BIOCARBON® LAMINATES

• BREATHING SUSTAINABILITY •

ENVIRONMENTAL PRODUCT DECLARATION

The International EPD® System

HIGH PRESSURE AND SOLID GRADE LAMINATES

Version: 1

EPD Registration Number: S-P-02470

EPD®

THE INTERNATIONAL EPD® SYSTEM

In accordance with ISO 14025
and EN 15804:2012+A2:2019

BIOCARBON® LAMINATES

· BREATHING SUSTAINABILITY ·

EPD Owner :	See Group. supporting ethical enterprise	See Ltd www.seegroupholdings.com
Prepared by:	ecoact an atos company	EcoAct Ltd www.eco-act.com

Programme:	The International EPD® System www.environdec.com
Programme Operator:	EPD International AB
EPD Registration Number:	S-P-02470
Scope:	Global
Issue Date:	18/01/2021
Valid to:	18/01/2026

1. Programme information

Programme:

The International EPD® System

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ISO standard ISO 21930 and CEN standard EN 15804 serves as the core Product Category Rules (PCR)
Product category rules (PCR): PCR 2019:14 Construction products, version 1.1
PCR review was conducted by: The Technical Committee of the International EPD® System. See www.environdec.com/TC for a list of members. Review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☑ External ☐ Internal **Covering** ☐ EPD process certification ☑ EPD verification
Third party verifier: Chris Foster, EuGeos **Approved by:** The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☑ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804. For further information about comparability, see EN 15804 and ISO 14025.

2. General information

Name of the product

BioCarbon Laminates High Pressure Laminate and Solid Grade Laminate

Owner of the declaration

See Ltd,
26 Brunel Road, Earlstrees Industrial Estate
Corby, Northants, NN17 4JW

Conductor of Life Cycle Assessment (LCA) and Environmental Product Declaration (EPD)

EcoAct UK
www.eco-act.com
Carbon Clear Limited trading as EcoAct
Registered Office: Unit A, 70-78 York Way, London N1 9AG

Product category rules

EN 15804:2012: Sustainability of construction works – Environmental product declaration – Core rules of the product category of construction products.

Date of publication and validity of EPD

Issue date: 18/01/2021
Valid to: 18/01/2026

Verification

The EPD is verified by an independent external party according to the EN 15804:2012+A2:2019 standard.
The EPD is verified by Chris Foster, EuGeos.

3. Product description

Product Composition:

The BioCarbon Laminates range of High-Pressure Laminates (HPL) and Solid Grade Laminates (SGL) and are produced in thicknesses between 0.5mm - 25mm, and a wide range of sheet sizes to suit application requirements.

The laminate sheets compose of layers of kraft paper impregnated with phenolic resin and decorative papers on both sides that are impregnated with melamine resin.

Description of the product:

All HPL and SGL laminates conform to CE mark standards of health, safety and environment protection standards for construction products sold within the European Economic Area (EEA). In addition to this, the laminates are certified to ISO 14001 for Environmental Management Standards, are FSC® certified materials, and comply with BS EN 438 standards for laminate sheet materials.

Applications

HPL

The BioCarbon Laminates High Pressure Laminate (HPL) provides the security of Anti-Microbial protection for hygiene sensitive areas, and the performance properties to make them suitable for a wide range of applications such as Private and residential housing, Public buildings, Healthcare, Hospitality, Washrooms and lockers, Commercial interiors, Leisure facilities, Retail, and Educational, Railway Stations, Airport terminals and Industrial Buildings.

Suitable for vertical and horizontal such as Hospital Furniture, Office Furniture, IPS Panelling, Doors and Desktops etc.

SGL

The BioCarbon Laminates Solid Grade Laminate (SGL) provides the security of Anti-Microbial protection for hygiene sensitive areas, and the performance properties to make them suitable for a wide range of applications such Private and residential housing, Public buildings, Healthcare, Hospitality, Washrooms and Lockers, Commercial interiors, Leisure facilities, Retail, and Educational, Railway Stations, Airport terminals and Industrial buildings.

Fire Retardancy comes as standard to EN13501-1 and ASTM84.

Suitable for freestanding applications in vertical such as Cubicles and storage, Wall cladding, Railing, Infill panels, Column panels, as well as horizontal applications in Work Surfaces, Office Furniture, Ceilings, Windowsills and Counter Tops etc.

Main product components and materials

The EPD refers to four grades of BioCarbon Laminates HPL & SGL: 1mm, 6mm, 12.5mm and 20mm.

Weight [kg/m^2] (% share of weight)						
	1mm	**6mm**	**12.5mm**	**20mm**	**PC**	**RM**
Kraft paper	0.92 (59.9%)	5.96 (67.5%)	12.60 (69.6%)	20.39 (70.4%)	0%	100%
Decorative paper	0.14 (9.2%)	0.28 (3.2%)	0.28 (1.6%)	0.28 (1.0%)	0%	100%
Melamine resin	0.11 (7.1%)	0.22 (2.5%)	0.22 (1.2%)	0.22 (0.8%)	0%	15%
Phenolic resin	0.36 (23.7%)	2.36 (26.8%)	5.00 (27.6%)	8.08 (27.9%)	0%	9%
Total	1.53	8.82	18.1	28.98		
Packaging						
Mixed plastics	0.02	0.11	0.23	0.37	0%	0%
Pallet	0	0.01	0.01	0.02	0%	100%

*Functional Unit: 1 m^2

Specific contents of resins are not listed to protect proprietary information.
PC = post-consumer material weight-%
RM = Renewable material, weight-%

Manufacture

The manufacture of BioCarbon Laminates consists of multiple stages outlined in the process flow diagram below.

Firstly, phenolic and melamine resins are manufactured. Kraft paper sheets are then impregnated with a phenolic resin while decorative paper sheets are impregnated with a melamine resin. The laminate is formed by pressing a top layer of melamine impregnated decorative paper with several layers of phenolic impregnated kraft paper depending on thickness. The pressed laminate is then trimmed to size.

The production site is Lamitech, Bolivar Cartagena, Colombia.

Release of dangerous substances

The product has tested in accordance with UL 2821 test method to show compliance to emission limits on UL 2818 section 7.1 and 7.2. Concentration level of formaldehyde is very low, below the 7.3 ppb threshold.

The product has been GREENGUARD certified by UL Environment.

4. LCA calculation information

Functional unit/Declared unit

The declared unit is 1m^2 of BioCarbon Laminates.

Service life

As a permanent component of building or infrastructure, laminates are typically used until the construction itself is demolished or refurbished. The life of the product itself is likely 100 years as a minimum. Due to the nature of it being a construction and interior component the service life has been estimated to be on average 40 years.

System boundaries

This Environmental Product Declaration considers cradle to gate with options, modules C1–C4, and module D. The list of modules considered are detailed in the table below.

