



LCA SUPPORT

ENVIRONMENTAL PRODUCT DECLARATION

IN ACCORDANCE WITH EN 15804+A2 & ISO 14025 / ISO 21930

THERMALLY MODIFIED PINE AND SPRUCE

THERMALLY MODIFIED RADIATA PINE

THERMALLY MODIFIED AYOUS

PLANING SERVICE

FIRE RETARDANT TREATMENT SERVICE

THERMOARENA OÜ



GENERAL INFORMATION

MANUFACTURER INFORMATION

Manufacturer	Thermoarena OÜ
Address	Farmi tee 5, Koigi küla, Järva maakond 72501, Estonia
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Website	thermoarena.com

The Building Information Foundation RTS sr

EPDs within the same product category but from different programmes may not be comparable.



EPD INFORMATION

The EPD owner has the sole ownership, liability, and responsibility for the EPD. Construction products EPDs may not be comparable if they do not comply with EN 15804 and if they are not compared in a building context.

EPD program operator	The Building Information Foundation RTS sr
EPD standards	This EPD is in accordance with EN 15804+A2 and ISO 14025 standards.
Product category rules	The CEN standard EN 15804 serves as the core PCR. In addition, the RTS PCR (English version, 26.8.2020) and EN 16485 is used.
EPD author	Mari Kirss Rangi Maja OÜ  www.lcasupport.com
EPD verification	Independent verification of this EPD and data, according to ISO 14025:2010: <input type="checkbox"/> Internal certification <input checked="" type="checkbox"/> External verification
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PRODUCT INFORMATION

Product name	Thermally modified pine and spruce Thermally modified radiata pine Thermally modified ayous Planing service Fire retardant treatment service
Place(s) of production	Estonia, Koigi

PRODUCT DESCRIPTION

Thermoarena is offering thermally modified lumber, wood decking and cladding of different types of wood: thermo pine, thermo spruce, thermo radiata pine and thermo ayous (also called African whitewood, abachi, obeche, wawa and sambawawa), planing for all types and cladding with Burnblock fire retardant for all types. We select and use only the raw materials that are best suited for our production in terms of type and quality. In our production of softwoods we use mainly Finnish PEFC certified sawmills.

Product 1, Product 2 and Product 3 is thermally modified timber. Service 1 is planing of thermally modified timber. Service 2 is average fire retardant treatment process covering all species of the EPD. It is possible to obtain the results for Thermoarena's planed timber and for fire-retardant treated timber by adding the results of the products and included services, while taking into account the share of waste material generated. The calculation principles are further explained in the Annex.

PRODUCT APPLICATION

Thermo modification ensures a longer lifespan for wooden products without the use of chemicals that are harmful to nature. In the construction of wooden buildings, in addition to the durability of wood, the fire resistance class of wood is also important, especially in the case of public buildings. Long-lasting thermal wood products with Burnblock fire retardant create many new possibilities for the construction of modern wooden buildings.

TECHNICAL SPECIFICATIONS

Thermally modified wood is an environmentally friendly and fully recyclable product, the manufacture of which does not include any harmful chemicals.

Unlike chemical impregnation, thermal modification enhances the wood through and through, not just the outer surface. The result is boards that are durable and stable in every sense. Product technical specifications are available in thermoarena.com

PRODUCT STANDARDS

EN305:2016

PHYSICAL PROPERTIES AND ADDITIONAL TECHNICAL INFORMATION

Further information can be found in thermoarena.com/products

PRODUCT RAW MATERIAL MAIN COMPOSITION

	Amount, mass- % and material origin				
Raw material category	Thermally modified pine and spruce	Thermally modified radiata pine	Thermally modified ayous	Planing	Fire retardant treatment
Metals	-	-	-	-	-
Minerals	-	-	-	-	-
Fossil materials	-	-	-	-	-
Bio-based materials	100%, Finland	100%, New Zealand	100%, Africa	-	100%, Europe

Biogenic carbon content	kg C per declared unit
Biogenic carbon content in product	Thermally modified pine/spruce – 205.34 kg Thermally modified radiata pine – 238.10 kg Thermally modified ayous – 178.94 kg Services - N/A
Biogenic carbon content in packaging	The share of biogenic containig materials is less than 5% of the total mass of the packaging. Biogenic carbon in packaging has not been declared.
Note. 1 kg biogenic carbon is equivalent to 44/12 kg of biogenic CO2 and has been calculated based on EN 16449.	

SUBSTANCES, REACH - VERY HIGH CONCERN

The product does not contain any REACH SVHC substances in amounts greater than 0,1 % (1000 ppm).



ABOUT THE MANUFACTURER

Thermoarena is a fast growing and evolving company that is constantly looking for new ways to improve its products and introduce new technologies.

We produce over 28,000 m³ of thermally modified wood per year and over 90% of our production we export to more than 30 countries all over the world.



Thermally modified pine

Thermally modified and planed pine

Thermally modified and planed pine with fire retardant treatment

(Other products included on the EPD are of similar appearance)

PRODUCT LIFE-CYCLE AND LIFE-CYCLE ASSESSMENT

Period for data	2021
Declared unit	1 m3
Mass per declared unit	Thermally modified pine/spruce - 431 kg Thermally modified radiata pine - 500 kg Thermally modified ayous - 376 kg Services - N/A

The study does not exclude any modules or processes which are stated mandatory in the EN 15804:2012+A2:2019 and the applied PCR. The study does not exclude any hazardous materials or substances.

