



ENVIRONMENTAL PRODUCT DECLARATION

Lunawood Thermowood® of Nordic Pine and Spruce and Radiata Pine

Scope of the declaration

This environmental product declaration refers to the Thermowood® produced by Oy Lunawood Ltd. The declaration has been prepared in accordance with EN 15804 + A1 and ISO 14025 standards and the additional requirements stated in the RTS PCR protocol. This declaration includes the life cycle stages from cradle to gate with options, waste processing (C3), disposal (C4) and recovery (D)



RAKENNUSTIETO

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GENERAL INFORMATION, DECLARATION SCOPE AND VERIFICATION

1. Owner of the declaration, manufacturer

OY LUNAWOOD LTD
Majja Masalin
Aleksanterinkatu 25 A
FI-15140 Lahti
majja.masalin@lunawood.com

2. Product name and number

Lunawood Thermowood of pine and spruce. Building 2000 Product No: 244.

3. Place of production

The average production data of Lunawood Thermowood® are based on inventories from Oy Lunawood Ltd mills in Kaskinen and Iisalmi (Finland).

4. Additional information

info@lunawood.com

5. Product category rules and scope of the declaration


This EPD has been prepared in accordance with EN 15804 + A1 and ISO 14025 standards together with the RTS PCR (Version, 2.6.2016). Product specific category rules have not been applied in this EPD. EPD of construction products may not be comparable if they do not comply with EN 15804 and seen in a building context. Environmental impacts and raw material use for the module A1 are obtained from RTS-EPD RTS_27_19 Finnish sawn dried timber of spruce or pine (dated 25.2.2019).

6. Author of the LCA and declaration

MSc Marja Jallinoja and D. Sc. (Econ) Tarmo Rätty
Natural Resources Institute Finland (Luke), Latokartanonkaari 9, 00790 Helsinki, Finland, www.luke.fi

7. Verification

This EPD has been verified according to the requirements of ISO 14025:2010, EN 15804 + A1 and RTS PCR protocol by a third party. The verification has been carried out by Vahanen Environment Ltd, Eng (UAS) Teija Käpynen.

European standard EN 15804:2012 A1 serves as the core PCR ^a	
Independent verification of the declaration data, according to ISO 14025:2010	
<input type="checkbox"/> Internal	<input checked="" type="checkbox"/> External
(^b)Third party verifier:  Vahanen Environment Oy, B. Eng. Teija Käpynen	
^a Product category rules ^b Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4).	

8. Declaration issue date and validity

This EPD is verified 12.12.2019. EPD is valid 29.11.2019–29.11.2024

PRODUCT INFORMATION

9. Products' descriptions

This EPD represents the production of Lunawood Rough Thermo Timber and Planed Lunawood Thermowood® with Thermo-S or Thermo-D treatment.

	Thermo-S	Thermo-D
Lunawood Rough Thermo Timber	X	X
Lunawood Planed Thermowood®	X	X

The letter 'S' in 'Thermo-S' stands for 'stability'. Along with appearance, stability is a key property in the end use applications of the products in this treatment class. The letter 'D' in 'Thermo-D' stands for 'durability'. Along with appearance, biological durability is a key property in the end use applications of products in this treatment class.

10. Technical specifications & Physical properties

	Moisture	Density at u=5%	Thickness mm	Width mm
Lunawood Rough Thermo Timber	5%	430 kg/m ³	22-50	100-225
Lunawood Planed Thermowood®	5%	390 kg/m ³	14-43	42-142

Treatment classes have no significant impact on dimensions & densities. The quality requirements are described in the product standard.

11. Product standard

ThermoWood® Handbook, International ThermoWood Association. www.thermowood.fi.

12. Raw materials of the product

Product raw-material	Amount, %
Softwoods, Scots Pine* (Pinus sylvestris L.), Radiata Pine (pinus radiata L.) and Norway Spruce* (Picea abies L.)	100
*Also described as Nordic Pine ja Nordic Spruce.	

The choice of softwood has no impacts on results.

13. Substances under European Chemicals Agency's REACH, SVHC restrictions

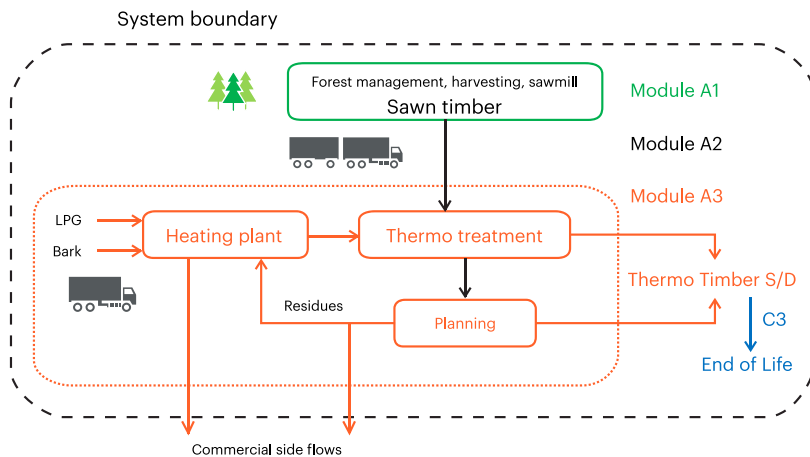
The product does not include substances from ECHA's Candidate List of Substances of Very High Concern.