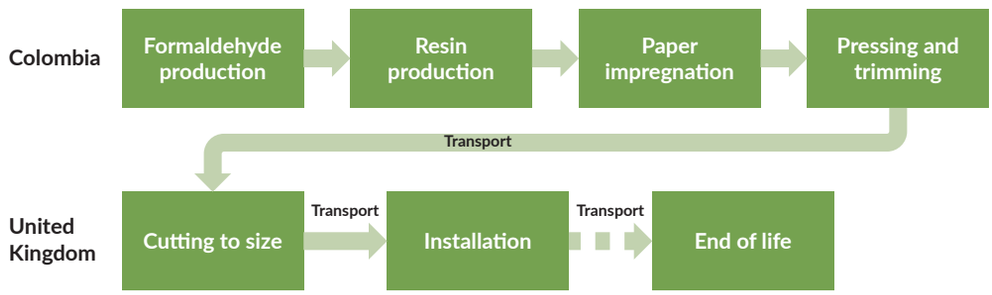
Product stage			Construction process		Use stage							End-of-life				Benefits outside boundary
Raw materials supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Energy use	Water use	De-construction	Transport	Waste processing	Disposal	Reuse, recovery, recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
GLO	GLO	CO/UK	UK	UK	-	-	-	-	-	-	-	UK	UK	UK	UK	CO/UK
>90% specific data					-	-	-	-	-	-	-	-	-	-	-	-
Product variation not relevant					-	-	-	-	-	-	-	-	-	-	-	-
Site variation not relevant					-	-	-	-	-	-	-	-	-	-	-	-

X = Included ND = Not Declared

As the product is a construction material, once it has been installed, no actions or operations are required to maintain the product during the use phase until the demolition of the construction. No operational energy or water use is required by the product.

Process Flow Diagram

System boundary



Cut-off rules

A cut-off criterion of 1% has been applied, however no specific exclusions have been made based on this. Capital goods have been generally excluded from primary data collection but considered where included in applied background data.

Data quality

Specific data for BioCarbon Laminates has been collected as far as possible. Primary data has been collected from manufacturer of the laminate for 2019. Data has been scaled up to cover a one-year average.

Further processing data for the preparation of the product for installation and installation data was also collected, here most recent data, 7 months, for 2020 was collected and scaled up to a full 12-month period.

Background data

Ecoinvent 3.6 was used for all background data and was modelled using GaBi ts 9.5.

Estimates

Estimates have been made throughout the study where no specific data is available. These have been based on expert approximations to represent the material used or process out as accurately as possible.

Allocation

All allocation within the primary data has been done using mass allocation.

Comparability

The comparison of different EPD data is only possible where EN 15804 has been followed, the same building context and product-specific characteristics of performance are considered, and the same stages have been included in the system boundary. According to EN 15804, EPDs of construction products may not be comparable if they do not comply with this standard. According to ISO 21930, EPDs may not be comparable if they are from different EPD programmes.

5. LCA additional technical information

Product stage, A1-A3

The product stage of the laminate products is subdivided into three modules; A1- raw material supply, A2- transport, and A3- manufacturing.

A1 Raw material supply

This module accounts for the extraction and processing of all raw materials upstream of the laminate manufacturing process. In particular, it covers the supply of raw materials for the production of melamine and phenolic resin, and the supply of kraft and decorative paper that are used in the laminate manufacturing process.

A2 Transport to manufacturer

Transport of the raw material to the manufacturing facility are considered in this module. This includes transport by ship, train, and freight lorry. Mainly secondary data has been used for this process.

A3 Manufacturing

The manufacturing process of the laminate consists of production of phenolic resin and melamine resin. The phenolic resin is impregnated onto kraft paper and the melamine resin onto decorative paper. These are then pressed together to form laminate of various thicknesses.

The third module considers the whole manufacturing process of laminate including energy consumption, emissions generated during manufacturing, and treatment of waste generated during the manufacturing process (including waste resins, paper and laminate).

This also includes the processing required to cut and adjust the size of the laminate for the specific building projects and the waste treatment of any offcuts from this.

Construction process stage, A4-A5

A4 Transport to site

This considers the transport of laminate from the manufacturing facility to a warehouse in the UK, as well as transport from this warehouse to the point of installation. This has been calculated from actual data for the transport from the manufacturing facility to the warehouse, and calculated scenarios using actual data for the transport from the warehouse to the point of installation.

Scenario information	Value	Unit
Vehicle	16-32t	EURO5
Distance	177	km
Capacity utilisation	50	%
Bulk density	1448	kg/m^3

A5 Installation

Installation considers the electricity consumption required and waste produced during the installation of the compact laminate.

Scenario information	Value	Unit
Ancillary materials	0	kg
Water use	0	m^3
Electricity	0.45	kWh
Waste laminate	0.09	kg
Material for energy recovery	0.09	kg
Direct emissions	0	kg

End of Life stage, C1-C4

We have developed a dedicated model for End of Life treatment of the laminate. Scenario information has been summarised below.

Process	Value	Unit
Collected with mixed construction waste	100	%
Material for reuse	0	%
Material for recycling	0	%
Material for energy recovery	97	%
Material for final disposal	3	%
Transport distance	100	km

C1 De-construction, demolition

This module considers the impact of the de-construction and/or demolition of the laminate. As no BioCarbon Laminates product has yet reached its end of life, de-construction was assumed to be in line with literature sources.

C2 Transport

This is the transport distance from the site to the waste processing facility. Average distance was estimated based on country specific ecoinvent waste treatment.

C3 Waste processing

Due to the compacted nature of BioCarbon Laminates, all waste material has been assumed disposed in landfill or incineration with no materials being recycled. The proportion of incineration with energy recovery to landfill has been calculated as 97.0% incineration and 3.0% landfill.

C4 Disposal

We have estimated that 3.0% of waste in disposed as landfill.

Benefits, D

Benefits considered in this module includes the avoided impact associated with energy from recovery.

Scenario information	Value	Unit
Lower heating value		
Phenolic resin (dry)	23.04	MJ/kg
Melamine resin (dry)	17.82	MJ/kg
Paper	15.45	MJ/kg
Incineration efficiency		
Electric	15.84	%
Thermal	28.51	%
Landfill gas utilisation		
Electric	27.80	%
Thermal	13.50	%
Landfill gas recovery		
Gas emitted directly	47.00	%
Gas captured and flared	18.02	%
Gas captured and utilised for energy	34.98	%