The study includes all major raw material and energy consumption. All inputs and outputs of the unit processes, for which data is available for, are included in the calculation. There is no neglected unit process more than 1% of total mass or energy flows. The module specific total neglected input and output flows also do not exceed 5% of energy usage or mass.

The data sources for the study Ecoinvent 3.8 (2021) with the Allocation, cut-off, EN15804 system model and specific EPDs. The LCA tools used to perform the study are One Click LCA and Open LCA.

SYSTEM BOUNDARY

The scope of the EPD is cradle to gate with options (A1-A4), modules C1–C4 and module D for the Products. The Services only include modules A1-A3 as later modules are not applicable.

	Product stage			Assembly stage		Use stage							End of life stage				Beyond the system boundaries		
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
Products	x	x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	x	x	x	x	x	x	x
Services	x	x	x	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR
	Raw materials	Transport	Manufacturing	Transport	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/ demolition	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling

Modules not declared = MND. Modules not relevant = MNR.

MANUFACTURING AND PACKAGING (A1-A3)

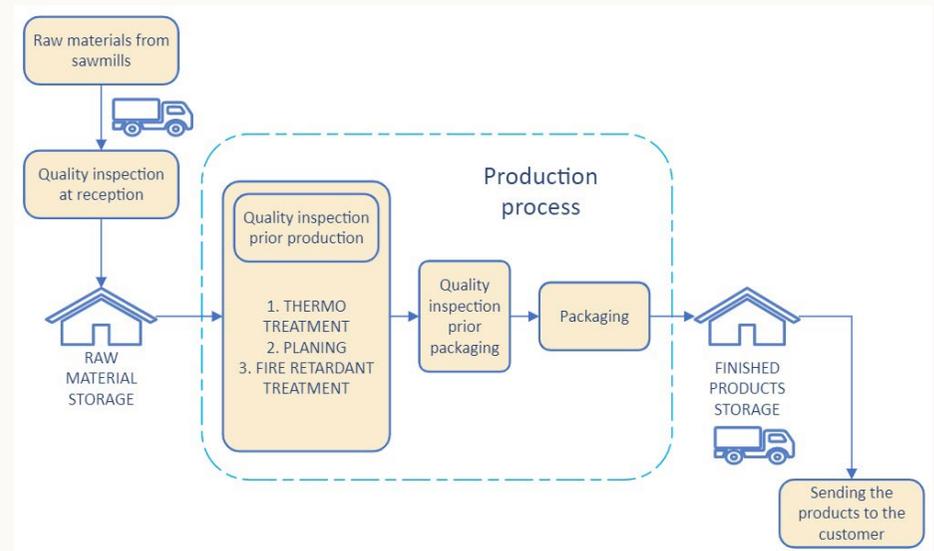
The environmental impacts considered for the product stage cover the manufacturing of raw materials used in the production as well as packaging materials and other ancillary materials. Also, fuels used by machines, and handling of waste formed in the production processes at the manufacturing facilities are included in this stage. The study also considers the material losses occurring during the manufacturing processes as well as losses during electricity transmission. Co-products allocation has been done on economical basis.

Vehicle capacity utilization volume factor is assumed to be 1, which means full load. Empty returns are not taken into account as it is assumed that return trip is used by transportation company to serve the needs of other clients. Pine and spruce is sourced from Finland (600 km by rail and lorry). Radiata pine is sourced from New Zealand (30,000 km by sea). Ayous is sourced from West Africa (9,000 km by sea). The listed values are supplemented with forest to harbour and harbour to manufacturing plant distances (100-250 km depending on wood species).

The thermal modification kilns are powered with shale oil, which is produced in Estonia. The electricity used in the plant is grid electricity and has been modelled based on Estonian residual mix for 2020-2021. Shale oil and electricity was allocated based on the energy consumption of the processes included in the manufacturing stage. Some of the wood waste generated in the manufacturing process is burned in the plant to generate heat in the winter months. FSC-certified wood emissions were included under GWP-biogenic, non-certified wood emissions were included under GWP-luluc.

The Products are packaged using plastic film and wood.

Scenario parameter	Value
Electricity data source and quality	Modelled electricity based on Estonian residual mix for 2020-2021
Electricity CO _{2e} / kWh	0.6



TRANSPORT AND INSTALLATION (A4-A5)

Transportation impacts occurred from final products delivery to construction site (A4) cover fuel direct exhaust emissions, environmental impacts of fuel production, as well as related infrastructure emissions.

The transportation distance is defined according to RTS PCR. The typical installation place was assumed as an weighted average. According to the manufacturer, transportation doesn't cause losses as products are packaged properly. The final product is transported

925 km by lorry, 1000 km by train and 450 km by sea. Vehicle capacity utilization volume factor is assumed to be 1.

Scenario parameter	Value
Specific transport CO ₂ e emissions, kg CO ₂ e / tkm	0.069 kg CO ₂ /tkm
Average transport distance, km	925 km by lorry, 1025 km by train and 25 km by sea
Capacity utilization (including empty return) %	100
Volume capacity utilization factor	=1
Bulk density of transported products (including packaging), kg/m ³ : Thermally modified pine/spruce - 432 kg Thermally modified radiata pine - 501 kg Thermally modified ayous - 377 kg Services - N/A	

Environmental impacts from installation into the building (A5) have not been included.

