EPD™

Environmental Product Declaration

Global GreenTag EPD Program:

Compliant to EN15804+A2 2019

Natralis™ Homogeneous Sheet Flooring
Distributed by AHF Products
3840 Hempland Road, Mountville, PA 17554, USA

ArmstrongFlooring™

ArmstrongFlooring

Natralis^{TM} Homogeneous Sheet Flooring

Mandatory Disclosures

EPD type	Cradle to grave A1 to C4 + D
EPD Number	ATX AS03 2022EP
Issue Date	Day 17th May 2022
Valid Until	Day 17th May 2027
Demonstration of Verification	
PCR	Standard EN 15804+A2 2019 serves as core Product Category Rules (PCR) [1]. Sub PCR FC:2019v1 Floor Coverings also applies [2]
☑ Internal	Delwyn Jones 28 07 2023 LCA & EPD developer Delwyn Jones, Director Ecquate 28 07 2023 LCA Reviewed by Direshni Naiker, Evah Associate 02 08 2023 EPD Reviewed by David Baggs, Global GreenTag Pty Ltd
☑ External	28 07 2023 Third Party Verifier[a] Mathilde Vlieg, MalaikaLCT a. Independent external verification of the declaration and data, mandatory for business-to-consumer communication according to ISO 14025:2010 [3].
Communication	This EPD discloses potential environmental outcomes compliant with EN 15804 for business-to-business communication.
Comparability	Construction product EPDs may not be comparable if not EN15804 compliant. Different program EPDs may not be comparable. Comparability is further dependent on the product category rules and data sources used.
Reliability	LCIA results are relative expressions that do not predict impacts on category endpoints, exceeding of thresholds, safety margins or risks.
Owner	This EPD is the property of the declared manufacturer.
Explanations	Further explanatory information is available at info@globalgreentag.com or by contacting certification1@globalgreentag.com [3].

EPD Program Operator	**LCA and EPD Producer**	**Declaration Owner**
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Program Description

EPD type	Cradle to grave scope EPD as defined by EN 15804 [1]
System boundary	The system boundary with nature includes resource acquisition, processing, manufacture, transport, installation, use to end of life plus waste arising.
Information modules	Figure 1 depicts all modules assessed including some with calculated zero results. Any module not declared (MND) does not indicate a zero result.

Information	Building Life Cycle Assessment															Supplementary		
Model	Actual			Scenarios												Potential		
Stages	Product			Construct		Building							End-of-Life				Benefit & load beyond system		
						Fabric					Operation							
Modules	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D1	D2	D3
Mandatory (M) & Optional (O) Unit Operations	Resources	Transport	Manufacture	Transport	Construct	Use	Maintain	Repair	Replace	Refurbish	Energy use	Water use	Demolish	Transport	Process Waste	Disposal	Reuse	Recovery	Recycling
Cradle to																			
Gate+ Options (O)	Mandatory			O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Grave				M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	O

Figure 1 Life Cycle Modules

Scope depiction	
Stages included	A1-3 A4-5, B1-5, C1-4 & D1.
Stages excluded	No stage was excluded. Stages B1, B4 to B7, C3, D2, D3 and D4 have no flows.

Data Sources and Quality

Primary Data	Data was collected from primary sources, 2019 to 2022, including the manufacturer, suppliers' standards, locations, logistics, market share, technology and management system in accordance with EN ISO 14044:2006, 4.3.2, [4]. All are physically biologically or chemically allocated. No flows are economically allocated.
Variability Range	Significant differences of average LCIA results are shown.
Data cut-off & quality criteria	Complies with EN 15804 [1]. The LCA used background data aged <10 years and quality parameters tabled below.

Background	**Data Quality**	**Parameters and Uncertainty (U)**			
Correlation	**Metric σg**	U ±0.01	U ±0.05	U ±0.10	U ±0.20
Reliability	**Reporting**	Site Audit	Expert verify	Region	Sector
	Sample	>66% trend	>25% trend	>10% batch	>5% batch
Completion	**Including**	>50%	>25%	>10%	>5%
	Cut-off	0.01%w/w	0.05%w/w	0.1%w/w	0.5%w/w
Temporal	**Data Age**	<3 years	≤5 years	<7.5 years	<10 years
	Duration	>3 years	<3 years	<2 years	1 year
Technology	**Typology**	Actual	Comparable	In Class	Convention
Geography	**Focus**	Process	Line	Plant	Corporate
	Range	Continent	Nation	Plant	Line
	Representation	Global, Africa, America, Europe, Pacific Rim			

