Global GreenTag[CertTM] EPD Program

Compliant to EN 15804:2012+A2 2019

Environmental Product Declaration

Autex Industries Ltd

GreenStuf® Thermal Insulation

702-718 Rosebank Road, Avondale, Auckland, New Zealand

GreenStuf® Polyester Insulation

GreenStuf® Polyester Insulation

EPD Information

EPD Verification and LCA Details	
EPD Scope	Cradle to Gate + Options
EPD	ATX AT01 2022EP
Issue Date	24th January 2022
Valid Until	24th January 2027

Demonstration of Verification

Standard EN 15804 serves as the core Product Category Rules (PCR) [1].

Independent external verification of the declaration and data, according to ISO 14025:2010

☑ External — Third Party Verifier[a] Shloka Ashar Sustainability Consultant

☑ Internal — LCA Reviewed by Mathilde Vlieg, VliegLCA

☑ Internal 01/02/22 — EPD Reviewed by David Baggs, Global GreenTag Pty Ltd

a: Optional for business-to-business communication; mandatory for business-to-consumer communication according to EN ISO 14025:2010, 9.4 [2].

The EPD is property of declared manufacturer. Different program EPDs may not be comparable as e.g., Australian transport is often more than elsewhere. Comparability is further dependent on the product category rules used and the source of the data. Further explanatory information can be found at www.globalgreentag.com or contact: certification1@globalgreentag.com.

This EPD discloses potential environmental outcomes compliant with EN 15804:2012+A2 2019 for business-to-business communication. LCIA results are relative expressions that do not predict impacts on category endpoints, exceeding of thresholds, safety margins or risks.

EPD Program Operator [3]	LCA and EPD Producer	Declaration Owner
Global GreenTag Pty Ltd	The Evah Institute	Autex Industries Ltd
PO Box 311	Division of Ecquate Pty Ltd	702 Rosebank Road, Avondale, Auckland, New Zealand
Cannon Hill, QLD 4170	PO Box 123 Thirroul NSW	Phone: +64 9 828 9179
Phone: +61 (0)7 33 999 686	Phone: +61 (0)7 5545 0998	http://www.autexglobal.com
http://www.globalgreentag.com	http://www.evah.com.au/	

Product Information

Product Name	GreenStuf® Thermal Insulation
Product code	Masonry Wall Blanket; Skillion Roof Blanket; Building Insulation Blanket (BIB); Underfloor, Roll Form; Wall Pad and Ceiling Pad;
Declared Unit	Declared product per kilogram [4, 5]
Factory warranty	10 years
Manufacturing Site	702-718 Rosebank Road, Avondale, Auckland, New Zealand
Site Representation and Geography	New Zealand, Australasia, Pacific Rim and the World
Cut-off criteria and Data quality	Complies with EN 15804:2012+A2 2019
Standards	Complies with AS/NZS 4859.1 requirements for thermal insulation. Reaction to fire performance is assessed in accordance with ISO 9705:1993 and AS 5637.1:2015 using AS ISO 9705 - 2003 methodology
Product Specifications	Autex GreenStuf® is made of thermally bonded polyester. The insulation is installed as coverings in building, wall, roof, ceiling and underfloor cavities to reduce heat transfer into and out of built spaces.

Functional & Technical Performance

Product Name	Depth mm	Cover g/m2	Size m
Masonry Wall Blanket R1.0	45	700	12.93*0.58
Skillion Roof Blanket R3.2	165	2050	2.40*0.87
Building Insulation Banket R1.5	100	750	2.40*1.20
Underfloor R1.5	100	750	8.9*0.45
Roll Form R1.5	100	750	10.35*0.87
Wall Pads R2.9	70	3600	1.16*0.56
Ceiling Pads R2.9	175	1550	1.22*0.43

Functional Performance in Building	Roll Form blankets layered to stop thermal bridging and increase construction R-value insulate walls, roofs, ceilings, floor and mid-floors. Ceiling and Wall Pads segments insulate ceilings, mid-floor cavities, and walls. Masonry Wall Blanket insulates strapped and lined concrete/ masonry walls. Skillion Roof Blanket delivers higher R-Value performance in depth-restricted construction cavities. Underfloor insulates exposed joist floors in homes. Building Insulation Blanket in roofing makes more energy efficient commercial and industrial spaces.
Range and variability	Significant differences of average LCIA results are declared. They were most sensitive to PET fibre melt-spin process energy reported ranging from (1.8 to 17.6)MJ/kg with a mean of 8.3MJ/kg and standard deviation of 8. As the LCIA variability based on such a mean is outside acceptable confidence limits, lower and upper median results from that range are declared.
Primary Data	Data was collected in accordance with EN ISO 14044:2006, 4.3.2, from primary sources including manufacturer and supplier data on standards, locations, logistics, technology, market share, management system and commitment to improved environmental performance [6].
No Chemicals of Very High Concern	Contains no substances in the “Authorised or Candidate Lists of Substances of Very High Concern (SVHCs)” with the European Chemicals Agency

Base Material Origin and Detail

Table 1 lists composition by component all from South Korea by type and percentage mass share.

