EPD™

Environmental Product Declaration

Global GreenTag EPD Program:

Compliant to EN15804+A2 2019

Armstrong Flooring Pty Ltd

Wall Covering Sheet

Wallflex products

29-39 Mills Road, Braeside Victoria 3195

ArmstrongFlooring™

ArmstrongFlooring

Wall Covering Sheet
Wallflex products

Mandatory Disclosures

EPD type	Cradle to grave A1 to C4 + D
EPD Number	ATX AS04 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 applies [2]
☑ Internal	28 04 2022 LCA and EPD by Delwyn Jones, Director Ecquate Pty Ltd 02 05 2022 LCA Reviewed by Direshni Naiker Evah Associate 24.05.2022 EPD Reviewed by David Baggs, Global GreenTag Pty Ltd
☑ External	28 04 2022 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 [2].
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 source used.
Reliability	LCIA results are relative expressions that do not predict impacts on category endpoints, exceeding of thresholds, products 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**
Global GreenTag Pty Ltd	Ecquate Pty Ltd	Armstrong Flooring Pty Ltd
PO Box 311 Cannon Hill	PO Box 123 Thirroul	29-39 Mills Road, Braeside
QLD 4170 Australia	NSW 2515 Australia	Victoria 3195
Phone: +61 (0)7 33 999 686	Phone: +61 (0)7 5545 0998	Phone: +61 (0)3 9586 5500
http://www.globalgreentag.com	http://www.evah.com.au	https://www.armstrongflooring.com

GLOBAL GREENTAG® INTERNATIONAL

Ecquate building ecopositive

Armstrong® FLOORING

Environmental Product Declaration

ArmstrongFlooring Wall Covering Sheet
Wallflex products

Program Description

EPD type	Cradle to grave A1 to C4 + D as defined by EN 15804 [1]
System boundary	The system boundary with nature includes material and energy acquisition, processing, manufacture, transport, installation, use plus waste arising to end of life.
Information Modules	Figure 1 depicts all modules being declared including some with zero results. Any module not declared (MND) does not indicate a zero result.

Information	Building Life Cycle Information																Supplementary		
Model	Actual					Scenarios											Potential		
Stages	Product			Construct		Building use							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 EPD Life Cycle Modules Cradle to Grave

Scope Depiction	
Stages included	A1-3 A4-5, B1-5, C1-4 & D1. Stages B6-7 and D2-3 have zero input & output flows
Stages excluded	No stage was excluded but B6-7 and D2-3 have zero flows with zero results

Data Sources and Quality

Primary Data	Data was collected from primary sources 2019 to 2022 including the manufacturer, suppliers and their publications on standards, locations, logistics, technology, market share, management system in accordance with EN ISO 14044:2006, 4.3.2, [4]. All are biochemical and physical allocated none are economically allocated.
Variability Range	Significant differences of average LCIA results are declared.
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 Wall Covering Sheet
Wallflex products

Product Information

Range name	Wallflex vinyl wall covering sheet
Brand names	Wallflex Ovation
Factory warranty	10 years
Manufacturing site	29-39 Mills Road, Braeside Victoria 3195
Site representation	29-39 Mills Road, Braeside Victoria 3195
Application	Resilient wall covering
Functional Performance in Building	Coated and reinforced resilient wall covering sheet
Specification	Interior mineral filled polyvinyl chloride sheet
Declared Unit	1 kg = 0.29412 m^2 of Armstrong 2mm Homogeneous wall covering
Functional Unit	20 years use of a kilogram of declared 3.4 kg/m^2 wall covering
Design Application	Hospitality, Health Care, Hospital, Aged Care, Education, Mercantile and Light Industrial sector buildings.
Practices Reference	https://www.armstrongflooring.com/pdbupimages-flr/223755.pdf
Installation Instructions	https://www.armstrongflooring.com/pdbupimages-flr/225776.pdf
Practicality	PUR coating aids maintenance. Design for uncomplicated or added frieze look.1.5 metre width ideal dado height for ease of installation.
Durability	Coating reduces maintenance and protects long term appearance. Excellent dent and gouge resistance. Improved indent resistance.