ArmstrongFlooring

Natralis^{TM} Homogeneous Sheet Flooring

Product Information

Range Names in full	Commercial Homogeneous Sheet Flooring
Product Name & Code	Armstrong Flooring^{TM} Natralis^{TM}
Manufacturer	Braeside Mills Operations Pty Ltd Trading As Armstrong Flooring
Factory warranty	10 years Commercial
Manufacturer address	29-39 Mills Road Braeside Victoria Australia 3195
Site representation	29-39 Mills Road Braeside Victoria Australia 3195
Application	Coated and reinforced floor covering
Function in Building	Interior dry-area resilient floor covering
Specification	Homogeneous mineral-filled polyvinyl chloride sheet
Declared unit	1 kg=0.3333 m^2 of Armstrong uncoated homogeneous floor covering
Functional unit	20 years interior use per kilogram of declared 3.0 kg/m^2 floor covering
Design Application	Hospital, Aged Care, Health Care, Education, Hospitality, Mercantile and Light Industrial sector buildings.
Practices Reference	https://www.armstrongflooring.com/commercial/en-us/products/hom/natralis.html
Installation Procedure	https://www.armstrongflooring.com/cdn/afi/pdbupimages-flr/Commercial-Sheet-Installation-Instructions.pdf
Practicality	Full depth replenishing polyurethane. Protective polyurethane finish reduces maintenance and increases scuff resistance.
Durability	Excellent dent and gouge resistance. Embossed surface texture and high-visual colour chip masks dirt and wear marking in high traffic areas.

Product Functional & Technical Performance

This section provides manufacturer specifications, additional information and datapoints required to calculate assessment results factoring different mass and periods.

Service	Standards	Parameters	Standard Conformance
Type	ASTM F1913	Resilient floor covering	Homogeneous sheet vinyl
Performance		Homogeneous floor covering	√
Binder content		Minimum Percentage	50%
Use area class		Light Commercial & Commercial	√
Lifetime [5 & 6]	ISO 15686	Reference Service Life	20 years
Dimensions	ISO 24341	Roll Width*Length	6.0*52.5 feet
	ASTM F386	Overall thickness	2.0 mm
Durability	ASTM D4060	Abrasion resistance	72,900 cycles
Slip resistance	ASTM D2047	Dry, Neolite	0.92
		Dry, Leather	0.75
Emissions	CDPH v1.2-2017	Volatile Organic Compound	FloorScore®
Smoke	ASTM E662	Flaming	≤450
		Non-Flaming	≤450
Fire	ASTM E648	Critical Radiant Flux	Class I
Surface Burning Characteristics	CAN/ULC S102.2	Flame Spread Rating (FSR)	With S-995 Adhesive: 25
		Smoke Developed Class (SDC)	With S-995 Adhesive: 70

Product Functional & Technical Performance

This section summarises factory components, functions, source nation and % mass share. In the product content listed below the % mass ±5% range has a confidence interval that is 90% certain to contain true population means at any time.

Listing such 90±5% certainty allows for intellectual property protection whilst ensuring fullest possible transparency. It also reflects normal component resource acquisition, supply chain, sedimentation, seasonality, manufacturing and product colourways variation over this EPD's 5-year validity period

Base material content range (%w/w)

Function	Component	Cradle	Natralis
Binder	Polyvinyl Chloride	Taiwan	>40<44
Filler	Limestone	Australia	>38<43
Plasticiser	Dioctyl Terephthalate	Mainland China	>10<13
Stabiliser	Calcium Zinc Soap	Australia	>1<3
Coating	Polyurethane	Australia	>1<2
White pigment	Titanium dioxide	Mainland China	>1<2
Stabiliser & plasticiser	Epoxidised Soybean Oil	Taiwan	>0.5<1
Binder	Post Industrial Scrap PVC	Australia	>0.5<1
Stabiliser	Diphenyloctyl Phosphite	Taiwan	<0.5
Modifier	Polyurethane	Australia	<0.5
Colour	Pigments	Global	<0.1
Other Components	Matte, cross-linking, coupling, levelling & coating components	Europe & Taiwan	<0.03 ea
Packing			
Carton & core	Cardboard 90% PCR	Australia	0.09
Wrap, spacer	Card & paper 90% PCR	Australia	0.83
Tape & liner	Polymer 55% PCR	Australia	0.05
Spools	Plastic	Australia	0.04
Tape & label	Paper	Australia	0.04

Completeness	
No Chemicals of Very High Concern	Contains no substances in the European Chemicals Agency "Authorised or Candidate Lists of Substances of Very High Concern (SVHCs)".
A1-A3 Stage inclusions	Operations include all known raw material acquisition, refining and processing plus scrap or material reuse from prior systems; electricity generated from all sources with extraction, refining & transport plus secondary fuel energy and recovery processes. Also, transport to factory gates; manufacture of inputs, ancillary material, product, packaging, maintenance, replacement plus flows leaving at end-of-waste boundary as well as fates of all flows at end of life.

System Analysis Scope and Boundaries

Stages A1 to 3 model actual operations. Stage A4 to C4 are modelled as scenarios. Typical scenarios are assumed to model forecast unit operations as described in the next section.

Figure 2. shows modelled processes in a cradle to grave system boundary to end of life fates beyond the boundary but space limits showing some operations to reuse, recycling or landfill grave.