Table 1 Base Material Chemical Analysis

Fibres	Masonry Wall Blanket	Skillion Roof Blanket	Building Insulation Blanket	Under-floor	Roll Form	Ceiling Pads	Wall Pads
rPET[1]	>35 <38	>30 <33	>52 <58	>52 <58	>52 <58	>40 <44	>40 <44
	>40 <44	>35 <39	>30 <33	>30 <33	>30 <33	>45 <50	>45 <50
PETG[2]	>25 <28	>35 <39	>18 <20	>18 <20	>18 <20	>15 <17	>15 <17

Program Description

EPD type	Cradle to gate + options as defined by EN 15804
System boundary	The system boundary with nature includes material and energy system input processing plus manufacture and transport to factory gate plus waste arising.
Service Life	Unspecified reference service life for this cradle to gate plus options scope
Comparability	Construction product EPDs may not be comparable if not EN15804 compliant
Scope	Compliance demands declaring modules A1–A3, C1–C4 and D. Scenarios for C1–C4 modules declare zero results. Justifications for D omission are given.
Stages excluded	A4-5 are excluded.
Product stages included	Stages denoted by x in Figure 1 are included from A1 raw material acquisition, extraction, refining and processing plus scrap reuse from prior systems; electricity generated from all sources with extraction, refining & transport plus secondary fuel energy and recovery processes. Also, A2 transport internal and to the factory gate as well as A3 manufacture of product packaging, inputs and flows leaving at end-of-waste boundary allocated as coproducts.
Omission of Modules C1–C4 End Of Life	All C1–C4 end of life results are zero because all insulation is assumed to outlast the fitout and build life. So, there is no processing to C1 deconstruct, C2 transport discards for processing to recyclers or landfills etc; C3 waste processing of scrap to reuse, recycle and recover energy. C4 waste disposal including pre-treatment and disposal site management.
Omission of Module D potential load or benefit beyond the system boundary	Unreliable background data excluded all conservative calculation of: • results or summing B1-B5, C1-C4 secondary flows leaving the system, • design to reuse, recycle and recover avoiding subsequent system loads, • benefits from exported energy ex C4 substituted another in next systems. • secondary flow results from substituting primary flows in next systems
End-of-life scenarios	No specification of end-of-life scenarios to forecast or link to any current practice is reasonable because the background data was too unreliable.

Information Modules System Scope and Boundaries

Figure 1 shows an x marking EPD LCA inventory and impact results to be declared as summed for modules A1-3. All modules B1 to C4 are declared as zero. Modules A4-5 and D1-3 that are marked not declared MND does not indicate zero inventory or impact. Figure 2 shows included processes in a cradle to grave system boundary and excluded scenarios in dashed lines to end of life fate to recycling or to landfill grave.

---

[1] Main fibre % mass share of post-consumer recycled Polyester (rPET)
[2] Bonding fibre of low melt primary Polyethylene terephthalate glycol

Model	Actual			Scenario													Potential		
Stage	Product			Construct		Operational Use							End of Life				Benefit & load beyond system		
						Fabric					Use								
Unit Operations	Raw material	Transport	Manufacture	Transport	Construct	Use	Maintain	Repair	Replace	Refurbish	Energy	Water	Demolish	Transport	Waste Process	Dispose	Reuse	Recycle	Recover
Module Key	A1	A2	A3	MND	MND	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D1	D2	D3
Cradle to Gate + Options	x	x	x	MND	MND	0	0	0	0	0	0	0	0	0	0	0	MND	MND	MND
Cradle to Grave	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Optional		

Figure 1 EPD Life Cycle Phases and Stages Cradle to Gate or Grave

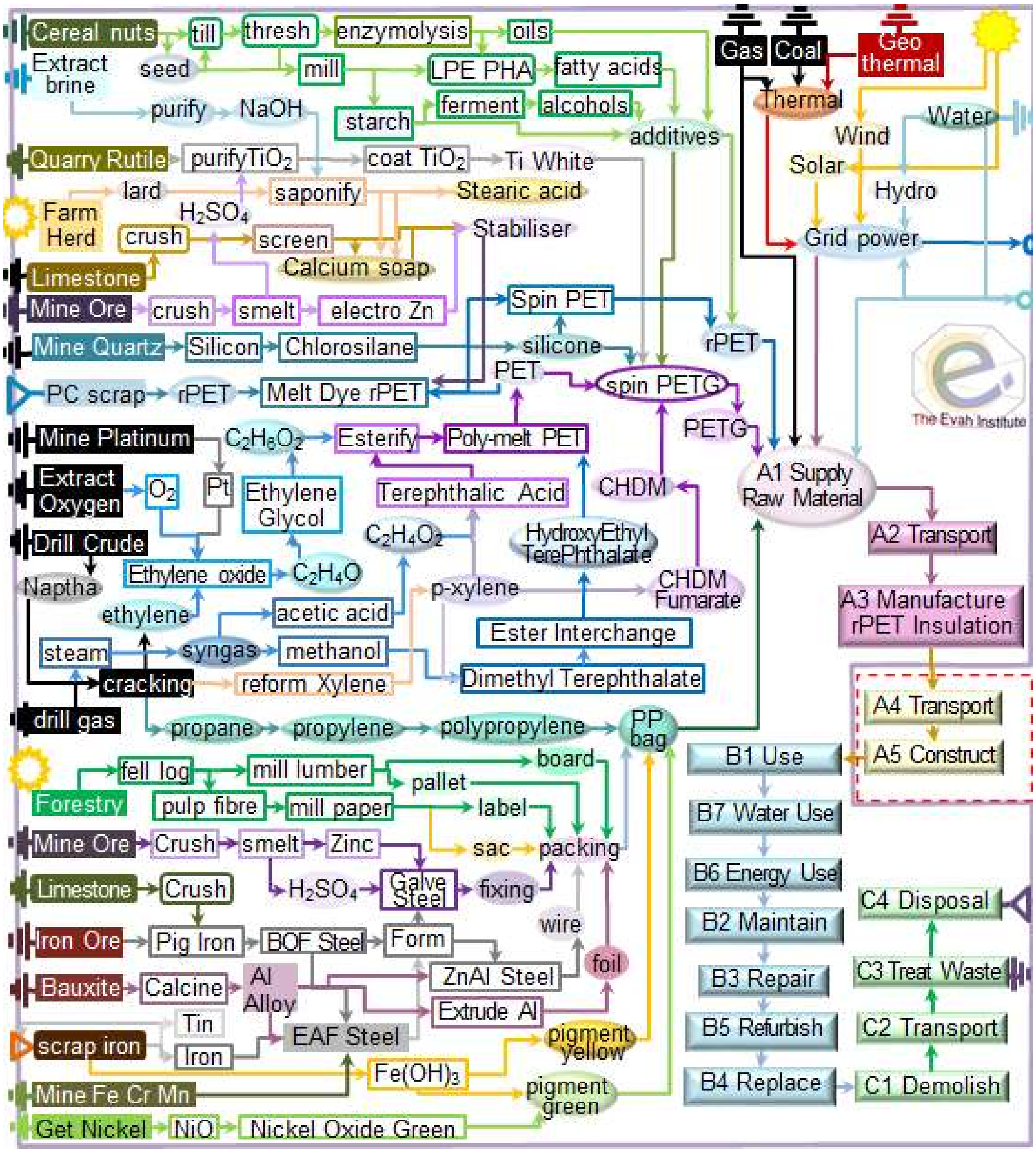
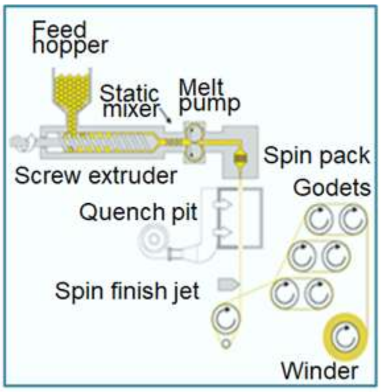