Product Functional & Technical Performance

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

Service Detail	Standards	Parameters	Conformance to Standards
Type	ISO 10581	Wall covering type	Homogeneous sheet vinyl
Performance		Homogeneous wall covering	√
Binder Content		Type	2
Lifetime [5 & 6]	ISO 15686	Reference Service Life (RSL)	20 years RSL
Dimensions	ISO 24340	Wear Layer thickness	2.0mm
	ISO 24341	Roll size width*length	1.5*20m
	ISO 24346	Overall Thickness	2.0mm
VOC emissions	ASTM D5116	Volatile Organic Compound (VOC)	<0.5mg/m^2/hr
Fire Resistance (Walling)	AS 5637.1	Cone calorimeter	Group 1
	AS/NZS 3837	Average specific extinction area	<250m^2/kg

Product Components

This section summarises factory components, functions, source nation and % mass share. In the product content listed below the % mass has a ±5% range and a confidence interval that is 90% certain to contain true population means at any time. This allows for intellectual property protection whilst ensuring fullest possible transparency. Listing such 90±5% certainty also considers normal resource acquisition, supply chain, sedimentation, seasonal, manufacturing and product colour variation over this EPD's 5-year validity period.

Base material content range (%w/w)

Function	Component	Source	Wallflex %	Ovation %
Binder	Polyvinyl Chloride	Taiwan	>20<25	>20<25
Filler	Limestone	Australia	>60<65	>60<65
Plasticiser	Dioctyl Terephthalate	Mainland China	>5<10	>5<10
White pigment	Titanium dioxide	Mainland China	>0.8<1.3	>0.8<1.3
Coating	Polyurethane	Europe	>0.8<1.3	>0.8<1.3
Plasticiser	Dioctyl adipate	South Korea	>0.7<1.2	>0.7<1.2
Stabiliser and plasticiser	Epoxidised Soybean Oil	Taiwan	>0.7<1.2	>0.7<1.2
Process aid	30% Ethoxy nonyl phosphate	Mainland China	>0.7<1.2	>0.7<1.2
Stabiliser	Calcium Zinc Soap	Australia	>0.4<0.9	>0.4<0.9
Process aid	Methyl Butyl methacrylate	Mainland China	>0.4<0.8	>0.4<0.8
Lubricant	Calcium Stearate	Australia	<0.1	<0.1
Colour	Pigments	Global	<0.1	<0.1
Lubricant	Stearic Acid	Indonesia	<0.1	<0.1
Coating additive & matte, cross-linker, coupling levelling agents	The six proprietary additives included in LCA modelling were all safety and hazard checked.	Europe and Taiwan	<0.03 ea	<0.03 ea
Packing				
Carton & core	Cardboard 90% PCR	Australia	0.09	0.09
Wrap, spacer	Card & paper 90% PCR	Australia	0.83	0.83
Tape & liner	Polymer 55% PCR	Australia	0.05	0.05
Spools	Plastic	Australia	0.04	0.04
Tape & label	Paper	Australia	0.04	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 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.

ArmstrongFlooring Wall Covering Sheet
Wallflex products

System Analysis Scope and Boundaries

Stages A1 to 3 model actual operations. Stage A4 to C4 are model scenarios. Typical scenarios are assumed to model forecast unit operations as described in the next section. Figure 2. shows included processes in a cradle to grave system boundary to end of life fates beyond the system boundary to unshown:

- reuse,
- recycling or
- landfill grave.