6. Results – core environmental impacts

1mm

		A1-A3 – Product Stage			A4-A5- Construction Stage		B1-B7 Use Stage							C- End of life				D- Benefits
Impact category	Unit	A1- Raw material supply	A2-Transport	A3- Manufacturing	A4- Transport	A5- Construction-installation process	B1- Use	B2- Maintenance	B3- Repair	B4- Replacement	B5- Refurbishment	B6- Operational energy use	B7 - Operational water use	C1- De-construction, demolition	C2- Transport	C3- Waste processing	C4- Disposal	
Climate change - total	kg CO_2 eq.	0.784	0.267	1.51	0.0416	0.184	ND	ND	ND	ND	ND	ND	ND	0.0494	0.0188	1.11	0.00318	-0.596
Climate change – fossil	kg CO_2 eq.	2.6	0.267	1.37	0.0415	0.181	ND	ND	ND	ND	ND	ND	ND	0.0494	0.0187	1.04	0.00135	-0.596
Climate change – biogenic	kg CO_2 eq.	-1.83	4.41E-05	0.113	2.22E-05	0.00305	ND	ND	ND	ND	ND	ND	ND	-1.39E-05	8.65E-06	0.0728	0.00183	1.51E-05
Climate change- land use change	kg CO_2 eq.	0.0131	0.000177	0.0335	1.49E-05	8.78E-06	ND	ND	ND	ND	ND	ND	ND	2.81E-06	7.16E-06	1.64E-05	2.3E-07	-5.15E-05
Ozone Depletion	kg CFC 11 eq.	2.63E-07	5.4E-08	1.18E-07	9.44E-09	1.75E-08	ND	ND	ND	ND	ND	ND	ND	5.68E-09	4.14E-09	1.3E-08	1.34E-10	-6.49E-08
Acidification	Mol. H^+ eq.	0.0171	0.00568	0.00476	0.00017	0.000261	ND	ND	ND	ND	ND	ND	ND	8.33E-05	0.000109	0.00217	4.37E-06	-0.00098
Eutrophication aquatic freshwater	kg P eq.	0.000919	2.07E-05	0.000103	3.04E-06	8.6E-06	ND	ND	ND	ND	ND	ND	ND	2.79E-06	1.72E-06	7.04E-06	7.01E-08	-0.000024
Eutrophication marine	kg N eq.	0.00374	0.00149	0.019	0.000051	8.29E-05	ND	ND	ND	ND	ND	ND	ND	2.51E-05	3.87E-05	0.00519	0.000645	-0.000271
Eutrophication terrestrial	Mol. N eq.	0.0441	0.0165	0.00926	0.000557	0.000803	ND	ND	ND	ND	ND	ND	ND	0.000254	0.000422	0.0115	1.63E-05	-0.0028
Photochemical ozone formation	kg ethene eq.	0.0111	0.00433	0.00293	0.000171	0.000217	ND	ND	ND	ND	ND	ND	ND	6.84E-05	0.000121	0.00276	0.000005	-0.000857
Depletion of abiotic resources – minerals and metals[1]	kg Sb eq.	4.61E-05	3.62E-06	3.03E-06	1.12E-06	2.14E-07	ND	ND	ND	ND	ND	ND	ND	6.67E-08	4.75E-07	9.96E-06	3.91E-09	-6.2E-07
Depletion of abiotic resources – fossil fuels	MJ (lower heating value)	50.3	3.67	20.9	0.63	3.92	ND	ND	ND	ND	ND	ND	ND	1.28	0.288	1.47	0.00984	-13
Water scarcity	m^3 world eq.	4.92	0.0169	0.327	0.00283	0.0249	ND	ND	ND	ND	ND	ND	ND	0.00806	0.00148	0.0394	0.00044	-0.073

Table 1: Environmental impacts by life cycle stage for 1mm

[1] The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

6mm

		A1-A3 – Product Stage			A4-A5- Construction Stage		B1-B7 Use Stage							C- End of life				D- Benefits
Impact category	Unit	A1- Raw material supply	A2-Transport	A3- Manufacturing	A4- Transport	A5- Construction-installation process	B1- Use	B2- Maintenance	B3- Repair	B4- Replacement	B5- Refurbishment	B6- Operational energy use	B7 - Operational water use	C1- De-construction, demolition	C2- Transport	C3- Waste processing	C4- Disposal	
Climate change - total	kg CO_2 eq.	3.51	1.54	6.31	0.24	0.338	ND	ND	ND	ND	ND	ND	ND	0.285	0.108	5.65	0.0185	-3.47
Climate change – fossil	kg CO_2 eq.	14.3	1.54	6.03	0.239	0.32	ND	ND	ND	ND	ND	ND	ND	0.285	0.108	5.25	0.00768	-3.47
Climate change – biogenic	kg CO_2 eq.	-10.8	0.000257	0.211	0.000128	0.0178	ND	ND	ND	ND	ND	ND	ND	-8.02E-05	4.99E-05	0.398	0.0108	0.000247
Climate change- land use change	kg CO_2 eq.	0.0714	0.00102	0.0631	0.000086	9.56E-06	ND	ND	ND	ND	ND	ND	ND	1.62E-05	4.13E-05	7.76E-05	1.06E-06	-0.000209
Ozone Depletion	kg CFC 11 eq.	1.35E-06	3.12E-07	5.4E-07	5.44E-08	1.79E-08	ND	ND	ND	ND	ND	ND	ND	3.28E-08	2.39E-08	5.75E-08	7.68E-10	-3.78E-07
Acidification	Mol. H^+ eq.	0.0909	0.0328	0.0144	0.000979	0.000287	ND	ND	ND	ND	ND	ND	ND	0.00048	0.000627	0.00756	2.36E-05	-0.0057
Eutrophication aquatic freshwater	kg P eq.	0.00536	0.00012	0.000279	1.75E-05	8.89E-06	ND	ND	ND	ND	ND	ND	ND	1.61E-05	9.9E-06	3.34E-05	3.48E-07	-0.00014
Eutrophication marine	kg N eq.	0.021	0.00858	0.0203	0.000294	0.000111	ND	ND	ND	ND	ND	ND	ND	0.000145	0.000223	0.0263	0.00214	-0.00158
Eutrophication terrestrial	Mol. N eq.	0.228	0.095	0.0338	0.00321	0.000929	ND	ND	ND	ND	ND	ND	ND	0.00146	0.00243	0.0394	8.68E-05	-0.0163
Photochemical ozone formation	kg ethene eq.	0.0643	0.025	0.0111	0.000983	0.000252	ND	ND	ND	ND	ND	ND	ND	0.000394	0.000695	0.00953	2.75E-05	-0.00499
Depletion of abiotic resources – minerals and metals[1]	kg Sb eq.	0.000212	0.000021	1.21E-05	6.48E-06	2.58E-07	ND	ND	ND	ND	ND	ND	ND	3.85E-07	2.74E-06	5.86E-05	2.21E-08	-3.61E-06
Depletion of abiotic resources – fossil fuels	MJ (lower heating value)	281	21.2	96.2	3.63	3.95	ND	ND	ND	ND	ND	ND	ND	7.35	1.66	6.05	0.0549	-75.7
Water scarcity	m^3 world eq.	25.9	0.0976	0.926	0.0163	0.0261	ND	ND	ND	ND	ND	ND	ND	0.0465	0.00852	0.177	0.0025	-0.425