Figure 2 Product Process Flow Chart

Background Data Quality Parameters and Sensitivity

PET fibre LCA results were most sensitive to energy use in the melt-spin process. Figure 3 depicts fibre melt-spun into filament a function of polymer extrusion energy not fibre diameter. It is then cut into staple fibers (often 38 mm) or then drawn and textured to make spun yarn.

As Figure 4 depicts surveys of industry and EcoInvent V2 to 3.4 LCI by Sandin, Roos & Johansson (2019) and van der Velden et al (2014) reported PET fibre melt-spin energy from lowest 1.8MJ/kg to highest 17.64MJ/kg [7 & 8]. The mean of 8.3MJ/kg had a standard deviation of 8.



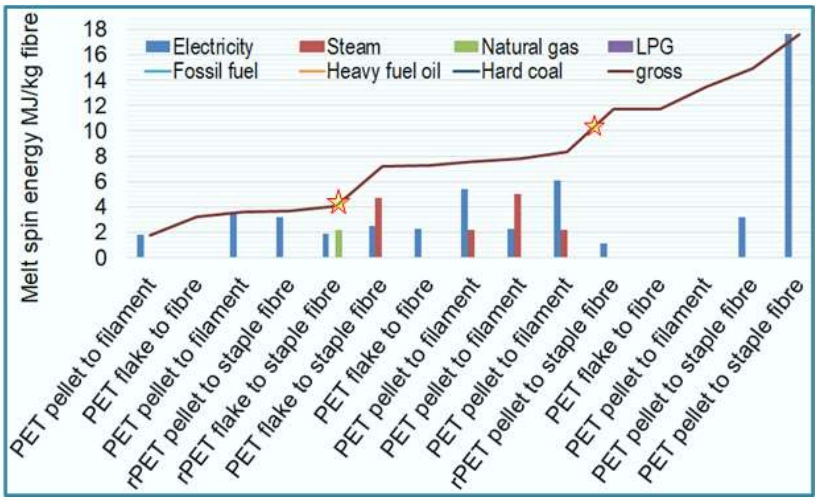


Figure 3. Melt-spin Process **Figure 4. PET Melt-spin Gross Energy & Sources**

They found gross melt-spin energy ranged from 3.2 to 11.7MJ/kg PET staple fibre and from 1.1 to 13.6MJ/kg partially drawn untextured filament. Table 2 lists survey data selected on quality and age.

Table 2 Pre-oriented Yarn Fibre Melt-spin Extrusion Energy MJ/kg

Process	gross	Electric	Heavy fuel oil	Natural gas	LPG	Steam	Hard coal	Fossil fuel
rPET pellet to staple fibre	3.684	3.204	0.48					
rPET flake to staple fibre	4.10	1.872		2.21	0.02			
PET flake to staple fibre	7.234	2.484				4.75		
PET pellet to filament	7.600	5.400				2.20		
PET pellet to filament	7.784	2.304	0.48			5.0		
PET pellet to filament	8.320	6.120				2.20		
rPET pellet to staple fibre	11.69	1.116					10.57	
PET pellet to staple fibre	14.90	3.2						11.7

As surveys reported such a wide hot melt-spin energy range and standard deviation that LCA results were most sensitive to, both lower and upper melt-spin energy were declared. Lower melt-spin energy modelled of 4.102MJ/kg staple fibre used 1.87MJ electricity, 2.21MJ natural gas and 0.02MJ propane.

Beyond 4.1MJ/kg, upper melt-spin energy was modelled to reflect a 10.4MJ/kg median using electricity only along with that using 8.1MJ Electricity, 2.21MJ Natural gas and 0.02MJ propane. Results of these 3 modelled value sets are discussed in the Interpretation section. For clarity this EPD declares results of one lower and one upper melt-spin value only.

Environmental Impact Methods and Terminology

This section outlines environmental impact methods used. The following glossary of terms lists units used and references to the impact calculation methods.