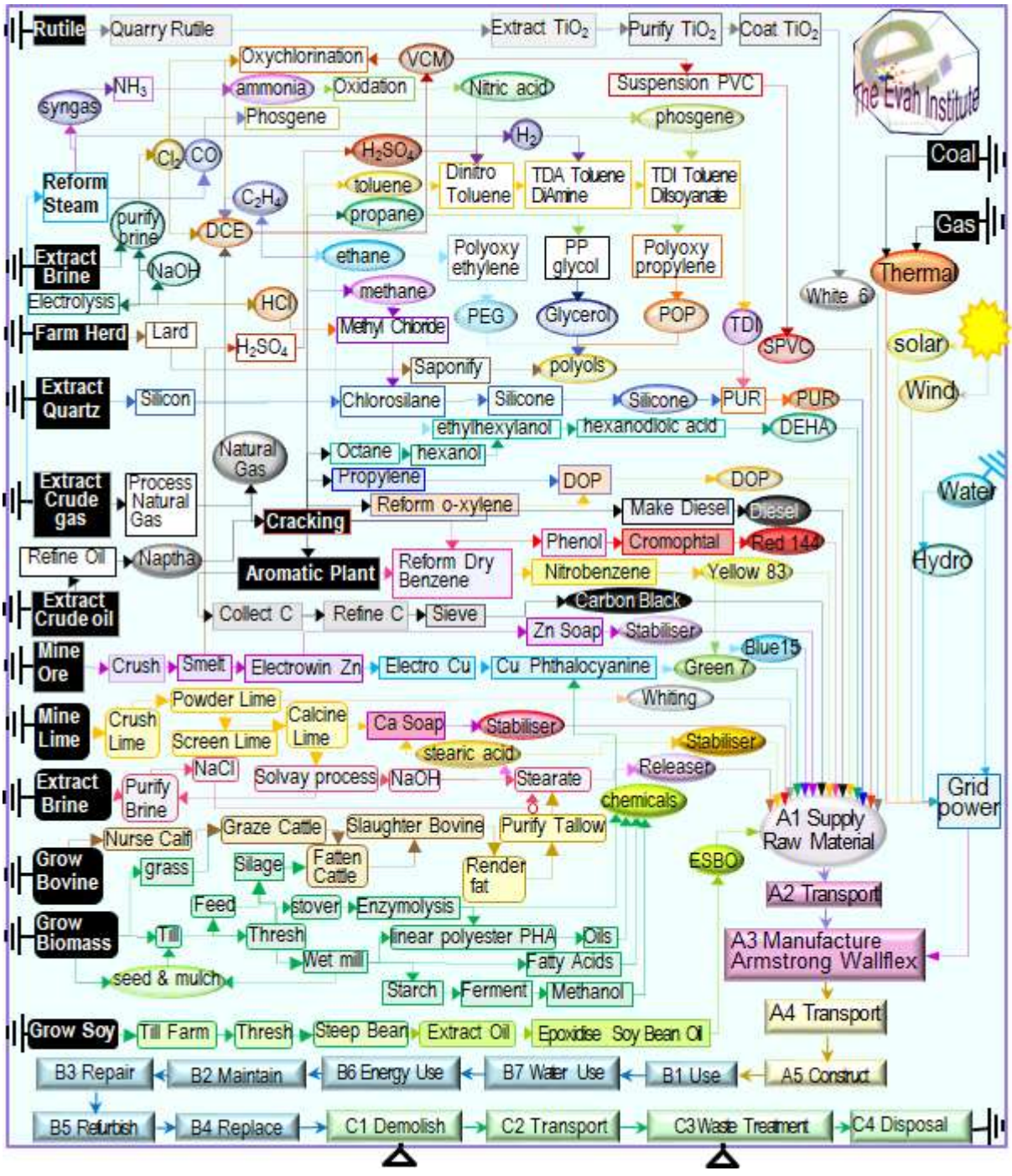

Figure 2. Product Process Flow Chart

ArmstrongFlooring Wall Covering Sheet
Wallflex products

Scenarios for Modules (Units/Functional Unit)

This section defines modelling scenarios. Stages A1 to A3 model actual operations. Stage A4 to D3 model scenarios described as listed below.

A Construction

A4 Transport to Site	Type specified	Amount	Type specified	Amount
Intercity road trucking	2t to 5t vans	220 km	85% Capacity	Full back load
Long distance road trucking	25t semi-trailer	600 km	85% Capacity	Full back load
Continental freight rail	Diesel train	600 km	85% Capacity	Full back load
Global container shipping	Factory to CBD	1,200km	85% Capacity	Full back load
Volume capacity (<1 to ≥1)	Utilisation factor	1	Uncompressed	Un-nested
A5 Installation: Ancillaries	Adhesive	0.025 kg	Edge trim	0.0001 kg
Packing	Cardboard	0.005 kg	Polymer	0.00001 kg
Water & Energy	Town water	0.00 m3	Energy type	0.0 MJ
Waste on site	Trims	0.05 kg	All packaging	As declared kg
Scrap, collection & routes	No recycling	0.0 kg	Energy recovery	0.0 kg
Emissions	Nil to air & water	0.0 kg	All from landfill	In LCA report

B Building

Stage B1 Use of building fabric has zero flows. Stage B2 and B3 scenarios are listed below. Stages B4 Replacement, B5 Refurbishment, B6 Building Operating Energy and B7 Building Operating Water each have zero flows