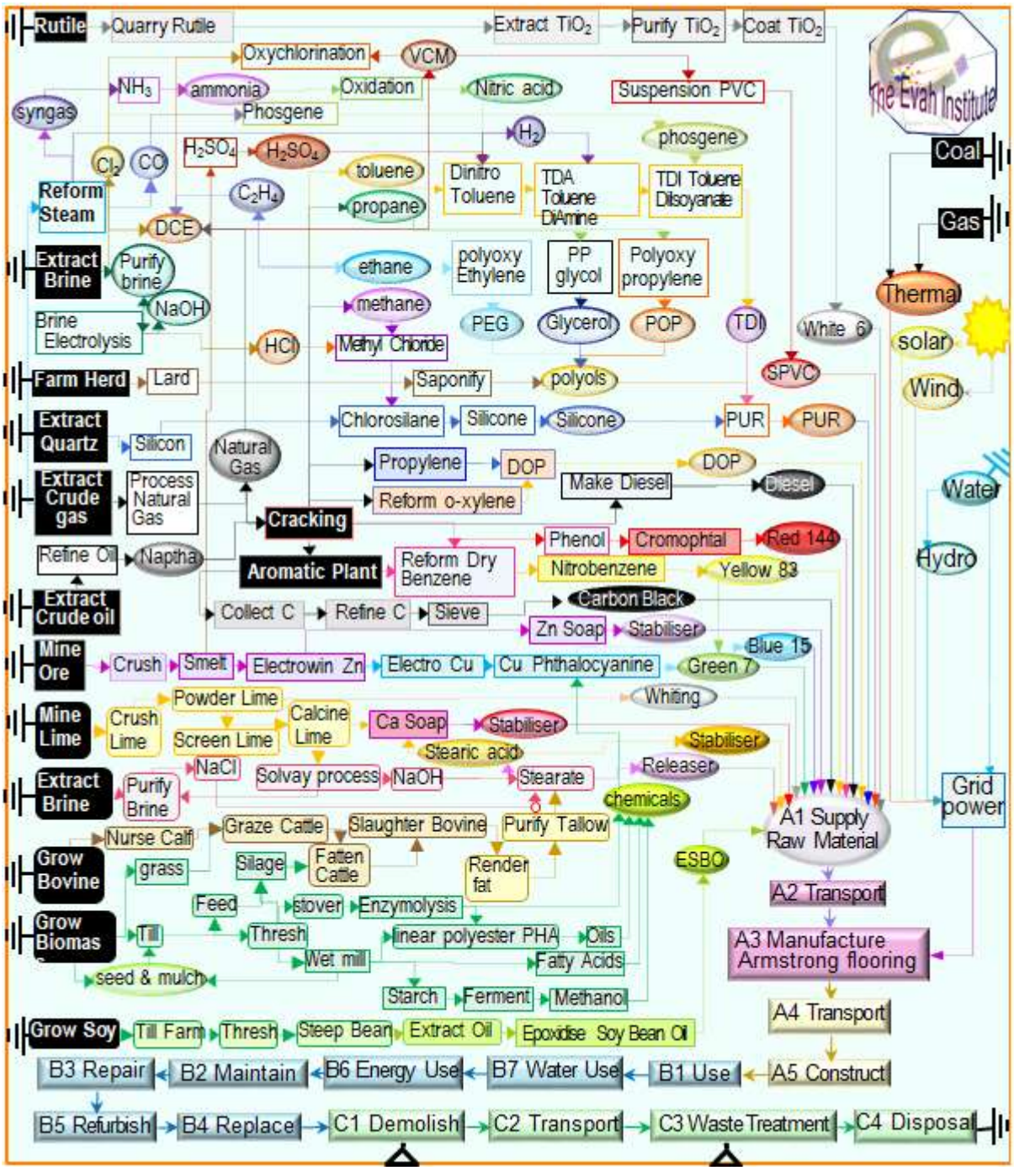

Figure 2. Product Process Flow Chart

Scenarios for Modules/Functional Unit

Stages A1 to A3 model actual operations. This section defines modelling scenarios for stage A4 to D3. Stages B1 Use of building fabric, B4 Replacement, B5 Refurbishment, B6 Building Operating Energy, B7 Building Operating Water, C3 Waste Treatment and D2 Recovery and D3 Recycling have zero inputs and outputs.

Phase	Operation	Type specified	Amount	Type specified	Amount
A4 Transport	Transport to Site	2t to 5t vans	22 km	85% Capacity	Full back load
	Long distance road	25t semi-trailer	600km	85% Capacity	Full back load
	Continental freight rail	Diesel train	600km	85% Capacity	Full back load
	Container shipping	Factory to CBD	1,200km	85% Capacity	Full back load
	Volume capacity (<1 ≥1)	Utilisation factor	1	Uncompressed	Un-nested
A5 Construct	Ancillaries	Adhesive	0.025kg	Edge trim	0.0001kg
	Packing	Cardboard	0.005kg	Polymer	0.00001kg
	Water & Energy	Town water	0.0m^3	Energy type	0.0MJ
	Waste on site	Trims	0.05kg	All packaging	As shown kg
	Scrap collection & route	No recycling	0.0kg	Energy recovery	0.0kg
	Emissions	Nil to air & water	0.0kg	All from landfill	In LCA report
B2 Maintain	Maker's specification	URL Declared	Specified	Clean cycle	Weekly
	Ancillaries	Scrubber pads	Negligible	Detergent	0.007kgpa
	Washing net water use	Town water	1.95kgpa	To drain 1.90	kgpa
	Vacuum cleaner energy	Once weekly	1.62MJpa	Power mix	Local AU mean
B3 Repair	Typical practice	Damaged parts	0.05kg	Worn parts	Same 5%
	Maker's specification	As per website	Specified	Freight to site	As A5
	Energy input & source	No excess	0.0MJpa	Packaging	As A5
C1 Demolish	Typical practice	Take up worn	0.40kg	Collection	Separate
	Collection process	In site waste	0.40kg	Separate to reuse	0.0kg
C2 Transport	Typical practice	25t truck road	50km	85% capacity	No back load
C4 Dispose	Typical practice	Product specific	0.40kg	Collect separately	0.40kg
	Typical practice	Worn to landfill	40%	All emissions	mass share
	Recovery system	No recycling	0.0kg	Not for energy	0.0kg
D1 Reuse	Typical practice	Retain low wear	60%	Reuse in place	0.60kg

Environmental Impact Terminology

Environmental impacts contributing to risks of social and ecological issues and collapse are tabled below with common names and remedies given for each indicator.