Glossary of Terms	Indicator Potential Methods	Units
Climate Change total	Global Warming Potential (GWP) total [9]	kg CO_{2eq}.
Climate Change fossil	GWP fossil fuels (GWP fossil) [9]	kg CO_{2eq}.
Climate Change biogenic	GWP biogenic (GWP biogenic) [9]	kg CO_{2eq}.
Climate Change land use	GWP land use & change (GWP luluc) [9]	kg CO_{2eq}.
Stratospheric Ozone Depletion	Stratospheric Ozone Depletion (ODP) [10]	kg CFC_{11eq}
Photochemical Ozone Creation	Photochemical Ozone Creation (POCP) [11]	kg NMOC eq
Photochemical Ozone Formation	Photochemical Ozone Formation (POCF) [11]	kg C_2H_{4eq}
Acidification	Acidification air land and water (AP) [12]	kg $SO_4^{+}{}_{eq}$
Acidification	Acidity Accumulated Exceedance (AP) [12]	mol $H^{+}{}_{eq}$
Eutrophication	Eutrophication of waters (EP) [13]	kg $PO_{4\ eq}$
Eutrophication Freshwater	EP nutrients freshwater (EP freshwater) [13]	kg P_{eq}
Eutrophication Marine	Eutrophication marine nutrients (EP marine) [13]	kg N_{eq}
Eutrophication Terrestrial	Terrestrial Accumulated Exceedance (EP terra) [13]	mol N_{eq}
Mineral & Metal Depletion	Abiotic Depletion (ADP minerals & metals) [14]	kg Sb_{eq}
Fossil Fuel Depletion	Abiotic Depletion fossil fuel (ADP fossil) [15]	MJ_{ncv}
Water Depletion	Water Deprivation-weighted (WDP) [16]	$m^3{}_{WDP\ eq}$

Different methods are reported to comply with the EN15804+A2 2019 standard versus those required for the Green Building Council of Australia (GBCA) credit assessment. Methods used for the lower 4.1MJ/kg melt-spin energy meet needs of the Green Building Council of Australia (GBCA) credit assessment. Methods used for upper electric 10.4MJ/kg melt-spin results/kg declared unit meet needs of both the EN15804+A2 2019 standard and GBCA credit assessments.

The following table describes environmental impacts contributing to risks of ecological issues and collapse lists each indicator with ***common names*** and remedies.

Global warming potential (GWP)	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 depletion potential (ODP)	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 (HCFC), 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 potential (AP)	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 potential (EP)	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 life 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 across over-fertilised land catchments.
Photochemical ozone creation potential (POCP)	Tropospheric photochemical ozone, called "***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.
Abiotic depletion potential elemental (ADPE)	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.
Abiotic depletion potential fossil fuel (ADPF)	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.

Aditional Environmental Information on Carbon Offsets

Autex has purchased carbon certificates to offset all these products greenhouse gas global warming potential (GWP). These certificates were 3rd party certified as compliant for this EPD.

Table 2a shows Total Greenhouse Gas with GWP Offset/kg declared unit modelled on lower 4.102MJ/kg melt-spin energy. In each lower energy case, all cradle to gate product emissions were more than fully offset . These are reported as negative emissions acting as a carbon sink.

Table 2a also shows that Total Greenhouse Gas had no GWP Offset/kg declared unit modelled on upper 10.4MJ/kg electric melt-spin.

Table 2a A1-A3 Total Greenhouse Gas with GWP Offset kg CO_{2e}/kg declared product

melt-spin energy modelled	Masonry Wall Blanket	Skillion Roof Blanket	BIB	Under-floor	Roll Form	Wall Pads	Ceiling Pads
Lower 4.102MJ/kg product	-1.35	-1.54	-1.28	-1.28	-1.28	-1.17	-1.17
Upper 10.4MJ/kg product	7.35	7.72	7.22	7.22	7.22	7.2	7.2

The lower melt spin energy reflects competing products data source position taken. The GWP offset amounts are the true 3rd party certified valid GWP estimates to be assigned these products and not calculated results tabled in the following section that compliance demands not show offset results.

Assessment Results Cradle to Gate

For Green Building Council credits the Additional Environmental Information 3rd party certified GWP offset amounts reported are valid for these products not calculated results and Table 2b and 2c. Table 2b shows calculated LCIA results/kg product using lower 4.102MJ/kg melt-spin energy excluding offsets. Table 2c shows calculated LCI and LCIA results/kg assuming upper 10.4MJ/kg electric melt-spin that has no offsets considering the effective GWP avoided using thermal insulation.

Table 2b A1-A3Calculated Lower GWP Results kg CO_{2e} /kg declared product

Impact potential sources	Masonry Wall Blanket	Skillion Roof Blanket	BIB	Under-floor	Roll Form	Wall Pads	Ceiling Pads
Greenhouse Gas Biogenic	-0.22	-0.29	-0.16	-0.16	-0.16	-0.14	-0.14
Greenhouse Gas Land Use Change LULUC	9.8E-10	1.0E-09	9.6E-10	9.6E-10	9.6E-10	9.1E-10	9.1E-10
Greenhouse Gas Fossil	2.80	3.24	2.62	2.62	2.62	2.38	2.38
Total Greenhouse Gas	2.59	2.95	2.45	2.45	2.45	2.24	2.24

Table 2c A1-A3Calculated Higher GWP Results kg CO_{2e} /kg declared product

Impact potential sources	Masonry Wall Blanket	Skillion Roof Blanket	BIB	Under-floor	Roll Form	Wall Pads	Ceiling Pads
Greenhouse Gas Biogenic	-0.30	-0.37	-0.24	-0.24	-0.24	-0.22	-0.22
Greenhouse Gas Land Use Change LULUC	9.8E-10	1.0E-09	9.6E-10	9.6E-10	9.6E-10	9.1E-10	9.1E-10
Greenhouse Gas Fossil	7.65	8.09	7.46	7.46	7.46	7.24	7.24
Total Greenhouse Gas	7.35	7.72	7.22	7.22	7.22	7.2	7.2

Results for Inventory and Potential Impact

Results for the lower melt-spin energy meet needs of the Green Building Council of Australia (GBCA) credit assessment.

