production stage with 1.07 E-1 kg (73%) and mainly the sourcing stage (9.22E-2, 61%). The production of PVC and acrylic varnish represent 71% and 7% of the HW production respectively. The second contributor is the installation stage (1.91E-2 kg - 13%). Non hazardous waste (total: 9.23 kg) is mainly supplied by the end of life of the product with its land filling (6.31 kg, 68%). The second contributor is the production stage A1-A3 (2.13 kg) where the A3 stage is the main producer (2.09 kg, 22%). In this stage, it is the CN electricity production, and the coal power generation (1.44 kg, 16%) which produce the main quantity. Radioactive wastes (total: 6.77 E-4 kg) is, obviously, produced by nuclear electricity generation, mainly at the A3 production stage (5.09 E-4, 75%). Korean electric consumption leads to 3.03E-5 kg of RW (45%).

## Other outputs

The level of recycling or reuse is weak. The level of recycled waste at construction or use stages is weak (3.3 E-3 kg/FU).

For the assessed floor coverings it is assumed that no significant degradation of materials occurs during land filling; no significant emissions are considered for more than 100 years.

The other indicators of pollution and of resource uses change in the same way. Globally, the impacts and others indicators are strongly correlated to the weight of the product for any stages except for A4 installation and A5 maintenance stage.

A good approximation to have the impact for any stage (except A4 and A5) is:

Impact for product of weight  $M = M * li / 5.69$ , where  $li$  is the impact for the reference product.

## 11 - Others environmental information

The Luxury Vinyl Tiles (LVT) have been certified to Ecospecifier Global GreenStar and have been found in conformance with the Global Green Tag Scheme Standard for the Tier and Level as follows: 'Green Tag Silver Streamlined' 2.0mm thick LVT tiles LCARate EcoPOINT 0.62; 2.5mm thick LVT tiles LCARate EcoPOINT 0.67 and 3.0mm thick LVT tiles LCARate EcoPOINT 0.71.

## 12 - References

GPI 2015	General Programme Instructions of the Australasian EPD programme (2015), The Australasian EPD programme.
ISO 10582	ISO 10582: 2012-04 Resilient floor coverings - Heterogeneous poly(vinyl chloride) floor coverings - Specification
ISO 14025	ISO 14025:2011-10 Environmental labels and declarations - Type III environmental declarations - Principles and procedures
ISO 14040	ISO 14040:2009-11 Environmental management - Life cycle assessment - Principles and framework
ISO 14044	ISO 14044:2006-10 Environmental management - Life cycle assessment - Requirements and guidelines
EN 15804	EN 15804:2010-08 Sustainability of construction works -Environmental Product Declarations - Core rules for the product category of construction products

ISO 21930	Sustainability of construction products - Environmental declaration of building products.
PCR 2012:01	The International EPD system - Product Category Rule 2012:01 - Construction products and services V2.0.
Ecoinvent	<a href="http://www.ecoinvent.org/support/documents-and-files/documents-and-files.html">http://www.ecoinvent.org/support/documents-and-files/documents-and-files.html</a>