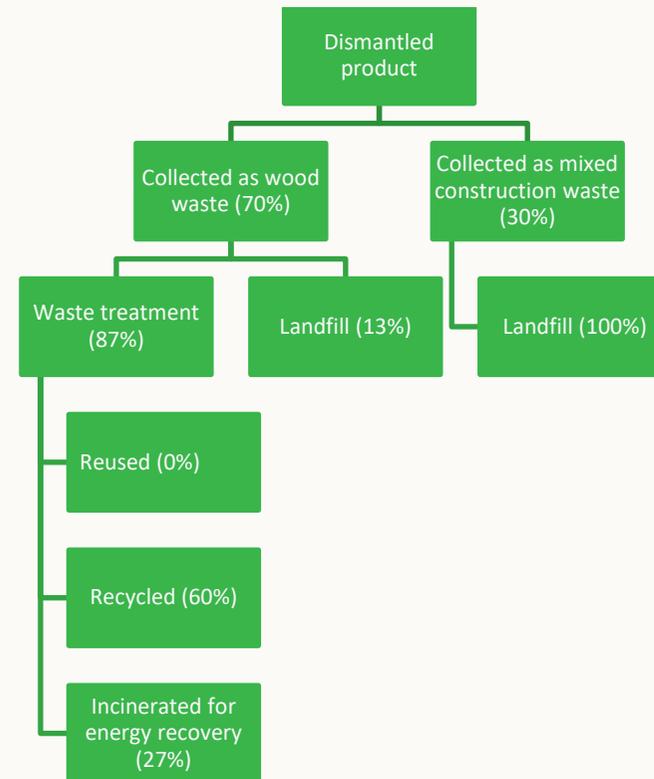
PRODUCT USE AND MAINTENANCE (B1-B7)

This EPD does not cover the use phase.

Air, soil, and water impacts during the use phase have not been studied.

PRODUCT END OF LIFE (C1-C4, D)

EOL scenarios have been based on EU waste management data from 2017-2021 and are representative of Europe.



It is assumed that 70% of the Products is collected as sorted wood waste and the rest as general construction and demolition waste (C1). Demolition is not assumed to require any energy or resources.

Sorted wood waste is sent to waste treatment facilities and mixed waste is sent to landfill (C2). It is assumed that the dismantled product is transported 250 km by lorry.

87% of the sorted wood waste is then recycled (60%) or incinerated (27%) for energy recovery (C3). The rest (13%) is landfilled (C4). In total, 42% of the dismantled product is recycled, 18.9% is incinerated for energy recovery and 39.1% is landfilled.

Any material that left the product system in C3 has been considered.

The heat and electricity produced as benefit when waste Product is incinerated in module C3 is considered. The efficiency rate for incineration is 73%.

Waste packaging from A5 has not been considered.

Module D includes an additional load for non-certified wood materials as energy recovery for this kind of material cannot be allocated as carbon neutral.

Scenario parameter	Pine and spruce	Radiata pine	Ayous
Collection process – kg collected separately	301.8	350.0	263.0
Collection process – kg collected with mixed waste	129.4	150.0	112.7
Recovery process – kg for re-use	0.0	0.0	0.0
Recovery process – kg for recycling	181.1	210.0	157.8
Recovery process – kg for energy recovery	81.50	94.50	71.02
Disposal (total) – kg for final deposition	168.6	195.5	146.9
Scenario assumptions e.g. transportation	Dismantled product is transported 250 km by lorry		

THERMALLY MODIFIED PINE/SPRUCE

ENVIRONMENTAL IMPACTS – CORE INDICATORS, EN 15804+A2, PEF

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Global warming potential – total	kg CO ₂ e	-4.33E+2	5.89E+1	0.00E+0	1.83E+1	4.68E+2	2.96E+2	-1.02E+2
Global warming potential – fossil	kg CO ₂ e	1.13E+2	5.89E+1	0.00E+0	1.83E+1	9.37E+0	1.85E+0	-1.58E+2
Global warming potential – biogenic	kg CO ₂ e	-5.46E+2	0.00E+0	0.00E+0	0.00E+0	3.33E+2	2.14E+2	0.00E+0
Global warming potential – LULUC	kg CO ₂ e	4.76E-1	4.81E-2	0.00E+0	7.01E-3	1.26E+2	8.07E+1	5.63E+1
Ozone depletion pot.	kg CFC-11e	1.32E-5	1.06E-5	0.00E+0	4.10E-6	1.28E-6	5.40E-7	-8.68E-6
Acidification potential	mol H ⁺ e	6.69E-1	3.95E-1	0.00E+0	7.22E-2	6.01E-2	1.53E-2	-1.33E-1
Eutrophication potential - freshwater	kg Pe	7.24E-3	7.39E-4	0.00E+0	1.29E-4	2.34E-4	3.54E-5	-9.98E-4
Eutrophication potential - marine	kg Ne	2.40E-1	1.33E-1	0.00E+0	2.16E-2	2.14E-2	1.01E-2	-5.57E-2
Eutrophication potential - terrestrial	mol Ne	2.35E+0	1.51E+0	0.00E+0	2.37E-1	2.31E-1	5.73E-2	-6.32E-1
Photochemical ozone formation (“smog”)	kg NMVOCe	7.08E-1	4.31E-1	0.00E+0	7.33E-2	6.34E-2	2.02E-2	-1.91E-1
Abiotic depletion potential - minerals & metals	kg Sbe	2.38E-4	1.83E-4	0.00E+0	6.36E-5	2.88E-5	6.07E-6	-2.08E-4
Abiotic depletion potential - fossil resources	MJ	1.91E+3	8.46E+2	0.00E+0	2.66E+2	1.27E+2	4.22E+1	-2.82E+3
Water use	m ³ e depr.	3.38E+1	6.15E+0	0.00E+0	1.19E+0	6.73E+0	2.53E-1	-2.51E+1