Table 2: Environmental impacts by life cycle stage for 6mm

[1] The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

12.5 mm

		A1-A3 – Product Stage			A4-A5- Construction Stage		B1-B7 Use Stage							C- End of life				D- Benefits
Impact category	Unit	A1- Raw material supply	A2-Transport	A3- Manufacturing	A4- Transport	A5- Construction-installation process	B1- Use	B2- Maintenance	B3- Repair	B4- Replacement	B5- Refurbishment	B6- Operational energy use	B7 - Operational water use	C1- De-construction, demolition	C2- Transport	C3- Waste processing	C4- Disposal	
Climate change - total	kg CO_2 eq.	6.63	3.17	12.5	0.492	0.535	ND	ND	ND	ND	ND	ND	ND	0.585	0.222	11.2	0.038	-7.14
Climate change – fossil	kg CO_2 eq.	28.9	3.17	12.1	0.491	0.498	ND	ND	ND	ND	ND	ND	ND	0.585	0.222	10.4	0.0157	-7.14
Climate change – biogenic	kg CO_2 eq.	-22.4	0.000529	0.36	0.000262	0.0366	ND	ND	ND	ND	ND	ND	ND	-0.000164	0.000102	0.804	0.0222	0.000544
Climate change- land use change	kg CO_2 eq.	0.144	0.00209	0.115	0.000176	1.06E-05	ND	ND	ND	ND	ND	ND	ND	3.33E-05	8.47E-05	0.00015	2.04E-06	-0.00041
Ozone Depletion	kg CFC 11 eq.	2.68E-06	6.42E-07	1.08E-06	1.12E-07	1.84E-08	ND	ND	ND	ND	ND	ND	ND	6.73E-08	4.89E-08	1.08E-07	1.57E-09	-7.78E-07
Acidification	Mol. H^+ eq.	0.182	0.0673	0.0278	0.00201	0.000321	ND	ND	ND	ND	ND	ND	ND	0.000985	0.00129	0.0127	4.74E-05	-0.0117
Eutrophication aquatic freshwater	kg P eq.	0.011	0.000246	0.000535	0.000036	9.26E-06	ND	ND	ND	ND	ND	ND	ND	0.000033	2.03E-05	6.46E-05	6.82E-07	-0.000287
Eutrophication marine	kg N eq.	0.0429	0.0176	0.0266	0.000603	0.000146	ND	ND	ND	ND	ND	ND	ND	0.000297	0.000457	0.0518	0.00351	-0.00325
Eutrophication terrestrial	Mol. N eq.	0.453	0.195	0.0655	0.00659	0.00109	ND	ND	ND	ND	ND	ND	ND	0.003	0.005	0.0658	0.000174	-0.0335
Photochemical ozone formation	kg ethene eq.	0.132	0.0513	0.0217	0.00202	0.000296	ND	ND	ND	ND	ND	ND	ND	0.000809	0.00143	0.016	5.58E-05	-0.0103
Depletion of abiotic resources – minerals and metals[1]	kg Sb eq.	0.000404	4.31E-05	2.42E-05	1.33E-05	3.14E-07	ND	ND	ND	ND	ND	ND	ND	7.9E-07	5.62E-06	0.000121	4.52E-08	-7.43E-06
Depletion of abiotic resources – fossil fuels	MJ (lower heating value)	571	43.6	194	7.45	3.99	ND	ND	ND	ND	ND	ND	ND	15.1	3.4	11	0.112	-156
Water scarcity	m^3 world eq.	51.9	0.2	1.78	0.0335	0.0276	ND	ND	ND	ND	ND	ND	ND	0.0954	0.0175	0.334	0.00511	-0.874

Table 3: Environmental impacts by life cycle stage for 12.5mm

[1] The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

20mm

		A1-A3 – Product Stage			A4-A5- Construction Stage		B1-B7 Use Stage							C- End of life				D- Benefits
Impact category	Unit	A1- Raw material supply	A2-Transport	A3- Manufacturing	A4- Transport	A5- Construction-installation process	B1- Use	B2- Maintenance	B3- Repair	B4- Replacement	B5- Refurbishment	B6- Operational energy use	B7 - Operational water use	C1- De-construction, demolition	C2- Transport	C3- Waste processing	C4- Disposal	
Climate change - total	kg CO_2 eq.	10.3	5.07	19.3	0.788	0.765	ND	ND	ND	ND	ND	ND	ND	0.936	0.355	17.6	0.0608	-11.4
Climate change – fossil	kg CO_2 eq.	46.1	5.07	18.7	0.787	0.706	ND	ND	ND	ND	ND	ND	ND	0.936	0.355	16.3	0.0251	-11.4
Climate change – biogenic	kg CO_2 eq.	-36	0.000848	0.464	0.00042	0.0586	ND	ND	ND	ND	ND	ND	ND	-0.000263	0.000164	1.28	0.0357	0.000892
Climate change- land use change	kg CO_2 eq.	0.23	0.00335	0.137	0.000283	1.17E-05	ND	ND	ND	ND	ND	ND	ND	5.33E-05	0.000136	0.000235	3.18E-06	-0.000646
Ozone Depletion	kg CFC 11 eq.	4.23E-06	1.03E-06	1.69E-06	1.79E-07	1.9E-08	ND	ND	ND	ND	ND	ND	ND	1.08E-07	7.84E-08	1.68E-07	2.52E-09	-1.25E-06
Acidification	Mol. H^+ eq.	0.289	0.108	0.0398	0.00322	0.000361	ND	ND	ND	ND	ND	ND	ND	0.00158	0.00206	0.0188	7.54E-05	-0.0188
Eutrophication aquatic freshwater	kg P eq.	0.0177	0.000393	0.000743	5.76E-05	9.69E-06	ND	ND	ND	ND	ND	ND	ND	5.28E-05	3.25E-05	0.000101	1.07E-06	-0.000461
Eutrophication marine	kg N eq.	0.0685	0.0282	0.035	0.000966	0.000188	ND	ND	ND	ND	ND	ND	ND	0.000476	0.000732	0.0818	0.00512	-0.00521
Eutrophication terrestrial	Mol. N eq.	0.717	0.312	0.0984	0.0106	0.00128	ND	ND	ND	ND	ND	ND	ND	0.0048	0.008	0.0966	0.000277	-0.0537
Photochemical ozone formation	kg ethene eq.	0.211	0.0822	0.0328	0.00323	0.000348	ND	ND	ND	ND	ND	ND	ND	0.0013	0.00228	0.0235	8.89E-05	-0.0165
Depletion of abiotic resources – minerals and metals[1]	kg Sb eq.	0.000629	0.000069	3.69E-05	2.13E-05	3.8E-07	ND	ND	ND	ND	ND	ND	ND	1.26E-06	0.000009	0.000194	7.22E-08	-1.19E-05
Depletion of abiotic resources – fossil fuels	MJ (lower heating value)	912	69.8	301	11.9	4.04	ND	ND	ND	ND	ND	ND	ND	24.2	5.45	16.9	0.178	-250
Water scarcity	m^3 world eq.	82.3	0.321	2.51	0.0537	0.0293	ND	ND	ND	ND	ND	ND	ND	0.153	0.028	0.519	0.00818	-1.4