Global warming forcing Climate Change	Greenhouse gases absorb infra-red radiation. This heat reduces thermal energy differentials, from equator to poles, forcing ocean current and wind circulation to blend and regulate climate. Weakly blended "lumpier" weather has more frequent, extreme heat wave, fire-storm, cyclone, rain-storm, flood and blizzard events. Accumulation of carbon dioxide, natural gas methane, nitrous oxides and volatile organic compounds from burning fossil fuels causes global warming. Forest and wilderness growth absorbing air-borne carbon in biomass can drawdown such accumulation. Urgent renewable energy reliance is vital in time to avoid imminent tipping points and the worsening "***climate emergency***".
Ozone layer depletion	Stratospheric ozone loss weakens the planet's solar shield so more shorter wavelength ultraviolet (UVB) light reaching earth damages plants and increases malignant melanoma and skin cancer in humans and animals. Chlorofluorocarbons, hydrochlorofluorocarbons, chlorobromomethane, hydrobromofluorocarbons, carbon tetrachloride, methyl chloroform, methyl bromide and halon gas cause ozone layer loss. To repair the "***ozone hole***" reliance on ozone-safe refrigerants, aerosols and solvents is essential to avoid further its depletion and enable accumulation of naturally-formed ozone.
Acidification	Acidification reduces soil and waterway pH, impedes nitrogen fixation vital for plant growth and inhibits natural decomposition. It increases rates and incidence of fish kills, forest loss and deterioration of buildings and materials. Chief synthetic causes of "***acid rain***" are emissions of sulphur and nitrogen oxides, hydrochloric and hydrofluoric acids and ammonia from burning ***fossil fuels*** polluting rain and snow precipitation world-wide.
Eutrophication of terrestrial, freshwater and marine life	Eutrophication from excessively high macronutrient levels added to natural waters promotes excessive plant growth that severely reduces oxygen, water and habitat security for aquatic and terrestrial organisms across related ecosystems. Chief synthetic cause of "***algal blooms***" is nitrogen (N, NOx, NH_4) and phosphorus (P, PO_4^{3-}) in rain run-off over-fertilised land catchments.
Photochemical ozone creation	Tropospheric photochemical ozone, called "***summer smog***" near ground level, is created from natural and synthetic compounds in UV sunlight. Low concentration smog damages vegetation and crops. High concentration smog is hazardous to human health. Chief synthetic causes are nitrogen oxides, carbon monoxide and volatile organic compounds (VOC) pollutants. Avoiding reliance on dirtiest coal fuel and volatile chemicals has reduced smog incidence in many areas globally.
Depletion of minerals, metals & water	Abiotic depletion of finite mineral resources increases time, effort and money required to obtain more resources to the point of extinction of naturally viable reserves. This can limit access to available, valuable and scarce elements vital for human-life. The youth movement "***extinction rebellion***" calls on adults to secure climate, reserves and biodiversity for current and future generations.
Depletion of fossil fuel reserves	Abiotic depletion of resources by consuming finite oil, natural gas, coal and yellowcake fossil fuel reserves leaves current and future generations suffering limited available, accessible, plentiful, essential valuable as well as scarce raw material, medicinal, chemical, feedstock and fuel stock. Approaching "***peak oil***" acknowledged fossil fuel reserves are finite and the need for decision-makers to act to avoid market instability, insecurity and or oil and gas wars.

Glossary of Terms and Units

Impact Potential, Inventory Input and Inventory output, acronyms, method and unit are defined below.