B2 Maintenance	Type specified	Amount	Type specified	Amount
Maker's specified process	URL declared	Specified	Clean cycle	Weekly
Ancillary material (kg)	Scrubber pads	Negligible	Detergent	0.007kgpa
Washing net water use	Town water	1.95kgpa	To drain 1.90	kgpa
Vacuum cleaning energy	Once weekly	1.62MJpa	Power mix	Local AU mean
B3 Repair	Damaged parts	0.05kg	Worn parts	Same 5%
Maker's specified process	As per website	Specified	Freight to site	As A5
Energy input & source	No excess	0.0MJpa	Packaging	As A5

Stage C1, C2 and C4 scenarios are listed below. Stage C3 Waste Treatment has zero flows.

C End Of Life

C1 Demolition	Type specified	Amount	Type specified	Amount
Operation	Take up worn area	0.40kg	Collection	Separate
Collection process	In site waste	0.40kg	Separate to reuse	0.0kg
C2 Transport	25t truck road	50km	85% capacity	No back load
C4 Disposal	Product specific	0.40kg	Collect separately	0.40kg
Typical Scenario	high wear to landfill	40%	All emissions	mass share
Recovery system	No recycling	0.0 kg	Not for energy	0.0 kg

Stage D1 scenario is listed below. Stages D2 Recovery and D3 Recycling have zero flows.

D Beyond System Boundary

D1 Reuse	Type specified	Amount	Type specified	Amount
Typical Scenario	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. hydrochlorofluorocarbons, Chlorofluorocarbons, hydrobromofluorocarbons, chlorobromomethane, 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 Potentials, acronyms, methods and units are defined below

Impact Potentials	Acronym	Description of Methods	Units
Climate Change biogenic	GWP $_{bio}$	GWP biogenic [7]	kg $CO_{2eq.}$
Climate Change fossil	GWP $_{ff}$	GWP fossil fuels [7]	kg $CO_{2eq.}$
Climate Change land use	GWP $_{luluc}$	GWP land use & change [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	kg N $_{eq}$
Eutrophication Terrestrial	EP $_{land}$	Excess Terrestrial nutrients	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 $_{WDP\ eq}$

Inventory inputs, acronyms, methods and units are defined below

	Input flows	Acronym	Description of Methods	Units
	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 material	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 material	PENRE	fossil-fuel used or burnt	MJ $_{ncv}$
Unrenewable	Primary Energy Total	PENRT	Fossil feedstock & fuel use	MJ $_{ncv}$

Outputs, acronyms, methods and units are defined below

Inventory Output flows	Acronym	Description of Methods	Units
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 station waste	kg
Components For Reuse	CRU	Production scrap for reuse as is	kg
Material For Recycling	MFR	Production scrap for remanufacture	kg
Material For Energy Recovery	MER	Production scrap for use as fuel	kg
Exported Energy Electrical	EEE	Common for buildings not products	MJ $_{ncv}$
Exported Energy Thermal	EET	Common for buildings not products	MJ $_{ncv}$

Module A1 to C4 Impact Results Cradle to Grave

Table 1.0 shows results in declared units/functional unit across A1 to A5, B2, B3, C1, C2 and C4. All flows and hence results were zero in B1 Use of building fabric, B4 Replacement, B5 Refurbishment, B6 Building Operating Energy, B7 Building Operating Water and C3 Waste Treatment.