Table 4: Environmental impacts by life cycle stage for 20mm

[1] The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

7. LCA Results – additional environmental impacts

1mm

		A1-A3 – Product Stage			A4-A5- Construction Stage		B1-B7 Use Stage							C- End of life				D- Benefits
Impact category	Unit	A1- Raw material supply	A2-Transport	A3- Manufacturing	A4- Transport	A5- Construction-installation process	B1- Use	B2- Maintenance	B3- Repair	B4- Replacement	B5- Refurbishment	B6- Operational energy use	B7 - Operational water use	C1- De-construction, demolition	C2- Transport	C3- Waste processing	C4- Disposal	
Eutrophication aquatic freshwater	kg PO_4 eq.	2.82E-03	6.35E-05	3.16E-04	9.33E-06	2.64E-05	ND	ND	ND	ND	ND	ND	ND	8.57E-06	5.28E-06	2.16E-05	2.15E-07	-7.37E-05
Climate change - GWP – GHG (IPCC AR5)	kg CO_2 eq.	4.930	2.540	0.264	1.410	0.041	ND	ND	ND	ND	ND	ND	ND	0.049	0.019	1.010	0.002	-0.587
Particulate Matter emissions	Disease incidence	2.73E-07	1.49E-08	1.52E-08	2.9E-09	9.35E-10	ND	ND	ND	ND	ND	ND	ND	2.85E-10	1.69E-09	9.62E-09	7.43E-11	-3.12E-09
Ionizing radiation, human health[2]	kBq U235e	0.16	0.0177	0.196	0.00323	0.124	ND	ND	ND	ND	ND	ND	ND	0.0404	0.00136	0.00281	4.74E-05	-0.294
Eco-toxicity (freshwater)[1]	CTUe	149	2.95	404	0.523	0.637	ND	ND	ND	ND	ND	ND	ND	0.202	0.263	3860	0.00758	-3.04
Human toxicity, cancer effects[1]	CTUh	3.35E-09	1.48E-10	1.74E-10	1.41E-11	1.39E-11	ND	ND	ND	ND	ND	ND	ND	3.87E-12	8.18E-12	5.19E-11	2.16E-13	-4.84E-11
Human toxicity, non-cancer effects[1]	CTUh	4.51E-08	2.63E-09	5.65E-09	4.94E-10	4.52E-10	ND	ND	ND	ND	ND	ND	ND	1.31E-10	2.5E-10	9.45E-10	4.98E-12	-1.71E-09
Land use related impacts/Soil quality		275	1.67	-1.51	0.431	0.163	ND	ND	ND	ND	ND	ND	ND	0.0512	0.245	0.723	0.00242	-0.517

Table 5: EN 15804 Additional impacts by Life Cycle stage for 1mm

[1] The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

[2]This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

6mm

		A1-A3 – Product Stage			A4-A5- Construction Stage		B1-B7 Use Stage							C- End of life				D- Benefits
Impact category	Unit	A1- Raw material supply	A2-Transport	A3- Manufacturing	A4- Transport	A5- Construction-installation process	B1- Use	B2- Maintenance	B3- Repair	B4- Replacement	B5- Refurbishment	B6- Operational energy use	B7 - Operational water use	C1- De-construction, demolition	C2- Transport	C3- Waste processing	C4- Disposal	
Eutrophication aquatic freshwater	kg PO_4 eq.	1.65E-02	3.68E-04	8.57E-04	5.37E-05	2.73E-05	ND	ND	ND	ND	ND	ND	ND	4.94E-05	3.04E-05	1.03E-04	1.07E-06	-4.30E-04
Climate change - GWP – GHG (IPCC AR5)	kg CO_2 eq.	13.902	1.528	6.041	0.237	0.324	ND	ND	ND	ND	ND	ND	ND	0.283	0.107	5.153	0.014	-3.420
Particulate Matter emissions	Disease incidence	1.47E-06	8.65E-08	4.52E-08	1.67E-08	1.22E-09	ND	ND	ND	ND	ND	ND	ND	1.65E-09	9.72E-09	4.24E-08	4.21E-10	-1.82E-08
Ionizing radiation, human health[2]	kBq U235e	0.901	0.102	1.1	0.0186	0.124	ND	ND	ND	ND	ND	ND	ND	0.233	0.00783	0.0143	0.000257	-1.71
Eco-toxicity (freshwater)[1]	CTUe	895	17.1	2354	3.02	0.728	ND	ND	ND	ND	ND	ND	ND	1.16	1.52	22770	0.0414	-17.7
Human toxicity, cancer effects[1]	CTUh	2.03E-08	8.58E-10	5.92E-10	8.14E-11	2.37E-11	ND	ND	ND	ND	ND	ND	ND	2.23E-11	4.72E-11	2.54E-10	1.21E-12	-2.82E-10
Human toxicity, non-cancer effects[1]	CTUh	2.57E-07	1.52E-08	2E-08	2.85E-09	6.9E-10	ND	ND	ND	ND	ND	ND	ND	7.56E-10	1.44E-09	4.31E-09	2.75E-11	-9.93E-09
Land use related impacts/Soil quality		1723	9.67	-0.354	2.48	0.193	ND	ND	ND	ND	ND	ND	ND	0.295	1.41	4.08	0.0137	-3.02

Table 6: EN 15804 Additional impacts by Life Cycle stage for 6mm

[1] The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

[2]This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

12.5mm

		A1-A3 – Product Stage			A4-A5- Construction Stage		B1-B7 Use Stage							C- End of life				D- Benefits
Impact category	Unit	A1- Raw material supply	A2-Transport	A3- Manufacturing	A4- Transport	A5- Construction-installation process	B1- Use	B2- Maintenance	B3- Repair	B4- Replacement	B5- Refurbishment	B6- Operational energy use	B7 - Operational water use	C1- De-construction, demolition	C2- Transport	C3- Waste processing	C4- Disposal	
Eutrophication aquatic freshwater	kg PO_4 eq.	3.38E-02	7.55E-04	1.64E-03	1.11E-04	2.84E-05	ND	ND	ND	ND	ND	ND	ND	1.01E-04	6.23E-05	1.98E-04	2.09E-06	-8.81E-04
Climate change - GWP – GHG (IPCC AR5)	kg CO_2 eq.	28.129	3.139	12.045	0.487	0.506	ND	ND	ND	ND	ND	ND	ND	0.581	0.220	10.199	0.028	-7.039
Particulate Matter emissions	Disease incidence	2.95E-06	1.78E-07	8.62E-08	3.43E-08	1.59E-09	ND	ND	ND	ND	ND	ND	ND	3.38E-09	2E-08	7.96E-08	8.6E-10	-3.74E-08
Ionizing radiation, human health[2]	kBq U235e	1.84	0.21	2.26	0.0382	0.124	ND	ND	ND	ND	ND	ND	ND	0.478	0.0161	0.0282	0.000519	-3.53
Eco-toxicity (freshwater)[1]	CTUe	1857	35	4856	6.19	0.843	ND	ND	ND	ND	ND	ND	ND	2.39	3.11	47018	0.0838	-36.4
Human toxicity, cancer effects[1]	CTUh	4.22E-08	1.76E-09	1.16E-09	1.67E-10	3.62E-11	ND	ND	ND	ND	ND	ND	ND	4.58E-11	9.68E-11	4.95E-10	2.47E-12	-5.79E-10
Human toxicity, non-cancer effects[1]	CTUh	5.27E-07	3.13E-08	3.93E-08	5.85E-09	9.94E-10	ND	ND	ND	ND	ND	ND	ND	1.55E-09	2.96E-09	8.2E-09	5.58E-11	-2.04E-08
Land use related impacts/Soil quality		3613	19.9	0.111	5.1	0.231	ND	ND	ND	ND	ND	ND	ND	0.606	2.9	8.32	0.028	-6.21