14. Declared unit

The declared unit is one m³ of Lunawood Thermowood® with 5% moisture content. Results can be converted to linear meters using conversion factors in section 26. The results are presented as production volume weighted averages. Inventoried products from two mills are identical such that the average presents a product on the market.

15. System boundaries

This EPD covers the following modules: A1 (raw material supply), A2 (transport) and A3 (manufacture) as well as C3 (waste processing) and C4 (disposal). In addition, module D – benefits and loads beyond the system boundary – have been included.



16. Cut-off criteria

In modules A1, A2 and A3, all used energy, packing materials and transportation until the end-of-waste state have been included. Module A4 (transportation to the construction site) is not reported as the GWP-value is less than 20% of the aggregated A1-A3 GWP-value. Module C includes assumption that product is used for energy recovery after initial use. In module C3, waste processing is assumed to be chipping, such that energy consumption for chipping is included. Also, carbon release from wood incineration is included in the module C3. Module D considers the benefits of using Thermowood® for energy recovery.

17. Production process

Sawn timber is transported from the manufacturers to Lunawood mills. The Thermowood® Thermo treatment is used. The process can be divided into three main phases, where temperature is first increased and kept at high temperature (130 °C) for drying in the kiln. At the second phase, once high-temperature drying has taken place, the temperature inside the kiln is increased to between 185 °C (Thermo-S) and 215 °C (Thermo-D). When the target level has been reached, the temperature remains constant for 2–3 hours depending on the treated dimensions. Finally, at phase 3, the kiln is cooled and re-moisturising takes place to bring the wood moisture content to a useable level, 4–7%. Rough Thermo Timber is planed onsite. Required heat is produced with liquid petroleum gas (Isalmi) and bark (Kaskinen). Otherwise the production process requires electricity and fuels for the different equipment, as well as hydraulic and lubrication oils. Boards are packed and transported to the customers. Allocation between the main products is based mainly measured energy uses and physical quantities. Side streams; shavings and cut-offs are either sold or used internally for energy. Allocation between main products and side streams is based on their economic value.

SCOPE OF THE LIFE CYCLE ASSESSMENT

All covered modules are marked with X. Also marks ND (module not declared) and NR (module not relevant) are used. This declaration covers “cradle-to-gate with options”. Module A4 remains below the cut off criterion.

Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundary		
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	NR	X	NR
Raw material supply	Transport	Manufacturing	Transport	Construction press	Use	Maintenance	Repair	Replacement	Refurbishment	Energy use	Water use	Demolition	Transport	Waste processing	Disposal	Re-Use	Recovery	Recycling

ENVIRONMENTAL IMPACTS AND RAW MATERIAL USE

18. Environmental impacts (A1-A3)

Table 18.a Thermo-D treated Rough Thermo Timber, environmental impacts per declared unit

Parameter	Unit	A1*-A3	C3	C4	D
Global warming excluding biogenic impacts	kg CO2 eq	298 [-104, 33,0]	1,93	MNR	-829**
Global warming potential Including biogenic impacts	kg CO2 eq	-426 [-104, 33,0]	724	MNR	
Depletion of stratospheric ozone layer	kg CFC 11 eq	4,82E-05 [-1,70E-05, 5,37E-06]	2,13E-07	MNR	
Acidification potential of soil and water	kg SO2 eq	1,24 [0,028, -0,0089]	4,77E-03	MNR	
Eutrophication potential	kg PO4 eq	0,132 [0,102, -0,0323]	2,18E-03	MNR	
Formation of photochemical ozone	kg C2H4 eq	0,0794 [-0,014, 0,0044]	3,06E-04	MNR	
Abiotic depletion potential for non-fossil resources	kg Sb eq	1,70E-04 [1,34E-05, -4,24E-06]	2,52E-06	MNR	
Abiotic depletion potential for fossil resources	MJ	4477 [-1347, 425]	25,5	MNR	

* Environmental impact in module A1 is based on RTS-EPD RTS_27_19 (dated 25.2.2019).
 ** Module D includes the emission of greenhouse gases from avoided combustion of peat.
 Absolute deviations from the mean in the brackets

Table 18.b Thermo-S treated Rough Thermo Timber, environmental impacts per declared unit