Table 1.0 A1 to C4 Impact Results/Functional Unit

Wallflex 2.0mm	A1-3 Acquire Transport & Manufacture	A4 Transport	A5 Construct	B2 Maintain	B3 Repair	C1 Demolish	C2 Transport	C4 Disposal
GWP biogenic	-0.53	-1.1E-06	-0.012	-0.091	-4.0E-03	-2.1E-04	-8.8E-07	0
GWP luluc	4.4E-04	1.7E-09	6.0E-06	7.33E-06	4.21E-07	2.0E-08	1.4E-09	3.5E-03
GWP fossil	2.53	0.02	0.30	0.62	0.23	1.8E-03	6.1E-03	7.1E-03
GWP total	2.00	0.02	0.29	0.53	0.23	1.6E-03	6.1E-03	1.1E-02
Ozone loss ODP	4.3E-08	1.7E-13	1.2E-08	3.0E-09	5.9E-09	6.8E-12	1.1E-13	7.1E-08
Smog POCP	1.3E-02	1.2E-04	1.9E-03	3.3E-03	1.4E-03	9.6E-06	6.0E-05	6.1E-04
Acidification AP	5.5E-03	1.2E-05	8.3E-04	1.4E-03	6.5E-04	4.1E-06	5.1E-06	1.1E-03
EP freshwater	3.1E-06	5.6E-10	2.3E-05	5.9E-07	2.2E-05	1.4E-09	3.1E-10	3.1E-04
EP marine	1.1E-03	2.3E-06	1.7E-04	2.4E-04	1.3E-04	7.4E-07	9.5E-07	2.6E-05
EP terrestrial	5.7E-03	7.9E-06	1.1E-03	1.8E-03	9.9E-04	5.4E-06	3.4E-06	4.2E-05
ADP fossil	2.52	2.3E-02	0.26	0.53	0.19	1.5E-03	7.5E-03	0
ADP mineral	6.3E-04	7.2E-06	4.6E-05	2.9E-04	2.2E-05	6.6E-07	4.0E-06	0
WDP water	2.5E-02	3.0E-06	5.2E-03	9.8E-03	2.7E-03	2.3E-05	1.4E-06	0
Ovation								
GWP biogenic	-0.53	-1.1E-06	-0.012	-0.091	-4.0E-03	-2.1E-04	-8.8E-07	0
GWP luluc	4.4E-04	1.7E-09	6.0E-06	7.33E-06	4.21E-07	2.0E-08	1.4E-09	3.5E-03
GWP fossil	2.53	0.02	0.30	0.62	0.23	1.8E-03	6.1E-03	7.1E-03
GWP total	2.00	0.02	0.29	0.53	0.23	1.6E-03	6.1E-03	1.1E-02
Ozone loss ODP	4.3E-08	1.7E-13	1.2E-08	3.0E-09	5.9E-09	6.8E-12	1.1E-13	7.1E-08
Smog POCP	1.3E-02	1.2E-04	1.9E-03	3.3E-03	1.4E-03	9.6E-06	6.0E-05	6.1E-04
Acidification AP	5.5E-03	1.2E-05	8.3E-04	1.4E-03	6.5E-04	4.1E-06	5.1E-06	1.1E-03
EP freshwater	3.1E-06	5.6E-10	2.3E-05	5.9E-07	2.2E-05	1.4E-09	3.1E-10	3.1E-04
EP marine	1.1E-03	2.3E-06	1.7E-04	2.4E-04	1.3E-04	7.4E-07	9.5E-07	2.6E-05
EP terrestrial	5.7E-03	7.9E-06	1.1E-03	1.8E-03	9.9E-04	5.4E-06	3.4E-06	4.2E-05
ADP fossil	2.52	2.3E-02	0.26	0.53	0.19	1.5E-03	7.5E-03	0
ADP mineral	6.3E-04	7.2E-06	4.6E-05	2.9E-04	2.2E-05	6.6E-07	4.0E-06	0

Table 2.0 shows product LCI inputs/functional unit across stages A1 to A5, B2, B3, C1, C2 and C4. All flows and hence results were zero in stages: B1 Use of building fabric, B4 Replacement, B5 Refurbishment, B6 Building Operating Energy, B7 Building Operating Water and C3 Waste Treatment.