Table 7: EN 15804 Additional impacts by Life Cycle stage for 12.5mm

[1] The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

[2]This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

20mm

		A1-A3 – Product Stage			A4-A5- Construction Stage		B1-B7 Use Stage							C- End of life				D- Benefits
Impact category	Unit	A1- Raw material supply	A2-Transport	A3- Manufacturing	A4- Transport	A5- Construction-installation process	B1- Use	B2- Maintenance	B3- Repair	B4- Replacement	B5- Refurbishment	B6- Operational energy use	B7 - Operational water use	C1- De-construction, demolition	C2- Transport	C3- Waste processing	C4- Disposal	
Eutrophication aquatic freshwater	kg PO_4 eq.	5.43E-02	1.21E-03	2.28E-03	1.77E-04	2.97E-05	ND	ND	ND	ND	ND	ND	ND	1.62E-04	9.98E-05	3.10E-04	3.28E-06	-1.42E-03
Climate change - GWP – GHG (IPCC AR5)	kg CO_2 eq.	44.809	5.027	18.588	0.780	0.720	ND	ND	ND	ND	ND	ND	ND	0.930	0.352	16.116	0.045	-11.282
Particulate Matter emissions	Disease incidence	4.69E-06	2.85E-07	1.25E-07	5.49E-08	2.02E-09	ND	ND	ND	ND	ND	ND	ND	5.41E-09	3.19E-08	1.23E-07	1.37E-09	-5.99E-08
Ionizing radiation, human health[2]	kBq U235e	2.93	0.336	3.61	0.0612	0.124	ND	ND	ND	ND	ND	ND	ND	0.766	0.0257	0.0446	0.000825	-5.65
Eco-toxicity (freshwater)[1]	CTUe	2984	56.1	7780	9.91	0.978	ND	ND	ND	ND	ND	ND	ND	3.82	4.98	75446	0.133	-58.4
Human toxicity, cancer effects[1]	CTUh	6.78E-08	2.82E-09	1.71E-09	2.67E-10	5.08E-11	ND	ND	ND	ND	ND	ND	ND	7.34E-11	1.55E-10	7.79E-10	3.95E-12	-9.29E-10
Human toxicity, non-cancer effects[1]	CTUh	8.42E-07	5.01E-08	5.85E-08	9.37E-09	1.35E-09	ND	ND	ND	ND	ND	ND	ND	2.48E-09	4.74E-09	1.28E-08	8.9E-11	-3.28E-08
Land use related impacts/Soil quality		5829	31.8	3.31	8.16	0.275	ND	ND	ND	ND	ND	ND	ND	0.97	4.64	13.3	0.0448	-9.96

Table 8: EN 15804 Additional impacts by Life Cycle stage for 20mm

[1] The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

[2]This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

8. LCA Results – resource use

1mm

		A1-A3 – Product Stage			A4-A5- Construction Stage		B1-B7 Use Stage							C- End of life				D- Benefits
Impact category	Unit	A1- Raw material supply	A2-Transport	A3- Manufacturing	A4- Transport	A5- Construction-installation process	B1- Use	B2- Maintenance	B3- Repair	B4- Replacement	B5- Refurbishment	B6- Operational energy use	B7 - Operational water use	C1- De-construction, demolition	C2- Transport	C3- Waste processing	C4- Disposal	
Use of renewable primary energy	MJ	34.5	0.0488	4.94	0.00885	0.0494	ND	ND	ND	ND	ND	ND	ND	0.0161	0.00355	0.0137	0.00019	-0.126
Use of renewable primary energy resources as raw materials	MJ	15.9	1.54	6.03	0.239	0.32	ND	ND	ND	ND	ND	ND	ND	0.285	0.108	5.25	0.00768	-3.47
Total use of renewable resources	MJ	50.4	0.0488	4.94	0.00885	0.0494	ND	ND	ND	ND	ND	ND	ND	0.0161	0.00355	0.0137	0.00019	-0.126
Use of non-renewable primary energy	MJ	40.988	3.67	20.9	0.63	3.92	ND	ND	ND	ND	ND	ND	ND	1.28	0.288	1.47	0.00984	-13
Use of non-renewable primary energy resources as raw materials	MJ	9.312	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Total use of non-renewable resources	MJ	50.3	3.67	20.9	0.63	3.92	ND	ND	ND	ND	ND	ND	ND	1.28	0.288	1.47	0.00984	-13
Use of secondary material	kg	0.00	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Use of renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Use of non-renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Use of net fresh water	M^3	0.114	0.000392	0.00762	0.000066	0.000581	ND	ND	ND	ND	ND	ND	ND	0.000188	3.44E-05	0.000918	1.03E-05	-0.0017

Table 9: Resource use categories by life cycle stage for 1mm

6mm

		A1-A3 – Product Stage			A4-A5- Construction Stage		B1-B7 Use Stage							C- End of life				D- Benefits
Impact category	Unit	A1- Raw material supply	A2-Transport	A3- Manufacturing	A4- Transport	A5- Construction-installation process	B1- Use	B2- Maintenance	B3- Repair	B4- Replacement	B5- Refurbishment	B6- Operational energy use	B7 - Operational water use	C1- De-construction, demolition	C2- Transport	C3- Waste processing	C4- Disposal	
Use of renewable primary energy	MJ	203.7	0.282	9.65	0.051	0.05	ND	ND	ND	ND	ND	ND	ND	0.0926	0.0204	0.0646	0.00092	-0.126
Use of renewable primary energy resources as raw materials	MJ	93.3	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Total use of renewable resources	MJ	297	0.282	9.65	0.051	0.05	ND	ND	ND	ND	ND	ND	ND	0.0926	0.0204	0.0646	0.00092	-0.126
Use of non-renewable primary energy	MJ	227.9	21.2	96.2	3.63	3.95	ND	ND	ND	ND	ND	ND	ND	7.35	1.66	6.05	0.0549	-13
Use of non-renewable primary energy resources as raw materials	MJ	53.1	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Total use of non-renewable resources	MJ	281	21.2	96.2	3.63	3.95	ND	ND	ND	ND	ND	ND	ND	7.35	1.66	6.05	0.0549	-13
Use of secondary material	kg	0.00	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Use of renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Use of non-renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Use of net fresh water	M^3	0.604	0.00227	0.0216	0.00038	0.000607	ND	ND	ND	ND	ND	ND	ND	0.00108	0.000198	0.00411	5.83E-05	-0.0017

Table 10: Resource use categories by life cycle stage for 6mm

12.5mm

		A1-A3 – Product Stage			A4-A5- Construction Stage		B1-B7 Use Stage							C- End of life				D- Benefits
Impact category	Unit	A1- Raw material supply	A2-Transport	A3- Manufacturing	A4- Transport	A5- Construction-installation process	B1- Use	B2- Maintenance	B3- Repair	B4- Replacement	B5- Refurbishment	B6- Operational energy use	B7 - Operational water use	C1- De-construction, demolition	C2- Transport	C3- Waste processing	C4- Disposal	
Use of renewable primary energy	MJ	420.7	0.58	17.7	0.105	0.0508	ND	ND	ND	ND	ND	ND	ND	0.0419	0.124	0.00179	-1.48	0.0419
Use of renewable primary energy resources as raw materials	MJ	192.3	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Total use of renewable resources	MJ	613	0.58	17.7	0.105	0.0508	ND	ND	ND	ND	ND	ND	ND	0.0419	0.124	0.00179	-1.48	0.0419
Use of non-renewable primary energy	MJ	463.4	43.6	194	7.45	3.99	ND	ND	ND	ND	ND	ND	ND	15.1	3.4	11	0.112	-156
Use of non-renewable primary energy resources as raw materials	MJ	108.6	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Total use of non-renewable resources	MJ	572	43.6	194	7.45	3.99	ND	ND	ND	ND	ND	ND	ND	15.1	3.4	11	0.112	-156
Use of secondary material	kg	0.00	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Use of renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Use of non-renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Use of net fresh water	M^3	1.21	0.00467	0.0415	0.00078	0.000642	ND	ND	ND	ND	ND	ND	ND	0.00222	0.000407	0.00778	0.000119	-0.0203