Impact Potentials	Acronym	Description of Methods	Units
Climate Change biogenic	GWP_{bio}	GWP biogenic [7]	kg CO_{2eq}
Climate Change land use	GWP_{luluc}	GWP land use & change [7]	kg CO_{2eq}
Climate Change fossil	GWP_{ff}	GWP fossil fuels [7]	kg CO_{2eq}
Climate Change total	GWP	Global Warming Potential [7]	kg CO_{2eq}.
Stratospheric Ozone Depletion	ODP	Stratospheric Ozone Loss [8]	kg CFC_{11eq}
Photochemical Ozone Creation	POCP	Summer Smog [9]	kg $NMOC_{eq}$
Acidification Potential	AP	Accumulated Exceedance [10]	mol H^{+}_{eq}
Eutrophication Freshwater	EP_{fresh}	Excess nutrients freshwater [11]	kg P_{eq}
Eutrophication Marine	EP_{marine}	Excess marine nutrients [11]	kg N_{eq}
Eutrophication Terrestrial	EP_{land}	Excess terrestrial nutrients [11]	mol N_{eq}
Mineral & Metal Depletion	ADP_{min}	Abiotic depletion minerals [12]	kg Sb_{eq}
Fossil Fuel Depletion	ADP_{fossil}	Abiotic depletion fossil fuel [13]	MJ $_{ncv}$
Water Depletion	WDP	Water Deprivation Scarcity [14,15]	m^3 $_{WDP\ eq}$
Fresh Water Net	FW	Lake, river, well & town water	m^3
Secondary Material	SM	Post-consumer recycled (PCR)	kg
Renewable Secondary Fuel	RSF	PCR biomass burnt	MJ $_{ncv}$
Renewable Primary Feedstock	PERM	Biomass retained material	MJ $_{ncv}$
Renewable Primary Energy Not Matter	PERE	Biomass fuels burnt	MJ $_{ncv}$
Renewable Primary Energy Total	PERT	Biomass burnt + retained	MJ $_{ncv}$
Unrenewable Secondary Fuel	NRSF	PCR fossil-fuels burnt	MJ $_{ncv}$
Unrenewable Primary Feedstock	PENRM	Fossil feedstock retained	MJ $_{ncv}$
Unrenewable Primary Energy Not Matter	PENRE	fossil-fuel used or burnt	MJ $_{ncv}$
Unrenewable Primary Energy Total	PENRT	Fossil feedstock & fuel use	MJ $_{ncv}$
Hazardous Waste Disposed	HWD	Processed to contain hazard risks	kg
Non-hazardous Waste Disposed	NHWD	Municipal landfill facility waste	kg
Radioactive Waste Disposed	RWD	Mostly nuclear power plant waste	kg
Components For Reuse	CRU	Production scrap for reuse as is	kg
Material For Recycling	MFR	Production scrap for recycling	kg
Material For Energy Recovery	MER	Production scrap for use as fuel	kg
Exported Energy Electrical	EEE	Common in buildings not products	MJ $_{ncv}$
Exported Energy Thermal	EET	Common in buildings not products	MJ $_{ncv}$

Results of Modules A and B

Table 1 shows results A1 to A5/functional unit.

Table 1 Results of A1 to A5/Functional Unit

Impact Potential	A1-3	A4	A5
Climate Change GWP biogenic	-0.05	-1.1E-06	-0.012
Climate Change GWP luluc	4.9E-06	1.7E-09	6.0E-06
Climate Change GWP fossil	3.63	0.02	0.30
Climate Change GWP total	3.58	0.02	0.29
Ozone Depletion Potential	1.4E-08	1.7E-13	1.2E-08
Photochemical Ozone Potential	2.1E-02	1.2E-04	1.9E-03
Acidification Potential	9.5E-03	1.2E-05	8.3E-04
Eutrophication freshwater	1.9E-06	5.6E-10	2.3E-05
Eutrophication marine	1.8E-03	2.3E-06	1.7E-04
Eutrophication terrestrial	1.5E-02	7.9E-06	1.1E-03
Mineral & Metal Depletion	2.88	2.3E-02	0.26
Fossil Fuel Depletion	1.6E-04	7.2E-06	4.6E-05
Fresh Water Net	59.4	1.8E-05	3.2E-02
Secondary Material	0.14	2.9E-06	0.025
Renewable Secondary Fuel	0.25	6.75E-06	0.011
Renewable Primary Energy Not Material	0.69	3.0E-04	0.200
Renewable Primary Feedstock	0.43	2.4E-03	0.034
Renewable Primary Energy Total	1.32	2.7E-03	0.0234
Unrenewable Secondary Fuel	0.17	7.4E-04	1.9E-04
Unrenewable Primary Energy Not Material	15.04	0.11	3.76
Unrenewable Primary Material	48.01	0.19	1.63
Unrenewable Primary Energy Total	63.05	0.30	5.38
Hazardous Waste Disposed	7.6E-03	3.7E-05	8.9E-04
Non-hazardous Waste Disposed	0.14	3.1E-04	5.2E-02
Radioactive Waste Disposed	1.4E-16	1.1E-31	4.5E-17
Components For Reuse	8.2E-03	4.4E-3	2.6E-04
Material For Recycling	5.4E-02	6.4E-06	3.2E-02
Material For Energy Recovery	7.7E-04	2.3E-07	2.7E-04
Exported Energy Electrical	0	0	0
Exported Energy Thermal	0	0	0

Results of B Modules

Table 2 shows results B1 to B7/functional unit. All flows were calculated as zero for stages B1, B4 to B7