Cradle to Gate Inventory and Potential Impact Results

Table 2 shows Masonry Wall Blanket and Skillion Roof Blanket product LCI and LCIA results/kg declared unit modelled on lower 4.102MJ/kg melt-spin energy.

Table 2 System LCI and LCIA Results A1-A3/kg

Impact potential categories	Units	Masonry Wall Blanket	Skillion Roof Blanket
Stratospheric Ozone Depletion	kg $CFC11_e$	1.5E-09	1.6E-09
Photochemical Ozone Creation	kg C_2H_{4e}	5.6E-03	6.7E-03
Acidification	kg SO_{2e}	8.0E-03	9.3E-03
Eutrophication of Water	kg PO_{4e}^3	2.0E-03	2.2E-03
Abiotic Depletion Fossil Fuel	MJ ncv[3]	2.7	3.2
Abiotic Depletion Mineral (Elemental)	kg Sb eq	3.6E-03	4.0E-03
Water Deprivation Weighted Scarcity	world m^3eq	0.13	6.03E-02
Input flow			
Net fresh water	m^3	0.34	0.37
Secondary material	kg	0.79	0.68
Secondary renewable fuel	MJ ncv	0.53	0.62
Secondary non-renewable fuel	MJ ncv	0.20	0.27
Primary renewable energy not feedstock	MJ ncv	3.6	3.8
Primary renewable feedstock energy	MJ ncv	1.0	1.4
Total primary renewable energy resources	MJ ncv	4.6	5.2
Primary energy not renewable or feedstock	MJ ncv	36.8	42.1
Primary non-renewable feedstock energy	MJ ncv	10.7	14.2
Total primary non-renewable energy use	MJ ncv	47.5	56.2
Output flows			
Hazardous waste disposed	kg	4.2E-03	4.6E-03
Non-hazardous waste disposed	kg	0.51	0.55
Radioactive waste disposed	kg	1.4E-09	1.5E-09
Components for reuse	kg	0.18	0.21
Material for recycling	kg	0.07	0.07
Material for energy recovery	kg	1.6E-04	2.0E-04
Exported electrical energy	MJ ncv	0.E+00	0.E+00
Exported thermal energy	MJ ncv	0.E+00	0.E+00

Table 3 shows Building Insulation Blanket, Underfloor and Roll Form product LCI and LCIA results/kg declared unit modelled on lower 4.102MJ/kg melt-spin energy.

[3] NCV stands for net calorific value

Table 3 System LCI and LCIA Results A1-A3/kg

Impact potential categories	Units	BIB	Underfloor	Roll Form
Stratospheric Ozone Depletion	kg $CFC11_e$	1.5E-09	1.5E-09	1.5E-09
Photochemical Ozone Creation	kg C_2H_{4e}	5.2E-03	5.2E-03	5.2E-03
Acidification	kg SO_{2e}	7.6E-03	7.6E-03	7.6E-03
Eutrophication of Water	kg PO_{4e}^3	1.8E-03	1.8E-03	1.8E-03
Abiotic Depletion Fossil Fuel	MJ_{ncv}	2.5	2.5	2.5
Abiotic Depletion Mineral (Elemental)	kg Sb_{eq}	3.3E-03	3.3E-03	3.3E-03
Water Deprivation Weighted Scarcity	world m^3eq	5.19E-02	5.19E-02	5.19E-02
Input flows				
Net fresh water	m^3	0.32	0.32	0.32
Secondary material	kg	0.86	0.86	0.86
Secondary renewable fuel	MJ_{ncv}	0.49	0.49	0.49
Secondary non-renewable fuel	MJ_{ncv}	0.19	0.19	0.19
Primary renewable energy not feedstock	MJ_{ncv}	3.5	3.5	3.5
Primary renewable feedstock energy	MJ_{ncv}	0.74	0.74	0.74
Total primary renewable energy resources	MJ_{ncv}	4.2	4.2	4.2
Primary energy not renewable or feedstock	MJ_{ncv}	34.6	34.6	34.6
Primary non-renewable energy feedstock	MJ_{ncv}	9.7	9.7	9.7
Total non-renewable primary energy use	MJ_{ncv}	44.3	44.3	44.3
Output flows				
Hazardous waste disposed	kg	4.7E-03	4.7E-03	4.7E-03
Non-hazardous waste disposed	kg	0.51	0.51	0.51
Radioactive waste disposed	kg	1.3E-09	1.3E-09	1.3E-09
Components for reuse	kg	0.19	0.19	0.19
Material for recycling	kg	0.07	0.07	0.07
Material for energy recovery	kg	1.4E-04	1.4E-04	1.4E-04
Exported electrical energy	MJ_{ncv}	0.E+00	0.E+00	0.E+00
Exported thermal energy	MJ_{ncv}	0.E+00	0.E+00	0.E+00

Table 4 shows Wall and Ceiling Pad product LCI and LCIA results/kg declared unit modelled on lower 4.102MJ/kg melt-spin energy.