Table 11: Resource use categories by life cycle stage for 12.5mm

20mm

		A1-A3 – Product Stage			A4-A5- Construction Stage		B1-B7 Use Stage							C- End of life				D- Benefits
Impact category	Unit	A1- Raw material supply	A2-Transport	A3- Manufacturing	A4- Transport	A5- Construction-installation process	B1- Use	B2- Maintenance	B3- Repair	B4- Replacement	B5- Refurbishment	B6- Operational energy use	B7 - Operational water use	C1- De-construction, demolition	C2- Transport	C3- Waste processing	C4- Disposal	
Use of renewable primary energy	MJ	675.6	0.929	21.5	0.168	0.0517	ND	ND	ND	ND	ND	ND	ND	0.304	0.0671	0.195	0.00281	-2.37
Use of renewable primary energy resources as raw materials	MJ	308.4	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Total use of renewable resources	MJ	984	0.929	21.5	0.168	0.0517	ND	ND	ND	ND	ND	ND	ND	0.304	0.0671	0.195	0.00281	-2.37
Use of non-renewable primary energy	MJ	738.3	69.8	301	11.9	4.04	ND	ND	ND	ND	ND	ND	ND	24.2	5.45	16.9	0.178	-250
Use of non-renewable primary energy resources as raw materials	MJ	173.7	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Total use of non-renewable resources	MJ	912	69.8	301	11.9	4.04	ND	ND	ND	ND	ND	ND	ND	24.2	5.45	16.9	0.178	-250
Use of secondary material	kg	0.00	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Use of renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Use of non-renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00	0.00	0.00
Use of net fresh water	M^3	1.92	0.00748	0.0585	0.00125	0.000682	ND	ND	ND	ND	ND	ND	ND	0.00356	0.000652	0.0121	0.00019	-0.0326

Table 12: Resource use categories by life cycle stage 20mm

9. LCA interpretation

The tables in the above section demonstrate how each stage contributes to the overall environmental impacts of the four thicknesses of BioCarbon Laminates per FU (1m^2). For all other than climate change including biogenic carbon, most of the environmental impact is due to the sourcing of raw materials (A1-A2), such as kraft paper and phenol. For example, for 12.5mm the raw materials account for between 57% (climate change, excl. biogenic carbon) and 96% (water scarcity).

The transportation module (A4) accounts for minimal environmental or resource use impact during the products life cycle.

Figure 1 below summarises the impact of each life cycle stage on three key impact indicators for 12.5mm, the main thickness. In terms of total global warming potential, the manufacturing stage (A3) has the largest impact of the life cycle stages at 12.5 kg CO_2e per m^2, due to the energy required for the manufacturing process. The waste treatment stage (C1-C4) also has a considerable impact of 12.0 kg CO_2e per m^2 because of the energy required for municipal incineration. Reuse of recycling of the laminate at the end of life would result in considerably lower emissions in this module. Raw materials sourcing (A1-A2) uses the largest amount of non-renewable energy of any stage in the lifecycle at 615 MJ per m^2 with most of this energy originating from the raw materials (A1) module. These stages are also where the vast majority (52.1 m^3) of water consumption occurs.

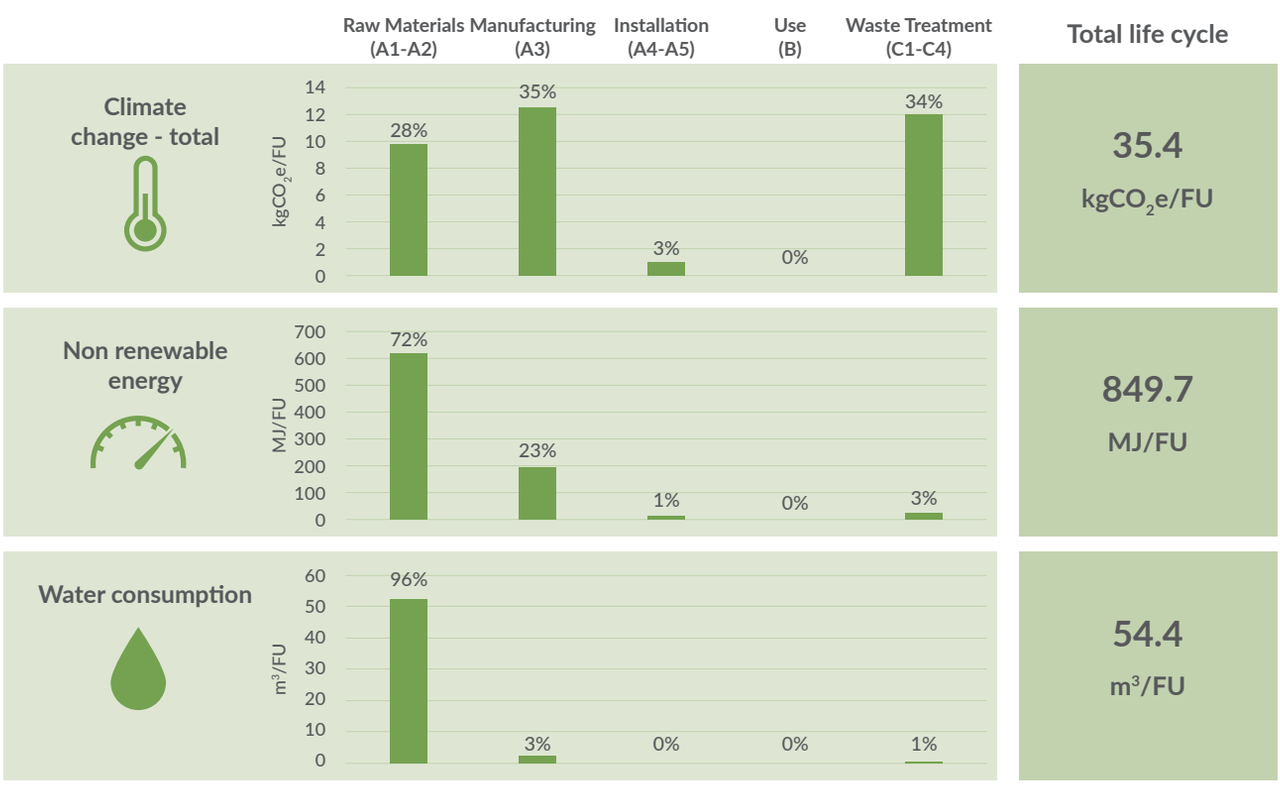


Figure 1: Summary of the impact of life cycle stages on three key environmental impact categories

Biogenic carbon

Biogenic carbon content of the product is detailed below.

Biogenic carbon content					
	1mm	6mm	12.5mm	20mm	Unit
Product	0.45	2.64	5.46	8.75	kg C
Packaging	0.02	0.09	0.19	0.30	kg C

Investigating the full range of thicknesses Figure 2 and Figure 3 below illustrates climate change impact for total emissions and fossil emissions respectively.