Table 2.0 A1 to C4 Inventory Results /Functional Unit

	Wallflex 2.0mm	A1-3 Acquire Transport & Manufacture	A4 Transport	A5 Construct	B2 Maintain	B3 Repair	C1 Demolish	C2 Transport	C4 Dispose
	Fresh Water Net	0.16	1.8E-05	3.2E-02	6.1E-02	1.7E-02	1.4E-04	8.7E-06	0
	Secondary Material	0.29	2.9E-06	0.025	0.044	0.014	4.1E-04	2.2E-06	0
Renewable	Secondary Fuel	0.43	6.75E-06	0.011	0.20	0.006	4.71E-04	5.12E-06	0
Renewable	Primary Energy not material	8,64	3.0E-04	0.200	0.41	0.071	1.2E-03	2.0E-04	0
Renewable	Primary Feedstock	0.31	2.4E-03	0.034	1.00	0.027	2.3E-03	1.6E-03	0
Renewable	Primary Energy Total	8.95	2.7E-03	0.0234	1.41	0.098	3.5E-03	1.8E-03	0
Unrenewable	Secondary Fuel	0.23	7.4E-04	1.9E-04	0.039	3.0E-03	8.9E-05	4.8E-04	0
Unrenewable	Primary Energy not material	35.1	0.11	3.76	7.74	2.98	2.2E-02	6.4E-02	0
Unrenewable	Primary Material	17.5	0.19	1.63	1.57	1.03	3.7E-03	3.7E-02	0
Unrenewable	Primary Energy Total	52.55	0.30	5.38	9.31	4.01	2.6E-02	1.0E-01	0
	Ovation								
	Fresh Water Net	0.16	1.8E-05	3.2E-02	6.1E-02	1.7E-02	1.4E-04	8.7E-06	0
	Secondary Material	0.29	2.9E-06	0.025	0.044	0.014	4.1E-04	2.2E-06	0
Renewable	Renewable Secondary Fuel	0.43	6.75E-06	0.011	0.20	0.006	4.71E-04	5.12E-06	0
Renewable	Primary Energy not material	8.64	3.0E-04	0.200	0.41	0.071	1.2E-03	2.0E-04	0
Renewable	Primary Feedstock	0.31	2.4E-03	0.034	1.00	0.027	2.3E-03	1.6E-03	0
Renewable	Primary Energy Total	8.95	2.7E-03	0.0234	1.41	0.098	3.5E-03	1.8E-03	0
Unrenewable	Secondary Fuel	0.23	7.4E-04	1.9E-04	0.039	3.0E-03	8.9E-05	4.8E-04	0
Unrenewable	Primary Energy not Material	35.1	0.11	3.76	7.74	2.98	2.2E-02	6.4E-02	0
Unrenewable	Primary Material	17.5	0.19	1.63	1.57	1.03	3.7E-03	3.7E-02	0
Unrenewable	Primary Energy Total	52.55	0.30	5.38	9.31	4.01	2.6E-02	1.0E-01	0

Table 3.0 lists all other modules' product outputs in declared units/functional unit for stage A1 to A5, B2, B3, C1, C2 and C4. All results are zero for stages: B1 Use of building fabric, B4 Replacement, B5 Refurbishment, B6 Building Operating Energy, B7 Building Operating Water and C3 Waste Processing.

Table 3.0 Module A1 to C4 Output Results/Functional Unit

Wallflex 2.0mm	A1-3 Acquire Transport & Manufacture	A4 Transport	A5 Construction	B2 Maintain	B3 Repair	C1 Demolition	C2 Transport	C4 Disposal
Hazardous Waste Disposed	6.4E-03	3.7E-05	8.9E-04	9.1E-04	6.2E-04	2.1E-06	1.2E-05	0
Non-hazardous Waste Disposed	0.23	3.1E-04	5.2E-02	9.9E-02	4.0E-02	2.3E-04	9.7E-05	4.0E-01
Radioactive Waste Disposed	6.3E-16	1.1E-31	4.5E-17	2.5E-17	2.3E-17	5.8E-20	8.5E-32	0
Components For Reuse	3.0E-02	4.4E-3	2.6E-04	1.7E-3	6.8E-3	3.8E-3	3.5E-3	0
Material For Recycling	1.9E-02	6.4E-06	3.2E-02	7.1E-02	3.4E-03	1.7E-04	4.6E-06	0
Material For Energy Recovery	5.4E-03	2.3E-07	2.7E-04	3.2E-05	1.2E-04	7.5E-08	1.5E-07	0
Exported Energy Electrical	0	0	0	0	0	0	0	0
Exported Energy Thermal	0	0	0	0	0	0	0	0
Ovation								
Hazardous Waste Disposed	6.4E-03	3.7E-05	8.9E-04	9.1E-04	6.2E-04	2.1E-06	1.2E-05	0
Non-hazardous Waste Disposed	0.23	3.1E-04	5.2E-02	9.9E-02	4.0E-02	2.3E-04	9.7E-05	4.0E-01
Radioactive Waste Disposed	6.3E-16	1.1E-31	4.5E-17	2.5E-17	2.3E-17	5.8E-20	8.5E-32	0
Components For Reuse	3.0E-02	4.4E-3	2.6E-04	1.7E-3	6.8E-3	3.8E-3	3.5E-3	0
Material For Recycling	1.9E-02	6.4E-06	3.2E-02	7.1E-02	3.4E-03	1.7E-04	4.6E-06	0
Material For Energy Recovery	5.4E-03	2.3E-07	2.7E-04	3.2E-05	1.2E-04	7.5E-08	1.5E-07	0
Exported Energy Electrical	0	0	0	0	0	0	0	0
Exported Energy Thermal	0	0	0	0	0	0	0	0