USE OF NATURAL RESOURCES

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Renew. PER as energy	MJ	8.12E+03	2.15E+01	0.00E+00	3.77E+00	-1.63E+03	-2.36E+03	-3.44E+03
Renew. PER as material	MJ	6.93E+03	0.00E+00	0.00E+00	0.00E+00	-4.22E+03	-2.71E+03	0.00E+00
Total use of renew. PER	MJ	1.51E+04	2.15E+01	0.00E+00	3.77E+00	-5.86E+03	-5.07E+03	-3.44E+03
Non-re. PER as energy	MJ	1.42E+03	8.46E+02	0.00E+00	2.66E+02	1.27E+02	4.22E+01	-2.82E+03
Non-re. PER as material	MJ	5.59E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-re. PER	MJ	1.97E+03	8.46E+02	0.00E+00	2.66E+02	1.27E+02	4.22E+01	-2.82E+03
Secondary materials	kg	7.18E-01	5.57E-01	0.00E+00	8.95E-02	8.68E-02	1.48E-02	1.81E+02
Renew. secondary fuels	MJ	5.02E-02	2.88E-03	0.00E+00	9.81E-04	8.39E-04	5.73E-04	-4.73E+00
Non-ren. secondary fuels	MJ	8.23E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water	m ³	-6.77E-01	1.57E-01	0.00E+00	3.34E-02	8.24E-03	4.38E-02	-5.98E-01

PER = Primary energy resources

END OF LIFE – WASTE

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste	kg	2.02E+01	1.95E+00	0.00E+00	3.02E-01	4.17E-01	0.00E+00	-8.56E-01
Non-hazardous waste	kg	1.36E+02	3.05E+01	0.00E+00	5.28E+00	9.04E+01	1.69E+02	-1.96E+01
Radioactive waste	kg	6.63E-03	5.72E-03	0.00E+00	1.83E-03	6.70E-04	0.00E+00	-1.33E-04

END OF LIFE – OUTPUT FLOWS

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Components for re-use	kg	0.00E+00						
Materials for recycling	kg	7.20E-02	0.00E+00	0.00E+00	0.00E+00	1.81E+02	0.00E+00	0.00E+00
Materials for energy rec	kg	1.11E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.62E+03	0.00E+00	0.00E+00

ENVIRONMENTAL IMPACTS – EN 15804+A1, CML / ISO 21930

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Global Warming Potential	kg CO ₂ e	1.11E+02	5.85E+01	0.00E+00	1.72E+01	9.37E+00	1.26E+01	-1.56E+02
Ozone depletion Potential	kg CFC-11e	1.04E-05	8.27E-06	0.00E+00	3.23E-06	1.02E-06	4.22E-07	-7.82E-06
Acidification	kg SO ₂ e	5.13E-01	2.98E-01	0.00E+00	5.61E-02	4.60E-02	1.16E-02	-9.35E-02
Eutrophication	kg PO ₄ ³ e	2.05E-01	7.20E-02	0.00E+00	1.29E-02	2.24E-02	4.89E-01	-4.31E-02
POCP ("smog")	kg C ₂ H ₄ e	3.53E-02	1.05E-02	0.00E+00	2.26E-03	1.69E-03	2.87E-03	-2.04E-02
ADP-elements	kg Sbe	2.43E-04	1.83E-04	0.00E+00	6.25E-05	2.84E-05	5.90E-06	-2.02E-04
ADP-fossil	MJ	1.97E+03	8.46E+02	0.00E+00	2.66E+02	1.27E+02	4.22E+01	-2.82E+03

KEY INFORMATION PER KG

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP – total	kg CO ₂ e	-1.00E+00	1.37E-01	0.00E+00	4.25E-02	1.09E+00	6.87E-01	-2.37E-01
GWP – fossil	kg CO ₂ e	2.62E-01	1.36E-01	0.00E+00	4.25E-02	2.17E-02	4.30E-03	-3.67E-01
GWP – biogenic	kg CO ₂ e	-1.27E+00	0.00E+00	0.00E+00	0.00E+00	7.72E-01	4.95E-01	0.00E+00
ADP-minerals & metals	kg Sbe	5.52E-07	4.24E-07	0.00E+00	1.48E-07	6.67E-08	1.41E-08	-4.82E-07
ADP-fossil	MJ	4.44E+00	1.96E+00	0.00E+00	6.18E-01	2.93E-01	9.78E-02	-6.55E+00
Water use	m ³ e depr.	7.83E-02	1.43E-02	0.00E+00	2.75E-03	1.56E-02	5.87E-04	-5.83E-02
Secondary materials	kg	1.66E-03	1.29E-03	0.00E+00	2.08E-04	2.01E-04	3.44E-05	4.20E-01
Biog. C in product (A3)	kg C	4.76E-01	N/A	N/A	N/A	N/A	N/A	N/A
Biog. C in packaging (A3)	kg C	ND	N/A	N/A	N/A	N/A	N/A	N/A