The emissions associated with installation (A4-A5) remain relatively constant across thicknesses. Emissions from materials (A1-A2), manufacturing (A3), and waste treatment (C1-C4) are all approximately linearly correlated with the thickness.

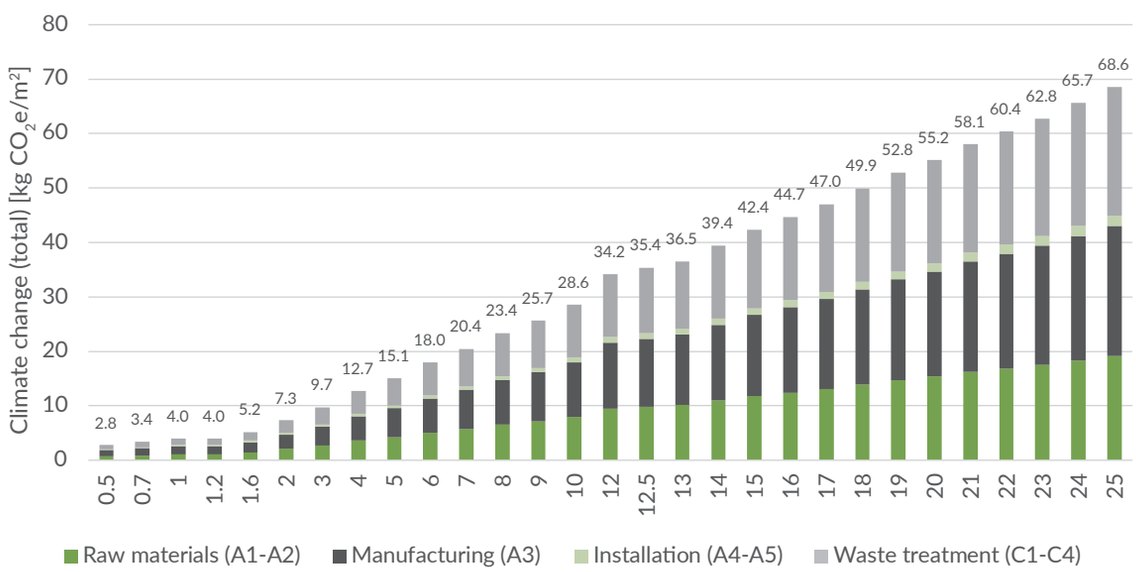


Figure 2 Climate change (total) impact across BioCarbon Laminates thicknesses

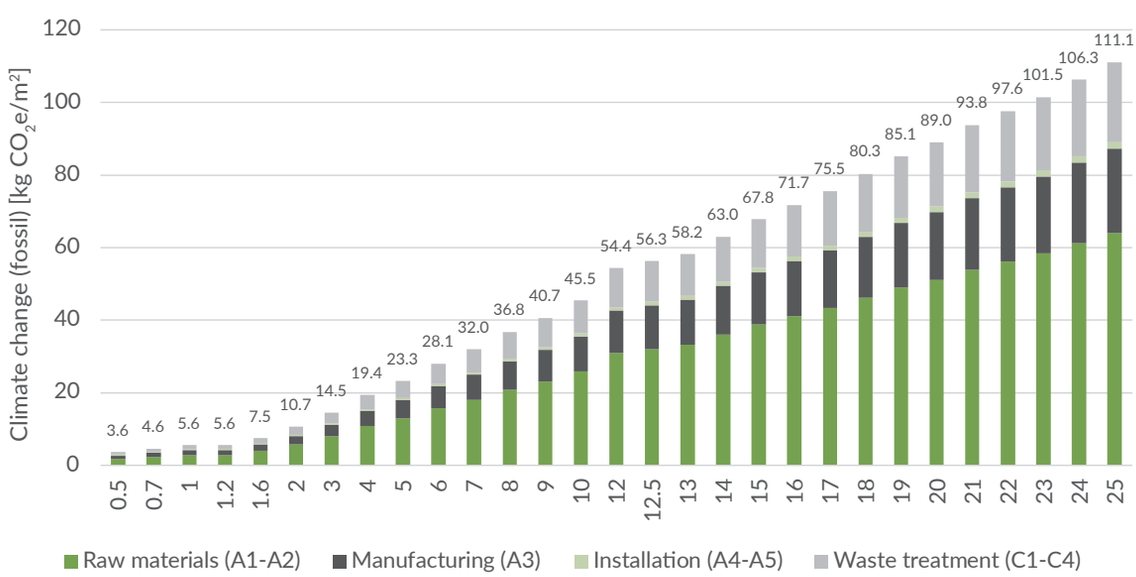


Figure 3 Climate change (fossil) impact across BioCarbon Laminates thicknesses

Waste data

A1-3 Product Stage

Waste Type	1mm	6mm	12.5mm	20mm	Unit
Hazardous waste	0	0	0	0	Kg
Non-hazardous waste	0.39	2.22	4.56	7.30	Kg
Radioactive waste	0	0	0	0	Kg

Process	1mm	6mm	12.5mm	20mm	Unit
Components for reuse	0.02	0.12	0.25	0.39	Kg
Material for recycling	0.00	0.00	0.00	0.00	Kg
Material for energy recovery	0.14	0.83	1.70	2.71	Kg
Material for final disposal	0.22	1.28	2.62	4.20	Kg
Exported energy	0.00	0.00	0.00	0.00	MJ

A4-5 Construction Stage

Waste Type	1mm	6mm	12.5mm	20mm	Unit
Hazardous waste	0	0	0	0	Kg
Non-hazardous waste	0.03	0.16	0.34	0.54	Kg
Radioactive waste	0	0	0	0	Kg

Process	1mm	6mm	12.5mm	20mm	Unit
Material for reuse	0.00	0.00	0.00	0.00	Kg
Material for recycling	0.00	0.00	0.00	0.00	Kg
Material for energy recovery	0.02	0.12	0.25	0.39	Kg
Material for final disposal	0.01	0.04	0.09	0.14	Kg
Exported energy	0.00	0.00	0.00	0.00	MJ

C1-4 End of Life

Waste Type	1mm	6mm	12.5mm	20mm	Unit
Hazardous waste	0	0	0	0	Kg
Non-hazardous waste	1.53	8.82	18.10	28.98	Kg
Radioactive waste	0	0	0	0	Kg

Process	1mm	6mm	12.5mm	20mm	Unit
Material for reuse	0.00	0.00	0.00	0.00	Kg
Material for recycling	0.00	0.00	0.00	0.00	Kg
Material for energy recovery	1.48	8.56	17.56	28.11	Kg
Material for final disposal	0.05	0.26	0.54	0.87	Kg
Exported energy	0.00	0.00	0.00	0.00	MJ

10. References

ISO 14025:2006 - Environmental labels and declarations - Type III environmental declarations - Principles and procedures

ISO 14040:2006 - Environmental management - Life Cycle Assessment - Principles and framework

ISO 14044:2006 - Environmental management - Life Cycle Assessment - Requirements and guidelines

EN 15804:2012+A2:2019 - Sustainability of construction works - Environmental product declaration - Core rules of the product category of construction products

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