GreenStuf
Polyester Insulation

Table 4 System LCI and LCIA Results A1-A3/kg

Impact potential categories	Units	Wall Pads	Ceiling Pads
Stratospheric Ozone Depletion	kg $R11_e$	1.3E-09	1.3E-09
Photochemical Ozone Creation	kg C_2H_{4e}	4.6E-03	4.6E-03
Acidification	kg SO_{2e}	6.8E-03	6.8E-03
Eutrophication of Water	kg PO_{4e}^3	1.7E-03	1.7E-03
Abiotic Depletion Fossil Fuel	MJ ncv	2.2	2.2
Abiotic Depletion Mineral (Elemental)	kg Sb eq	3.0E-03	3.0E-03
Water Deprivation Weighted Scarcity	world m^3eq	5.02E-02	5.02E-02
Input flow			
Net fresh water	m^3	0.31	0.31
Secondary material	kg	0.89	0.89
Secondary renewable fuel	MJ ncv	0.45	0.45
Secondary non-renewable fuel	MJ ncv	0.13	0.13
Primary renewable energy not feedstock	MJ ncv	3.32	3.32
Primary renewable feedstock energy	MJ ncv	0.62	0.62
Total primary renewable energy resources	MJ ncv	3.94	3.94
Primary energy not renewable or feedstock	MJ ncv	31.8	31.8
Primary non-renewable feedstock energy	MJ ncv	7.4	7.4
Total primary non-renewable energy use	MJ ncv	39.1	39.1
Output flows			
Hazardous waste disposed	kg	3.9E-03	3.9E-03
Non-hazardous waste disposed	kg	0.47	0.47
Radioactive waste disposed	kg	1.3E-09	1.3E-09
Components for reuse	kg	0.17	0.17
Material for recycling	kg	0.07	0.07
Material for energy recovery	kg	1.3E-04	1.3E-04
Exported electrical energy	MJ ncv	0.E+00	0.E+00
Exported thermal energy	MJ ncv	0.E+00	0.E+00

Results for upper melt-spin-energy results/kg declared unit complies with both EN15804+A2 2019 and GBCA credit assessments. Table 5 shows Masonry Wall Blanket and Skillion Roof Blanket product LCI and LCIA results/kg declared unit modelled on upper 10.4MJ/kg electric melt-spin energy.

Table 5 System LCI and LCIA Results A1-A3/kg

Impact potential categories	Units	Masonry Wall Blanket	Skillion Roof Blanket
Stratospheric Ozone Depletion	kg $CFC11_{eq}$	6.3E-09	6.4E-09
Photochemical Ozone Formation	kg C_2H_{4eq}	1.2E-02	1.3E-02
Photochemical Ozone Creation	kg NMVOC $_{eq}$	8.8E-03	9.4E-03
Acidification Potential	kg SO_{2eq}	1.4E-02	1.6E-02
Acidity Accumulated Exceedance	Mole H^+	2.5E-02	2.6E-02
Eutrophication Potential	kg $PO_{4eq}{}^3$	3.7E-03	4.1E-03
Eutrophication Potential Freshwater	kg P $_{eq}$	1.6E-06	2.1E-06
Eutrophication Potential Terrestrial	Mole N $_{eq}$	1.4E-02	1.5E-02
Eutrophication Potential Marine	kg N $_{eq}$	6.8E-03	7.1E-03
Abiotic Depletion [4]Fossil Fuel	MJ $_{ncv}$	6.5	7.0
Abiotic Depletion Mineral (Elemental)	kg Sb $_{eq}$	7.8E-03	8.1E-03
Water Deprivation Weighted Scarcity	world m^3eq	0.12	0.14
Input flow			
Net fresh water	m^3	0.76	0.87
Secondary material	kg	0.79	0.68
Secondary renewable fuel	MJ $_{ncv}$	1.8	1.9
Secondary non-renewable fuel	MJ $_{ncv}$	0.21	0.21
Primary renewable energy not feedstock	MJ $_{ncv}$	7.3	7.5
Primary renewable feedstock energy	MJ $_{ncv}$	0.92	1.3
Total primary renewable energy resources	MJ $_{ncv}$	8.2	8.8
Primary energy not renewable or feedstock	MJ $_{ncv}$	105	110
Primary non-renewable feedstock energy	MJ $_{ncv}$	14	17
Total primary non-renewable energy use	MJ $_{ncv}$	118	127
Output flows			
Hazardous waste disposed	kg	5.8E-03	6.5E-03
Non-hazardous waste disposed	kg	2.10	2.15
Radioactive waste disposed	kg	6.5E-09	6.6E-09
Components for reuse	kg	0.75	0.77
Material for recycling	kg	0.09	0.09
Material for energy recovery	kg	5.0E-04	5.3E-04
Exported electrical energy	MJ $_{ncv}$	0.E+00	0.E+00
Exported thermal energy	MJ $_{ncv}$	0.E+00	0.E+00

[4] ADP Characterisation factors from the Institute of Environmental Sciences Faculty of Science (CML) University of Leiden, Netherlands.

Table 6 shows Building Insulation Blanket, Underfloor and Roll Form product LCI and LCIA results/kg declared unit modelled on upper 10.4MJ/kg electric melt-spin energy.