THERMALLY MODIFIED RADIATA PINE

ENVIRONMENTAL IMPACTS – CORE INDICATORS, EN 15804+A2, PEF

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Global warming potential – total	kg CO ₂ e	-6.13E+02	6.82E+01	0.00E+00	2.13E+01	5.43E+02	3.44E+02	-1.68E+02
Global warming potential – fossil	kg CO ₂ e	2.60E+02	6.82E+01	0.00E+00	2.13E+01	1.09E+01	2.15E+00	-1.68E+02
Global warming potential – biogenic	kg CO ₂ e	-8.73E+02	0.00E+00	0.00E+00	0.00E+00	5.32E+02	3.41E+02	0.00E+00
Global warming potential – LULUC	kg CO ₂ e	5.91E-01	5.57E-02	0.00E+00	8.13E-03	4.88E-02	2.15E-03	9.29E-03
Ozone depletion pot.	kg CFC-11e	4.22E-05	1.23E-05	0.00E+00	4.75E-06	1.49E-06	6.26E-07	-9.04E-06
Acidification potential	mol H ⁺ e	5.75E+00	4.57E-01	0.00E+00	8.38E-02	6.97E-02	1.78E-02	-1.23E-01
Eutrophication potential - freshwater	kg Pe	7.69E-03	8.57E-04	0.00E+00	1.50E-04	2.72E-04	4.11E-05	-7.64E-04
Eutrophication potential - marine	kg Ne	1.45E+00	1.55E-01	0.00E+00	2.50E-02	2.48E-02	1.17E-02	-5.36E-02
Eutrophication potential - terrestrial	mol Ne	1.59E+01	1.75E+00	0.00E+00	2.75E-01	2.67E-01	6.65E-02	-6.05E-01
Photochemical ozone formation (“smog”)	kg NMVOCe	4.27E+00	5.00E-01	0.00E+00	8.50E-02	7.35E-02	2.35E-02	-1.82E-01
Abiotic depletion potential - minerals & metals	kg Sbe	4.27E-04	2.12E-04	0.00E+00	7.38E-05	3.34E-05	7.04E-06	-2.02E-04
Abiotic depletion potential - fossil resources	MJ	3.79E+03	9.80E+02	0.00E+00	3.09E+02	1.47E+02	4.89E+01	-2.98E+03
Water use	m ³ e depr.	3.85E+01	7.12E+00	0.00E+00	1.38E+00	7.80E+00	2.93E-01	-2.30E+01

USE OF NATURAL RESOURCES

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Renew. PER as energy	MJ	8.79E+03	2.49E+01	0.00E+00	4.38E+00	-2.01E+03	-2.74E+03	-3.40E+03
Renew. PER as material	MJ	7.43E+03	0.00E+00	0.00E+00	0.00E+00	-4.52E+03	-2.90E+03	0.00E+00
Total use of renew. PER	MJ	1.62E+04	2.49E+01	0.00E+00	4.38E+00	-6.53E+03	-5.64E+03	-3.40E+03
Non-re. PER as energy	MJ	3.24E+03	9.80E+02	0.00E+00	3.09E+02	1.47E+02	4.89E+01	-2.98E+03
Non-re. PER as material	MJ	5.45E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-re. PER	MJ	3.79E+03	9.80E+02	0.00E+00	3.09E+02	1.47E+02	4.89E+01	-2.98E+03
Secondary materials	kg	1.54E+00	6.45E-01	0.00E+00	1.04E-01	1.01E-01	1.72E-02	2.10E+02
Renew. secondary fuels	MJ	4.52E-02	3.34E-03	0.00E+00	1.14E-03	9.73E-04	6.65E-04	-3.78E+00
Non-ren. secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water	m ³	-5.95E-01	1.82E-01	0.00E+00	3.88E-02	9.56E-03	5.08E-02	-5.48E-01

PER = Primary energy resources

END OF LIFE – WASTE

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste	kg	2.29E+01	2.26E+00	0.00E+00	3.50E-01	4.83E-01	0.00E+00	-8.01E-01
Non-hazardous waste	kg	1.60E+02	3.53E+01	0.00E+00	6.13E+00	1.05E+02	1.96E+02	-1.44E+01
Radioactive waste	kg	1.97E-02	6.62E-03	0.00E+00	2.13E-03	7.77E-04	0.00E+00	8.80E-05

END OF LIFE – OUTPUT FLOWS

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Components for re-use	kg	0.00E+00						
Materials for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.10E+02	0.00E+00	0.00E+00
Materials for energy rec	kg	0.00E+00						
Exported energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.81E+03	0.00E+00	0.00E+00

ENVIRONMENTAL IMPACTS – EN 15804+A1, CML / ISO 21930

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Global Warming Potential	kg CO ₂ e	2.53E+02	6.77E+01	0.00E+00	2.00E+01	1.09E+01	1.47E+01	-1.65E+02
Ozone depletion Potential	kg CFC-11e	3.34E-05	9.58E-06	0.00E+00	3.75E-06	1.18E-06	4.89E-07	-8.15E-06
Acidification	kg SO ₂ e	4.45E+00	3.45E-01	0.00E+00	6.50E-02	5.33E-02	1.35E-02	-8.55E-02
Eutrophication	kg PO ₄ ³ e	6.39E-01	8.34E-02	0.00E+00	1.50E-02	2.59E-02	5.67E-01	-3.70E-02
POCP (“smog”)	kg C ₂ H ₄ e	1.38E-01	1.21E-02	0.00E+00	2.63E-03	1.96E-03	3.32E-03	-1.94E-02
ADP-elements	kg Sbe	4.24E-04	2.12E-04	0.00E+00	7.25E-05	3.29E-05	6.84E-06	-1.97E-04
ADP-fossil	MJ	3.79E+03	9.80E+02	0.00E+00	3.09E+02	1.47E+02	4.89E+01	-2.98E+03