Table 2 Results B1 to B7/Functional Unit

Impact Potential	B1	B2	B3	B4-7
Climate Change GWP biogenic	0	-0.091	-4.0E-03	0
Climate Change GWP luluc	0	7.33E-06	4.21E-07	0
Climate Change GWP fossil	0	0.62	0.23	0
Climate Change GWP total	0	0.53	0.23	0
Ozone Depletion Potential	0	3.0E-09	5.9E-09	0
Photochemical Ozone Potential	0	3.3E-03	1.4E-03	0
Acidification Potential	0	1.4E-03	6.5E-04	0
Eutrophication freshwater	0	5.9E-07	2.2E-05	0
Eutrophication marine	0	2.4E-04	1.3E-04	0
Eutrophication terrestrial	0	1.8E-03	9.9E-04	0
Mineral & Metal Depletion	0	0.53	0.19	0
Fossil Fuel Depletion	0	2.9E-04	2.2E-05	0
Fresh Water Net	0	6.1E-02	1.7E-02	0
Secondary Material	0	0.044	0.014	0
Renewable Secondary Fuel	0	0.20	0.006	0
Renewable Primary Energy Not Material	0	0.41	0.071	0
Renewable Primary Feedstock	0	1.00	0.027	0
Renewable Primary Energy Total	0	1.41	0.098	0
Unrenewable Secondary Fuel	0	0.039	3.0E-03	0
Unrenewable Primary Energy Not Material	0	7.74	2.98	0
Unrenewable Primary Material	0	1.57	1.03	0
Unrenewable Primary Energy Total	0	9.31	4.01	0
Hazardous Waste Disposed	0	9.1E-04	6.2E-04	0
Non-hazardous Waste Disposed	0	9.9E-02	4.0E-02	0
Radioactive Waste Disposed	0	2.5E-17	2.3E-17	0
Components For Reuse	0	1.7E-3	6.8E-3	0
Material For Recycling	0	7.1E-02	3.4E-03	0
Material For Energy Recovery	0	3.2E-05	1.2E-04	0
Exported Energy Electrical	0	0	0	0
Exported Energy Thermal	0	0	0	0

Results of C Modules

Table 3 shows results C1 to C4/functional unit. All flows were calculated as zero for stages C3.

Table 3 Results Module C1, C2 and C4 /Functional Unit

Impact Potential	C1	C2	C3	C4
Climate Change GWP biogenic	-2.1E-04	-8.8E-07	0	1.2E-03
Climate Change GWP luluc	2.0E-08	1.4E-09	0	3.5E-03
Climate Change GWP fossil	1.8E-03	6.1E-03	0	7.1E-03
Climate Change GWP total	1.6E-03	6.1E-03	0	1.1E-02
Ozone Depletion Potential	6.8E-12	1.1E-13	0	7.1E-08
Photochemical Ozone Potential	9.6E-06	6.0E-05	0	6.1E-04
Acidification Potential	4.1E-06	5.1E-06	0	1.1E-03
Eutrophication freshwater	1.4E-09	3.1E-10	0	3.1E-04
Eutrophication marine	7.4E-07	9.5E-07	0	2.6E-05
Eutrophication terrestrial	5.4E-06	3.4E-06	0	4.2E-05
Mineral & Metal Depletion	1.5E-03	7.5E-03	0	0
Fossil Fuel Depletion	6.6E-07	4.0E-06	0	0
Fresh Water Net	1.4E-04	8.7E-06	0	0
Secondary Material	4.1E-04	2.2E-06	0	0
Renewable Secondary Fuel	4.71E-04	5.12E-06	0	0
Renewable Primary Energy Not Material	1.2E-03	2.0E-04	0	0
Renewable Primary Feedstock	2.3E-03	1.6E-03	0	0
Renewable Primary Energy Total	3.5E-03	1.8E-03	0	0
Unrenewable Secondary Fuel	8.9E-05	4.8E-04	0	0
Unrenewable Primary Energy Not Material	2.2E-02	6.4E-02	0	0
Unrenewable Primary Material	3.7E-03	3.7E-02	0	0
Unrenewable Primary Energy Total	2.6E-02	1.0E-01	0	0
Hazardous Waste Disposed	2.1E-06	1.2E-05	0	0
Non-hazardous Waste Disposed	2.3E-04	9.7E-05	0	4.0E-01
Radioactive Waste Disposed	5.8E-20	8.5E-32	0	0
Components For Reuse	3.8E-3	3.5E-3	0	0
Material For Recycling	1.7E-04	4.6E-06	0	0
Material For Energy Recovery	7.5E-08	1.5E-07	0	0
Exported Energy Electrical	0	0	0	0
Exported Energy Thermal	0	0	0	0

Results of D Modules Beyond System Boundaries

Table 4 shows D1 to D4 results/functional unit. Negative results show product reuse over full building life. All flows were calculated as zero for stages D2, D3 and D4

Table 4 Results D1 /Functional Unit

Impact Potential	D1	D2	D3	D4
Climate Change GWP biogenic	-3.0E-02	0	0	0
Climate Change GWP luluc	-2.2	0	0	0
Climate Change GWP fossil	-2.9E-06	0	0	0
Climate Change GWP total	-2.2	0	0	0
Ozone Depletion Potential	-8.3E-09	0	0	0
Photochemical Ozone Potential	-1.2E-02	0	0	0
Acidification Potential	-5.7E-03	0	0	0
Eutrophication freshwater	-1.2E-06	0	0	0
Eutrophication marine	-1.1E-03	0	0	0
Eutrophication terrestrial	-9.2E-03	0	0	0
Mineral & Metal Depletion	-9.4E-05	0	0	0
Fossil Fuel Depletion	-1.7	0	0	0
Fresh Water Net	-3.6	0	0	0
Secondary Material	-8.4E-02	0	0	0
Renewable Secondary Fuel	-0.15	0	0	0
Renewable Primary Energy Feedstock	-0.41	0	0	0
Renewable Primary Energy Not Material	-0.26	0	0	0
Renewable Primary Energy Total	-0.79	0	0	0
Unrenewable Secondary Fuel	-0.10	0	0	0
Unrenewable Primary Energy Not Material	-9.0	0	0	0
Unrenewable Primary Energy Feedstock	-29	0	0	0
Unrenewable Primary Energy Total	-38	0	0	0
Hazardous Waste Disposed	-4.6E-03	0	0	0
Non-hazardous Waste Disposed	-8.4E-02	0	0	0
Radioactive Waste Disposed	-8.5E-17	0	0	0
Components For Reuse	-3.4E-03	0	0	0
Material For Recycling	-3.2E-02	0	0	0
Material For Energy Recovery	-4.6E-04	0	0	0
Exported Energy Electrical	0	0	0	0
Exported Energy Thermal	0	0	0	0