Module D Results Beyond System Boundaries

Table 4 shows Module D Beyond system boundaries D1 Reuse stage credits products results /functional unit as negatives as they reduce the impacts over the building life. All flows and results were zero for D1 Exported Energy Electrical (EEE) and Thermal (EET) as well as D2 Recovery and D3 Recycling.

Table 4 D1 Reuse Results /Functional Unit

Impact Potentials		Wallflex 2.0mm	Ovation
Climate Change GWP biogenic		-0.32	-0.32
Climate Change GWP fossil		-2.6E-04	-2.6E-04
Climate Change GWP luluc		-1.52	-1.52
Climate Change GWP total		-1.20	-1.20
Ozone Depletion Potential		-2.6E-08	-2.6E-08
Photochemical Ozone Potential		-8.0E-03	-8.0E-03
Acidification Potential		-3.3E-03	-3.3E-03
Eutrophication freshwater		-1.8E-06	-1.8E-06
Eutrophication marine		-6.9E-04	-6.9E-04
Eutrophication terrestrial		-3.4E-03	-3.4E-03
Mineral & Metal Depletion		-1.51	-1.51
Fossil Fuel Depletion		-3.8E-04	-3.8E-04
Water Depletion		-1.5E-02	-1.5E-02
Inventory input flows			
	Fresh Water Net	-0.09	-0.09
	Secondary Material	-1.7E-01	-1.7E-01
Renewable	Renewable Secondary Fuel	-0.09	-0.09
Renewable	Primary Energy Feedstock	-0.17	-0.17
Renewable	Primary Energy not Material	-0.26	-0.26
Renewable	Primary Energy Total	-5.18	-5.18
Unrenewable	Secondary Fuel	-0.19	-0.19
Unrenewable	Primary Energy not Material	-5.37	-5.37
Unrenewable	Primary Energy Feedstock	-0.14	-0.14
Unrenewable	Primary Energy Total	-21.06	-21.06
Inventory output flows			
Hazardous Waste Disposed		-3.9E-03	-3.9E-03
Non-hazardous Waste Disposed		-0.16	-0.16
Radioactive Waste Disposed		-3.8E-16	-3.8E-16
Components For Reuse		-1.8E-02	-1.8E-02
Material For Recycling		-1.1E-02	-1.1E-02
Material For Energy Recovery		-3.2E-03	-3.2E-03

Interpretation

This section interprets results. Table 5 lists component content % mass share versus Global Warming Potential (GWP kg CO_{2e}) and % share gross embodied energy (EE) results/kg products cradle to gate A1 to A3. It shows Stearic acid with biogenic carbon and negative GWP indicating drawdown by photosynthesis offsetting climate change.

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

Figure 4 charts GWP versus Abiotic Depletion of Fossil Fuel (ADPFF) results/kg A1 to A3. It shows most GWP emissions from electricity usage then PVC binder, thirdly natural gas use and fourthly DEHA plasticiser content.

Table 5 Component EE% Vs GWP/kg

Component	Mass%	EE%	GWP
$CaCO_3$	<65	1.23	0.08
PVC	<25	27.1	2.61
DOTP	<10	8.94	2.10
TiO_2	<1.3	1.13	3.62
PUR	<1.3	1.95	4.48
DEHA	<1.2	1.67	4.33
ESBO	<1.2	1.87	3.91
ENP	<1.2	2.7	2.63
Soap	<0.9	1.1	3.68
MBMA	<0.8	1.25	4.98
Stearate	<0.1	0.22	4.09
Pigment	<0.1	0.08	2.24
Stearic acid	<0.1	0.12	-1.70