KEY INFORMATION PER KG OF PRODUCT

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP – total	kg CO ₂ e	-1.23E+00	1.36E-01	0.00E+00	4.25E-02	1.09E+00	6.87E-01	-3.35E-01
GWP – fossil	kg CO ₂ e	5.19E-01	1.36E-01	0.00E+00	4.25E-02	2.17E-02	4.30E-03	-3.35E-01
GWP – biogenic	kg CO ₂ e	-1.75E+00	0.00E+00	0.00E+00	0.00E+00	1.06E+00	6.83E-01	0.00E+00
ADP-minerals & metals	kg Sbe	8.53E-07	4.24E-07	0.00E+00	1.48E-07	6.67E-08	1.41E-08	-4.03E-07
ADP-fossil	MJ	7.58E+00	1.96E+00	0.00E+00	6.18E-01	2.93E-01	9.78E-02	-5.96E+00
Water use	m ³ e depr.	7.71E-02	1.42E-02	0.00E+00	2.75E-03	1.56E-02	5.87E-04	-4.61E-02
Secondary materials	kg	3.09E-03	1.29E-03	0.00E+00	2.08E-04	2.01E-04	3.44E-05	4.20E-01
Biog. C in product (A3)	kg C	4.76E-01	N/A	N/A	N/A	N/A	N/A	N/A
Biog. C in packaging (A3)	kg C	ND	N/A	N/A	N/A	N/A	N/A	N/A

THERMALLY MODIFIED AYOUS

ENVIRONMENTAL IMPACTS – CORE INDICATORS, EN 15804+A2, PEF

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Global warming potential – total	kg CO ₂ e	-1.94E+01	5.14E+01	0.00E+00	1.60E+01	4.08E+02	2.58E+02	-1.42E+01
Global warming potential – fossil	kg CO ₂ e	1.79E+02	5.13E+01	0.00E+00	1.60E+01	8.17E+00	1.62E+00	-1.39E+02
Global warming potential – biogenic	kg CO ₂ e	-1.99E+02	0.00E+00	0.00E+00	0.00E+00	1.20E+02	7.70E+01	0.00E+00
Global warming potential – LULUC	kg CO ₂ e	2.83E-01	4.20E-02	0.00E+00	6.11E-03	2.80E+02	1.80E+02	1.25E+02
Ozone depletion pot.	kg CFC-11e	3.00E-05	9.27E-06	0.00E+00	3.57E-06	1.12E-06	4.70E-07	-7.56E-06
Acidification potential	mol H ⁺ e	2.27E+00	3.44E-01	0.00E+00	6.29E-02	5.24E-02	1.34E-02	-1.02E-01
Eutrophication potential - freshwater	kg Pe	5.23E-03	6.45E-04	0.00E+00	1.13E-04	2.04E-04	3.09E-05	-5.88E-04
Eutrophication potential - marine	kg Ne	7.14E-01	1.16E-01	0.00E+00	1.88E-02	1.86E-02	8.82E-03	-4.46E-02
Eutrophication potential - terrestrial	mol Ne	7.56E+00	1.32E+00	0.00E+00	2.07E-01	2.01E-01	5.00E-02	-5.03E-01
Photochemical ozone formation (“smog”)	kg NMVOCe	2.14E+00	3.76E-01	0.00E+00	6.39E-02	5.52E-02	1.76E-02	-1.51E-01
Abiotic depletion potential - minerals & metals	kg Sbe	2.56E-04	1.60E-04	0.00E+00	5.54E-05	2.51E-05	5.29E-06	-1.65E-04
Abiotic depletion potential - fossil resources	MJ	2.84E+03	7.38E+02	0.00E+00	2.32E+02	1.10E+02	3.67E+01	-2.47E+03
Water use	m ³ e depr.	3.25E+01	5.36E+00	0.00E+00	1.03E+00	5.86E+00	2.20E-01	-1.83E+01

USE OF NATURAL RESOURCES

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Renew. PER as energy	MJ	4.18E+04	1.87E+01	0.00E+00	3.29E+00	-1.40E+03	-2.06E+03	-2.55E+03
Renew. PER as material	MJ	6.15E+03	0.00E+00	0.00E+00	0.00E+00	-3.75E+03	-2.41E+03	0.00E+00
Total use of renew. PER	MJ	4.80E+04	1.87E+01	0.00E+00	3.29E+00	-5.15E+03	-4.46E+03	-2.55E+03
Non-re. PER as energy	MJ	2.28E+03	7.38E+02	0.00E+00	2.32E+02	1.10E+02	3.67E+01	-2.47E+03
Non-re. PER as material	MJ	5.64E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-re. PER	MJ	2.84E+03	7.38E+02	0.00E+00	2.32E+02	1.10E+02	3.67E+01	-2.47E+03
Secondary materials	kg	7.74E-01	4.85E-01	0.00E+00	7.80E-02	7.57E-02	1.29E-02	1.58E+02
Renew. secondary fuels	MJ	4.70E-02	2.51E-03	0.00E+00	8.55E-04	7.31E-04	5.00E-04	-2.84E+00
Non-ren. secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water	m ³	-7.08E-01	1.37E-01	0.00E+00	2.91E-02	7.18E-03	3.82E-02	-4.36E-01

PER = Primary energy resources

END OF LIFE – WASTE

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste	kg	1.95E+01	1.70E+00	0.00E+00	2.63E-01	3.63E-01	0.00E+00	-6.83E-01
Non-hazardous waste	kg	1.16E+02	2.66E+01	0.00E+00	4.60E+00	7.88E+01	1.47E+02	-1.14E+01
Radioactive waste	kg	1.39E-02	4.99E-03	0.00E+00	1.60E-03	5.84E-04	0.00E+00	5.19E-05