Table 6 System Life Cycle Inventory and Impact Assessment A1-A3/kg

Impact potential categories	Units	BIB	Underfloor	Roll Form
Stratospheric Ozone Depletion	kg $CFC11_{eq}$	6.3E-09	6.3E-09	6.3E-09
Photochemical Ozone Formation	kg C_2H_{4eq}	1.2E-02	1.2E-02	1.2E-02
Photochemical Ozone Creation	kg NMVOC $_{eq}$	8.4E-03	8.4E-03	8.4E-03
Acidification Potential	kg SO_{2eq}	1.3E-02	1.3E-02	1.3E-02
Acidity Accumulated Exceedance	Mole H^+	2.4E-02	2.4E-02	2.4E-02
Eutrophication Potential	kg $PO_{4eq}{}^3$	3.4E-03	3.4E-03	3.4E-03
Eutrophication Potential Freshwater	kg P $_{eq}$	1.4E-06	1.4E-06	1.4E-06
Eutrophication Potential Terrestrial	Mole N $_{eq}$	1.3E-02	1.3E-02	1.3E-02
Eutrophication Potential Marine	kg N $_{eq}$	6.7E-03	6.7E-03	6.7E-03
Abiotic Depletion Fossil Fuel	MJ $_{ncv}$	6.27	6.27	6.27
Abiotic Depletion Mineral (Elemental)	kg Sb $_{eq}$	7.5E-03	7.5E-03	7.5E-03
Water Deprivation Weighted Scarcity	world m^3eq	0.11	0.11	0.11
Input flows				
Net fresh water	m^3	0.68	0.68	0.68
Secondary material	kg	0.86	0.86	0.86
Secondary renewable fuel	MJ $_{ncv}$	1.8	1.8	1.8
Secondary non-renewable fuel	MJ $_{ncv}$	0.20	0.20	0.20
Primary renewable energy not feedstock	MJ $_{ncv}$	7.2	7.2	7.2
Primary renewable feedstock energy	MJ $_{ncv}$	0.66	0.66	0.66
Total primary renewable energy resources	MJ $_{ncv}$	7.8	7.8	7.8
Primary energy not renewable or feedstock	MJ $_{ncv}$	103	103	103
Primary non-renewable energy feedstock	MJ $_{ncv}$	13	13	13
Total non-renewable primary energy use	MJ $_{ncv}$	116	116	116
Output flows				
Hazardous waste disposed	kg	6.2E-03	6.2E-03	6.2E-03
Non-hazardous waste disposed	kg	2.10	2.10	2.10
Radioactive waste disposed	kg	6.4E-09	6.4E-09	6.4E-09
Components for reuse	kg	0.76	0.76	0.76
Material for recycling	kg	0.09	0.09	0.09
Material for energy recovery	kg	4.7E-04	4.7E-04	4.7E-04
Exported electrical energy	MJ $_{ncv}$	0.E+00	0.E+00	0.E+00
Exported thermal energy	MJ $_{ncv}$	0.E+00	0.E+00	0.E+00

Table 7 shows Wall and Ceiling Pad product LCI and LCIA results/kg declared unit modelled on upper 10.4MJ/kg electric melt-spin.

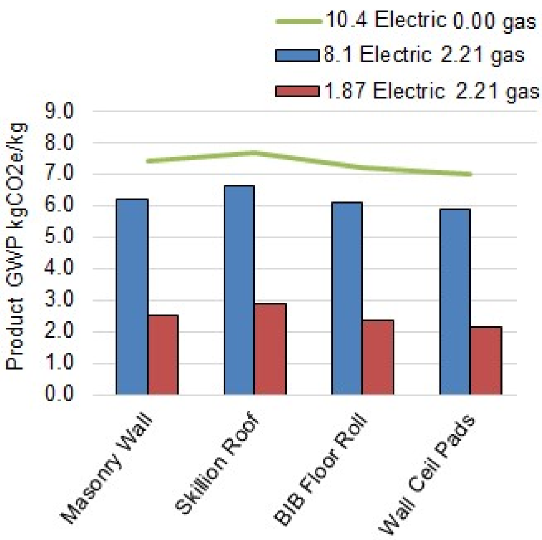
Table 7 System Life Cycle Inventory and Impact Assessment A1-A3/kg

Impact potential categories	Units	Wall Pads	Ceiling Pads
Stratospheric Ozone Depletion	kg $CFC11_{eq}$	6.2E-09	6.2E-09
Photochemical Ozone Formation	kg C_2H_{4eq}	1.1E-02	1.1E-02
Photochemical Ozone Creation	kg NMVOC $_{eq}$	8.2E-03	8.2E-03
Acidification Potential	kg SO_{2eq}	1.3E-02	1.3E-02
Acidity Accumulated Exceedance	Mole H^+	2.3E-02	2.3E-02
Eutrophication Potential	kg PO_{4eq}^3	3.2E-03	3.2E-03
Eutrophication Potential Freshwater	kg P $_{eq}$	1.2E-06	1.2E-06
Eutrophication Potential Terrestrial	Mole N $_{eq}$	1.3E-02	1.3E-02
Eutrophication Potential Marine	kg N $_{eq}$	6.5E-03	6.5E-03
Abiotic Depletion Fossil Fuel	MJ $_{ncv}$	6.03	6.03
Abiotic Depletion Mineral (Elemental)	kg Sb $_{eq}$	7.2E-03	7.2E-03
Water Deprivation Weighted Scarcity	world m^3eq	0.11	0.11
Input flow			
Net fresh water	m^3	0.64	0.64
Secondary material	kg	0.89	0.89
Secondary renewable fuel	MJ $_{ncv}$	1.8	1.8
Secondary non-renewable fuel	MJ $_{ncv}$	0.15	0.15
Primary renewable energy not feedstock	MJ $_{ncv}$	7.2	7.2
Primary renewable feedstock energy	MJ $_{ncv}$	0.54	0.54
Total primary renewable energy resources	MJ $_{ncv}$	7.6	7.6
Primary energy not renewable or feedstock	MJ $_{ncv}$	100	100
Primary non-renewable feedstock energy	MJ $_{ncv}$	11	11
Total primary non-renewable energy use	MJ $_{ncv}$	111	111
Output flows			
Hazardous waste disposed	kg	5.3E-03	5.3E-03
Non-hazardous waste disposed	kg	2.1	2.1
Radioactive waste disposed	kg	6.4E-09	6.4E-09
Components for reuse	kg	0.73	0.73
Material for recycling	kg	0.08	0.08
Material for energy recovery	kg	4.6E-04	4.6E-04
Exported electrical energy	MJ $_{ncv}$	0.E+00	0.E+00
Exported thermal energy	MJ $_{ncv}$	0.E+00	0.E+00

Interpretation

This interpretation discusses results from 2 upper 10.40MJ and a lower 4.102MJ value. Figure 5 depicts Global Warming Potential (GWP) results from the three models. Compared to lower energy models, upper electric GWP was 2.7 to 3.1 times higher and upper gas with electric GWP was 2.3 to 2.6 times higher.