Interpretation

This section interprets the results. Table 5 lists cradle to gate component share % mass versus Global Warming Potential (GWP kg CO_{2e}) and gross embodied energy (EE) % /kg product results.

Figure 3 charts cradle to gate mass % versus gross % share EE/kg results A1 to A3. It shows highest EE sensitivity PVC binder content and least EE sensitive limestone ($CaCO_3$) filler content.

Figure 4 charts GWP versus Abiotic Depletion of Fossil Fuel (ADPFF)/kg A1 to A3. It shows most GWP emissions from PVC binder second is electricity usage and third is DOTP plasticiser.

Table 5 Component & EE% Vs GWP/kg

Component	Mass%	EE%	GWP
PVC	<45	38.0	0.99
DOTP	<15	12.3	0.26
PUR	<5	3.1	0.14
CaZn Soap	<3	1.8	0.07
ESBO	<1	1.4	0.06
TiO_2	<2	0.9	0.03
DPOP	<0.5	0.3	0.01
$CaCO_3$	<45	0.6	0.00

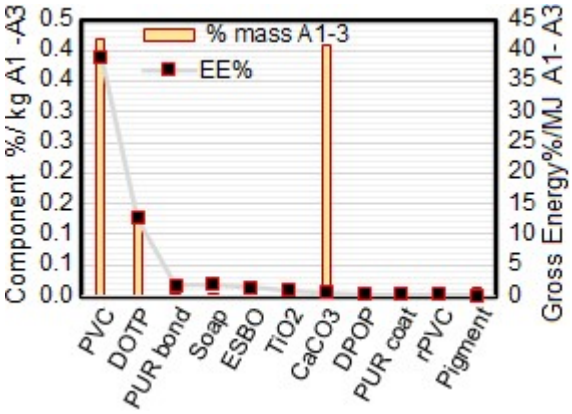

Figure 3 Component & EE % share//kg A1-A3

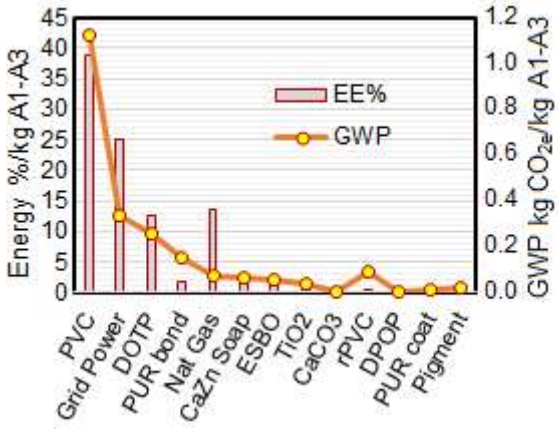

Figure 4 GWP Vs ADP FF/kg A1-A3

Figure 5 charts GWP versus ADP FF/kg product results A1 to C4. Figure 6 charts Photochemical Smog (POCP), Acidification (AP H+), Marine Eutrophication (EPM) and GWP/kg product results A1 to C4. Both charts show product manufacture A1 to A3 highest and B2 maintenance (cleaning) second highest. A3 Construct (Install) and B3 Repair are third but other stages have no significance.