END OF LIFE – OUTPUT FLOWS

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Components for re-use	kg	0.00E+00						
Materials for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E+02	0.00E+00	0.00E+00
Materials for energy rec	kg	0.00E+00						
Exported energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.33E+03	0.00E+00	0.00E+00

ENVIRONMENTAL IMPACTS – EN 15804+A1, CML / ISO 21930

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
Global Warming Potential	kg CO ₂ e	2.25E+02	5.10E+01	0.00E+00	1.50E+01	8.17E+00	1.10E+01	-1.37E+02
Ozone depletion Potential	kg CFC-11e	2.33E-05	7.21E-06	0.00E+00	2.82E-06	8.86E-07	3.67E-07	-6.81E-06
Acidification	kg SO ₂ e	1.72E+00	2.60E-01	0.00E+00	4.89E-02	4.01E-02	1.01E-02	-7.15E-02
Eutrophication	kg PO ₄ ³ e	3.49E-01	6.28E-02	0.00E+00	1.13E-02	1.95E-02	4.26E-01	-2.98E-02
POCP (“smog”)	kg C ₂ H ₄ e	7.34E-02	9.13E-03	0.00E+00	1.97E-03	1.47E-03	2.50E-03	-1.56E-02
ADP-elements	kg Sbe	2.54E-04	1.60E-04	0.00E+00	5.45E-05	2.47E-05	5.14E-06	-1.61E-04
ADP-fossil	MJ	2.84E+03	7.38E+02	0.00E+00	2.32E+02	1.10E+02	3.67E+01	-2.47E+03

KEY INFORMATION PER KG OF PRODUCT

Impact category	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP – total	kg CO ₂ e	-5.15E-02	1.37E-01	0.00E+00	4.25E-02	1.09E+00	6.87E-01	-3.78E-02
GWP – fossil	kg CO ₂ e	4.77E-01	1.37E-01	0.00E+00	4.25E-02	2.17E-02	4.30E-03	-3.71E-01
GWP – biogenic	kg CO ₂ e	-5.29E-01	0.00E+00	0.00E+00	0.00E+00	3.19E-01	2.05E-01	0.00E+00
ADP-minerals & metals	kg Sbe	6.81E-07	4.25E-07	0.00E+00	1.48E-07	6.67E-08	1.41E-08	-4.40E-07
ADP-fossil	MJ	7.56E+00	1.96E+00	0.00E+00	6.18E-01	2.93E-01	9.78E-02	-6.58E+00
Water use	m ³ e depr.	8.66E-02	1.43E-02	0.00E+00	2.75E-03	1.56E-02	5.87E-04	-4.88E-02
Secondary materials	kg	2.06E-03	1.29E-03	0.00E+00	2.08E-04	2.01E-04	3.44E-05	4.20E-01
Biog. C in product (A3)	kg C	4.76E-01	N/A	N/A	N/A	N/A	N/A	N/A
Biog. C in packaging (A3)	kg C	ND	N/A	N/A	N/A	N/A	N/A	N/A

PLANING AND FIRE RETARDANT TREATMENT SERVICES

ENVIRONMENTAL IMPACTS – CORE INDICATORS, EN 15804+A2, PEF

Service		Planing	Fire retardant treatment
Impact category	Unit	A1-A3	A1-A3
Global warming potential – total	kg CO ₂ e	1.10E+01	9.61E+01
Global warming potential – fossil	kg CO ₂ e	1.10E+01	9.60E+01
Global warming potential – biogenic	kg CO ₂ e	0.00E+00	0.00E+00
Global warming potential – LULUC	kg CO ₂ e	7.89E-03	8.27E-02
Ozone depletion pot.	kg CFC-11e	3.73E-07	7.70E-06
Acidification potential	mol H ⁺ e	6.82E-02	4.57E-01
Eutrophication potential - freshwater	kg Pe	4.29E-04	8.31E-03
Eutrophication potential - marine	kg Ne	9.46E-03	1.54E-01
Eutrophication potential - terrestrial	mol Ne	1.02E-01	7.99E-01
Photochemical ozone formation (“smog”)	kg NMVOCe	2.86E-02	2.14E-01
Abiotic depletion potential - minerals & metals	kg Sbe	2.26E-05	3.43E-04
Abiotic depletion potential - fossil resources	MJ	1.98E+02	2.62E+03
Water use	m ³ e depr.	1.74E+00	9.31E+01

USE OF NATURAL RESOURCES

Service		Planing	Fire retardant treatment
Impact category	Unit	A1-A3	A1-A3
Renew. PER as energy	MJ	5.04E+00	4.28E+01
Renew. PER as material	MJ	0.00E+00	0.00E+00
Total use of renew. PER	MJ	5.04E+00	4.28E+01
Non-re. PER as energy	MJ	1.98E+02	9.18E+02
Non-re. PER as material	MJ	0.00E+00	1.63E+03
Total use of non-re. PER	MJ	1.98E+02	2.55E+03
Secondary materials	kg	1.16E-02	2.73E-01
Renew. secondary fuels	MJ	1.04E-04	2.06E-03
Non-ren. secondary fuels	MJ	0.00E+00	0.00E+00
Use of net fresh water	m ³	3.88E-02	3.93E+01

PER = Primary energy resources

END OF LIFE – WASTE

Service		Planing	Fire retardant treatment
Impact category	Unit	A1-A3	A1-A3
Hazardous waste	kg	0.00E+00	4.82E+01
Non-hazardous waste	kg	0.00E+00	1.71E+02
Radioactive waste	kg	0.00E+00	4.64E-03