In 2017-18 a 3rd party reviewed EPD of 6 polyester fabrics by Roos also used upper melt-spin energy data [15]. Figure 6 depicts that LCA's GWP of dope dyed polyester filament fibre extrusion spinning charted versus wet treatment and knitting. That small scale fibre production high GWP should be less with larger-scale efficiency.



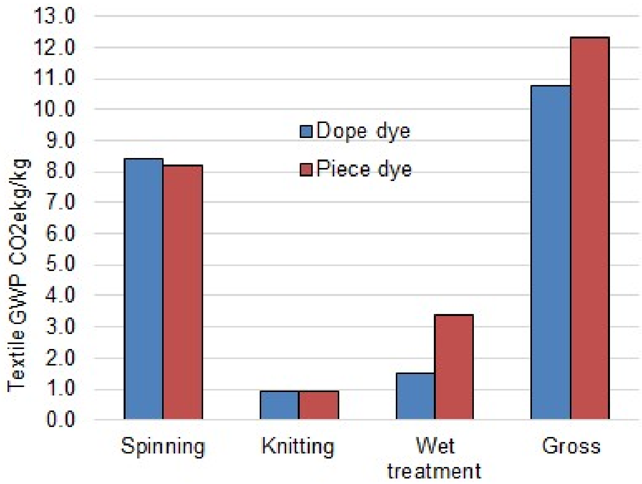
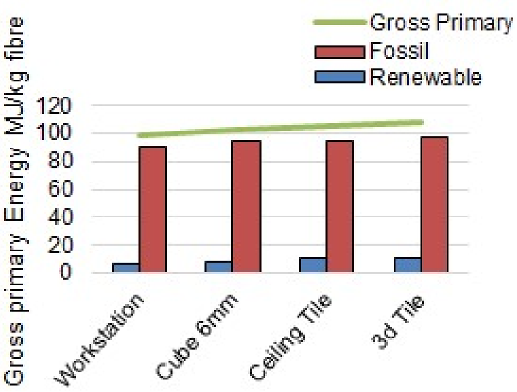


Figure 5. PET Fibre GWP kg CO_{2e}/kg

Figure 6. PET Fabric GWP kg CO_{2e}/kg

Nevertheless, this LCA using EcoInvent V3.4 LCI based on first-hand industry PET fibre spinning data shows GWP comparable to upper 10.4 MJ electric melt-spin results declared as Figure 7 depicts. Sandin, Roos & Johansson (2019) also report gross production energy use between 96 and 125 MJ/kg PET fibre as declared herein [7]. Their results were comparable to that calculated GWP from 1.7 to 4.5kg $CO_{2\ eq}$/ kg PET fibre as Figure 8 depicts.



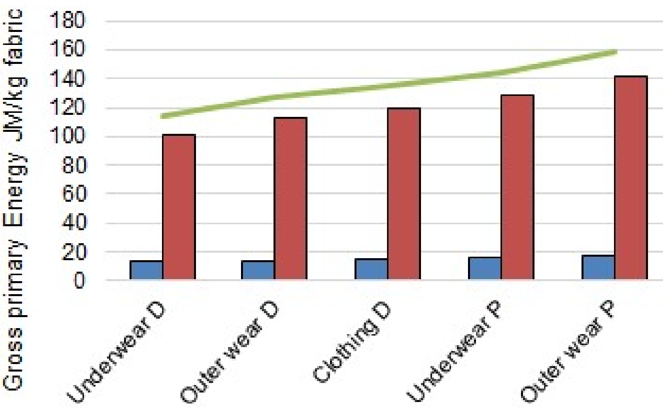


Figure7. Melt-spin MJ/kg PET Fibre

Figure 8. Melt-spin MJ/kg PET Fabric

Such variation in energy use and GWP result suggests that more accurate melt-spin energy definition is vital for true polyester LCA modelling to have confidence in affected EPDs. Unless based on recent post 2019 rPET staple fibre spinning-industry datasets, LCA results based on one melt-spin energy background data value are probably too uncertain to be declared representative of PET fibre.

References for this EPD

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

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

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

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

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

[6] ISO14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines.

[7] Environmental impact of textile fibres –what we know and what we don't know, Sandin, G., Roos, S., & Johansson, M., ISBN:978-91-88695-91-8, Mistra Future Fashion report number: 2019:03 part 2.

[8] LCA benchmarking study on textiles made of cotton, polyester, nylon, acryl, or elastane. Natascha M. van der Velden & Martin K. Patel & Joost G. Vogtländer. Int J Life Cycle Assess (2014) 19:331–356, DOI 10.1007/s11367-013-0626-9

[9] 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 et al. 2008 as applied in ReCiPe LOTOS-EUROS.

[10] Seppälä et al.,2006 and Posch et al., 2008, Accumulated Exceedance.

[11] Struijs et al., 2009b, EUTREND model, as implemented in ReCiPe.

[12] CML–IA V4.1 LCA methodology, 2002, October 2012, CML University of Leiden, Netherlands.

[13] 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.

[14] Boulay et al., 2016, Available WAter REmaining (AWARE).

[15] PET Fabric https://portal.environdec.com/api/api/v1/EPDLibrary/Files/123f5ad6-8cb9-4a8a-afad-751c6a9d6647/Data.

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.

International Energy Agency, Energy Statistics 2020 http://www.iea.org

ISO 14015:2001 EMS: Environmental assessment of sites & organizations (EASO)

ISO 14040:2006 EM: Life cycle assessment (LCA): Principles & framework, London, BSI, 2006.

ISO 15392:2008 Sustainability in building construction General principles

ISO 15686-1:2011 Buildings & constructed assets - Service life planning - Part 1: General principles and framework

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