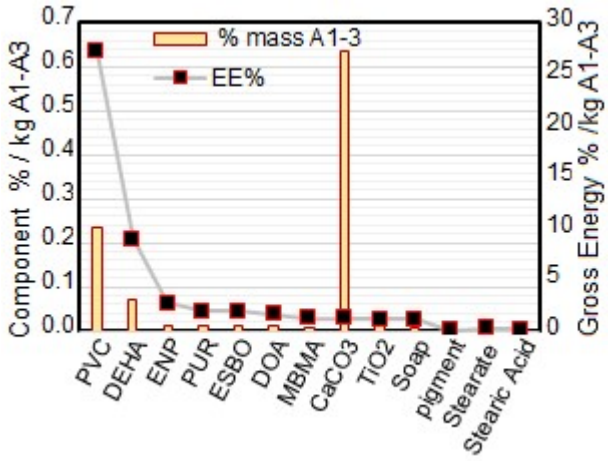

Figure 3 Component & EE % share//kg A1-A3

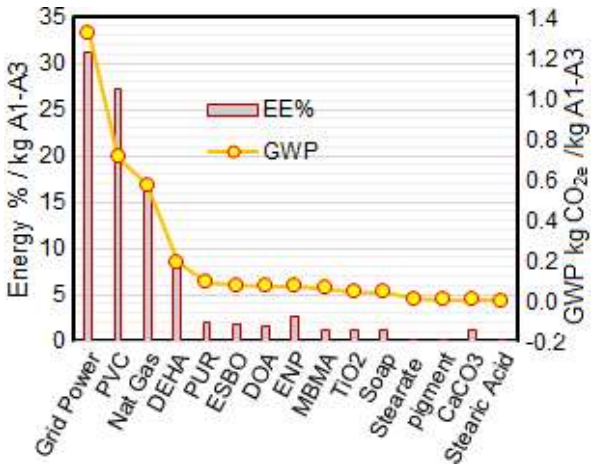

Figure 4 GWP Vs ADP FF/kg A1-A3

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

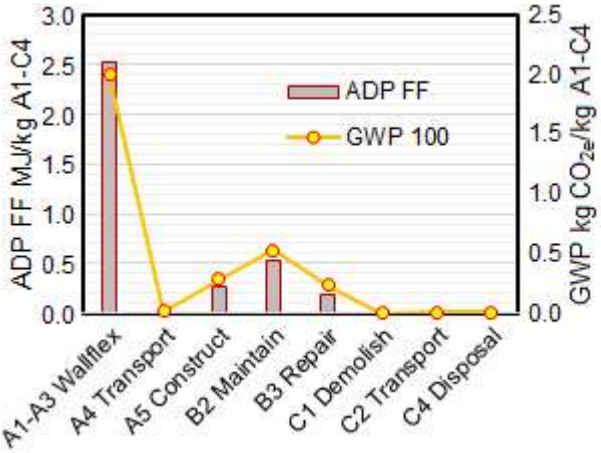

Figure 5 GWP Vs ADP FF /kg A1 to C4

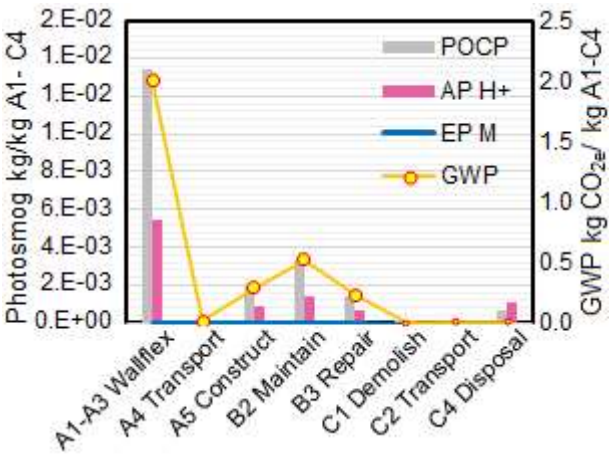

Figure 6 GWP, POCP, AP & EPM/kg A1 to C4

Module D Beyond System Boundary results show typical D1 Reuse of 60% of least-worn product in low traffic rooms and areas for 40 more years reduces all impacts >40%/kg for a 60-year building life with the same new product to 40% of wall area in high traffic areas. Results for phases A4 to C4 are significant and these remain unchanged for replacement product 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, J of 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, T I 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, I J of 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 LCIA method which comprises 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, CML University of Leiden, Netherlands.

[14] Guinée et al., 2002, and van Oers et al., 2002 CML LCA methodology 2002a, Institute of Environmental Sciences (CML), Faculty of Science, University of Leiden, 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 of 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.