END OF LIFE – OUTPUT FLOWS

Service		Planing	Fire retardant treatment
Impact category	Unit	A1-A3	A1-A3
Components for re-use	kg	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00
Materials for energy rec	kg	0.00E+00	0.00E+00
Exported energy	MJ	0.00E+00	0.00E+00

ENVIRONMENTAL IMPACTS – EN 15804+A1, CML / ISO 21930

Service		Planing	Fire retardant treatment
Impact category	Unit	A1-A3	A1-A3
Global Warming Potential	kg CO ₂ e	1.09E+01	8.35E+01
Ozone depletion Potential	kg CFC ₁₁ e	3.26E-07	6.59E-06
Acidification	kg SO ₂ e	5.61E-02	3.75E-01
Eutrophication	kg PO ₄ ³ e	1.81E-02	2.21E-01
POCP ("smog")	kg C ₂ H ₄ e	2.28E-03	2.09E-02
ADP-elements	kg Sbe	2.24E-05	3.09E-04
ADP-fossil	MJ	1.98E+02	2.62E+03

KEY INFORMATION PER KG OF PRODUCT

Service		Planing	Planing	Planing	Fire retardant treatment	Fire retardant treatment	Fire retardant treatment
Wood species		Pine/spruce	Radiata pine	Ayous	Pine/spruce	Radiata pine	Ayous
Mass of final product (kg/m3)		431	500	376	431	500	376
Impact category	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
GWP – total	kg CO ₂ e	2.54E-02	2.19E-02	2.92E-02	5.26E-04	4.53E-04	6.03E-04
GWP – fossil	kg CO ₂ e	2.54E-02	2.19E-02	2.91E-02	5.25E-04	4.53E-04	6.03E-04
GWP – biogenic	kg CO ₂ e	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ADP-minerals & metals	kg Sbe	5.25E-08	4.53E-08	6.02E-08	1.88E-09	1.62E-09	2.15E-09
ADP-fossil	MJ	4.60E-01	3.96E-01	5.27E-01	1.43E-02	1.24E-02	1.64E-02
Water use	m ³ e depr.	4.04E-03	3.48E-03	4.64E-03	5.09E-04	4.39E-04	5.84E-04
Secondary materials	kg	2.69E-05	2.32E-05	3.09E-05	1.49E-06	1.29E-06	1.71E-06
Biog. C in product	kg C	N/A	N/A	N/A	N/A	N/A	N/A
Biog. C in packaging	kg C	N/A	N/A	N/A	N/A	N/A	N/A

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ANNEX – CALCULATION OF PLANED AND FIRE RETARDANT TREATED TIMBER PRODUCTS

The results tables include results for thermally modified pine/spruce, thermally modified radiata pine and thermally modified ayous. In addition, the results include planing and fire retardant treatments as processes. It is possible to obtain the results for Thermoarena’s planed thermally modified timber and fire retardant treated timber by adding all involved products and services.

To obtain the aggregated impacts for modules A1-A3, the results of thermally modified pine/spruce or radiata pine or ayous shall be multiplied by 1.139 to include wood shavings, sawdust, etc generated during the planing process. They are either incinerated in the plant or sold as co-products. The allocation used is economic, so some of the impacts of the co-products have been allocated to the main product (based on prices and revenue generated).

Thereafter, planing or planing and fire retardant treatment services are added. A4 and EOL impacts are the same as the A4 and EOL impacts of thermally modified timber of the same species. Burnblock does not contain any hazardous materials. Wood treated with Burnblock is in that sense similar to untreated wood and can be disposed of as regular wood waste.

The calculation formulas are as follows:

	A1-A3	A4 and EOL
Planed thermally modified timber	Thermally modified timber x 1.139 + Planing	Thermally modified timber x 1
Fire retardant treated and planed thermally modified timber	Thermally modified timber x 1.139 + Planing + Fire retardant treatment	Thermally modified timber x 1

The only exceptions are GWP-biogenic, GWP-luluc, PER as material and total use of PER impact categories. GWP-biogenic and PER as materials shall not be multiplied by 1.139 in A1-A3 as the indicators are dependant on the mass of the material remaining in the product. GWP-luluc values are dependant on the share of FSC-certified material used in the product. Therefore, the GWP-luluc category shall include additional emissions of 28.71 kg CO2e for timber and spruce, 0 kg for radiata pine and 63.84 kg CO2e for ayous.

For ease of use, all GWP-values have been included in the following table for all possible variations.

	EN 15804+A2				EN 15804+A1
	GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	Global warming
	kg CO2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e
Thermally modified pine/spruce	-433.04	112.87	-546.39	0.48	110.54
Thermally modified radiata pine	-612.71	259.71	-873.02	0.59	253.12
Thermally modified ayous	-19.37	179.08	-198.73	0.28	225.42
Planed thermally modified pine/spruce	-377.62	139.51	-546.39	29.25	123.64
Planed thermally modified radiata pine	-565.57	306.77	-873.02	0.68	269.07
Planed thermally modified ayous	80.36	214.92	-198.73	64.17	240.82
Fire retardant treated and planed thermally modified pine/spruce	-281.57	235.56	-546.39	29.25	207.16
Fire retardant treated and planed thermally modified radiata pine	-469.52	402.81	-873.02	0.68	352.59
Fire retardant treated and planed thermally modified ayous	176.41	310.97	-198.73	64.17	324.34