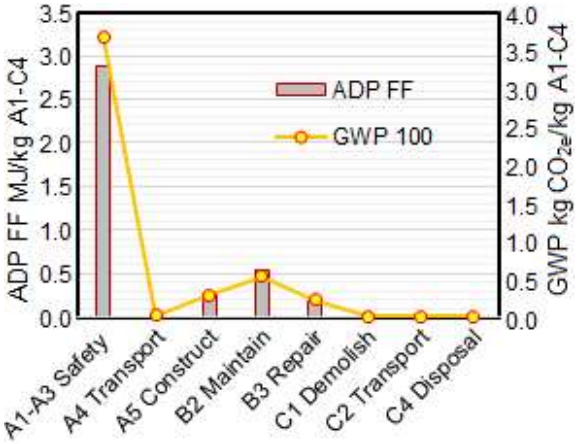

Figure 5 GWP Vs ADP FF /kg A1 to C4

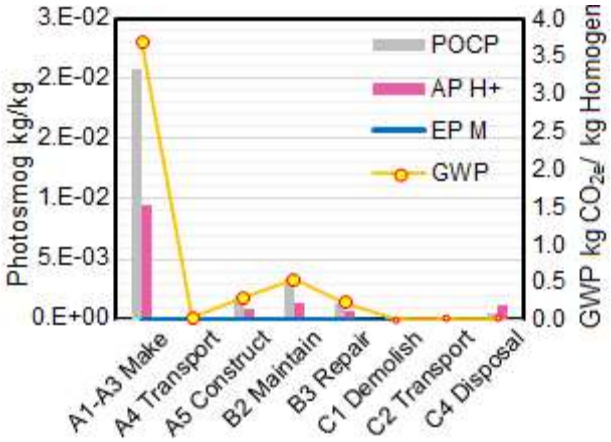

Figure 6 GWP, POCP, AP & EPM/kg A1 to C4

Module D Beyond System Boundary results show typical D1 Reuse for 40 more years of 60% of least-worn product in low traffic bedroom, office and storage areas. The same new flooring replacing only 40% of the floor area in high traffic areas avoids a significant majority of impacts over a 60-year building life. Significant results for phases A4 to C4 remain unchanged for replacement flooring over the building life.

References

[1] EN 15804:2012+A2:2019 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.

[2] GreenTag™ 2021 EPD Program, Product Category Rules https://www.globalgreentag.com/EPD.

[3] ISO 14025:2010 Environmental labels and declarations – Type III – environmental declarations - Principles and procedures.

[4] ISO14044:2006 Environmental management – LCA – Requirements and guidelines.

[5] ISO 15686-2:2012 Buildings and constructed assets - Service life planning - Part 2: Service life prediction procedures.

[6] ISO 15686-8:2008 Buildings and constructed assets - Service-life planning - Part 8: Reference service life and service-life estimation.

[7] IPCC 2013, Global Warming Potential 100-year, IPCC Fifth Assessment Report Climate Change.

[8] WMO 2014, Ozone Depletion Potentials for Steady-state, Scientific Assessment of Ozone Depletion: 2014, Global Ozone Research and Monitoring Project Report No. 55, 2014.

[9] Van Zelm, R., Huijbregts, M., Hollander, H., Jaarsveld, H., Sauter, F., Struijs, J., Wijnen, H., Van de meent, D. 2008, European characterization factors for human health damage of PM10 and ozone in LCIA, Atmos Environ 42(3):441-453, LOTOS-EUROS. DOI: 10.1016/j.atmosenv.2007.09.072

[10] Seppälä, J., Posch, M., Johansson, M. & Hettelingh, J-P. 2006 Country-dependent Characterisation Factors for Acidification and Terrestrial Eutrophication Based on Accumulated Exceedance as an Impact Category Indicator, Int J of LCA 11(6):403-416 Nov 2006 DOI:10.1065/lca2005.06.215

[11] Posch, M., Seppälä, J., Hettelingh, J-P. & Johansson, M. (2008) The role of atmospheric dispersion models and ecosystem sensitivity in the determination of characterisation factors for acidifying and eutrophying emissions in LCIA, Sept 2008, I J LCA 13(6):477-486. DOI:10.1007/s11367-008-0025-9

[12] Struijs, J., Beusen, A., van Jaarsveld, H. & Huijbregts, M.A.J. (2009b). Aquatic Eutrophication. Ch 6 in: Goedkoop, M., Heijungs, R., Huijbregts, M.A.J., De Schryver, A., Struijs, J., Van Zelm, R. (2009). ReCiPe 2008 A life cycle impact assessment method comprising harmonised category indicators at the midpoint and the endpoint level. Report I: Characterisation factors, 1st Ed. EUTREND model.

[13] CML–IA V4.1 LCA methodology, 2002, October 2012, Institute of Environmental Sciences (CML), Faculty of Science, University of Leiden, Netherlands.

[14] Guinée et al., 2002, & van Oers et al., 2002 CML LCA methodology 2002a, CML, Netherlands.

[15] Boulay, A-M., Bare, J., Benini, L., Berger, M., Lathuilliere, M., Manzardo, A., Margni, M., Motoshita, M., Núñez, M., Pastor, A., Ridoutt, B. Oki, T. Worbe, S. & Pfister, S (2018). The WULCA consensus characterization model for water scarcity footprints: assessing impacts of water consumption based on available water remaining (AWARE) I J LCA. 23. 1-11. 10.1007/s11367-017-1333-8.

Bibliography

Ciroth A., Hildenbrand J., Zamagni A. & Foster C., 2015, Data Review Criteria. Annex A: LCI Dataset Review Criteria, 10.13140/RG.2.1.2383.4485 UN EP Life Cycle Initiative

EN ISO 14024:2000, Environmental labels and declarations - Type I environmental labelling -Principles and procedures (ISO 14024:1999).

EN ISO 14040:2006, Environmental management - Life cycle assessment - Principles and framework (ISO14040:2006).

EN 15643-1:2010, Sustainability of construction works - Sustainability assessment of buildings - Part 1: General framework.

EN 15643-2, Sustainability of construction works - Assessment of buildings - Part 2: Framework for the assessment of environmental performance.

EN 16449, Wood and wood-based products - Calculation of the biogenic carbon content of wood and conversion to carbon dioxide.

ISO 21930:2007 Sustainability in building construction - Environmental declaration of building products.

ISO 21931-1:2010, Sustainability in building construction - Framework for methods of assessment of the environmental performance of construction works - Part 1: Buildings.