Parameter	Unit	A1*-A3	C3	C4	D
Global warming excluding biogenic impacts	kg CO ₂ eq	208 [-17,5, 108]	1,93	MNR	-829**
Global warming potential Including biogenic impacts	kg CO ₂ eq	-516,0** [-17,5, 108]	724	MNR	
Depletion of stratospheric ozone layer	kg CFC 11 eq	3,37E-05 [-2,85E-06, 1,75E-05]	2,13E-07	MNR	
Acidification potential of soil and water	kg SO ₂ eq	1,22 [0,0030, -0,0185]	4,77E-03	MNR	
Eutrophication potential	kg PO ₄ eq	0,200 [0,017, -0,105]	2,18E-03	MNR	
Formation of photochemical ozone	kg C ₂ H ₄ eq	0,0670 [-0,0025, 0,0151]	3,06E-04	MNR	
Abiotic depletion potential for non-fossil resources	kg Sb eq	1,77E-04 [2,22E-06, -1,36E-05]	2,52E-06	MNR	
Abiotic depletion potential for fossil resources	MJ	3321 [-227, 1394]	25,5	MNR	

* Environmental impact in module A1 is based on RTS-EPD RTS_27_19 (dated 25.2.2019).
 ** Module D includes the emission of greenhouse gases from avoided combustion of peat.
 Absolute deviations from the mean in the brackets

Table 18.c Thermo-D treated Planed Thermowood®, environmental impacts per declared unit

Parameter	Unit	A1*-A3	C3	C4	D
Global warming excluding biogenic impacts	kg CO ₂ eq	315 [-84,3, 84,3]	1,75	MNR	-752**
Global warming potential Including biogenic impacts	kg CO ₂ eq	-342 [-84,3, 84,3]	656	MNR	
Depletion of stratospheric ozone layer	kg CFC 11 eq	5,02E-05 [-1,37E-05, 1,37E-05]	1,94E-07	MNR	
Acidification potential of soil and water	kg SO ₂ eq	1,44 [0,0419, -0,0419]	4,32E-03	MNR	
Eutrophication potential	kg PO ₄ eq	0,228 [-0,0104, 0,0104]	1,98E-03	MNR	
Formation of photochemical ozone	kg C ₂ H ₄ eq	0,0831 [-0,0025, 0,0151]	2,77E-04	MNR	
Abiotic depletion potential for non-fossil resources	kg Sb eq	2,18E-04 [2,22E-06, -1,36E-05]	2,29E-06	MNR	
Abiotic depletion potential for fossil resources	MJ	4767 [-1074, 1074]	23,1	MNR	
* Environmental impact in module A1 is based on RTS-EPD RTS_27_19 (dated 25.2.2019). ** Module D includes the emission of greenhouse gases from avoided combustion of peat. Absolute deviations from the mean in the brackets					

Table 18.d Thermo-S treated Planed Thermowood®, environmental impacts per declared unit

Parameter	Unit	A1*-A3	C3	C4	D
Global warming excluding biogenic impacts	kg CO ₂ eq	248 [-21,4, 131]	1,75	MNR	-752**
Global warming potential Including biogenic impacts	kg CO ₂ eq	-409 [-21,4, 131]	656	MNR	
Depletion of stratospheric ozone layer	kg CFC 11 eq	3,96E-05 [-3,48E-06, 2,14E-05]	1,94E-07	MNR	
Acidification potential of soil and water	kg SO ₂ eq	0,00 [0,0090, -0,0550]	4,32E-03	MNR	
Eutrophication potential	kg PO ₄ eq	0,269 [0,0216, -0,1325]	1,98E-03	MNR	
Formation of photochemical ozone	kg C ₂ H ₄ eq	0,0743 [-0,0027, 0,0168]	2,77E-04	MNR	
Abiotic depletion potential for non-fossil resources	kg Sb eq	2,22E-04 [3,28E-06, -2,02E-05]	2,29E-06	MNR	
Abiotic depletion potential for fossil resources	MJ	3960 [-268, 1644]	23,1	MNR	
* Environmental impact in module A1 is based on RTS-EPD RTS_27_19 (dated 25.2.2019). ** Module D includes the emission of greenhouse gases from avoided combustion of peat. Absolute deviations from the mean in the brackets					

19. Use of natural resources

Table 19.a Thermo-D treated Rough Thermo Timber, resource use per declared unit

Parameter	Unit	A1*-A3	C3	C4	D
Renewable primary energy resources used as energy carrier	MJ	30782 [-3355, 1060]	23	MNR	-
Renewable primary energy resources used as raw materials	MJ	8353 0	0	MNR	-
Total use of renewable primary energy resources	MJ	39135 [-3356, 1060]	23	MNR	-
Non-renewable primary energy resources used as energy carriers	MJ	5270 [-1224, 387]	60	MNR	-
Non renewable primary energy resources used as raw materials	MJ	4,61 [0, 0]	0	MNR	-
Total use of non renewable primary energy resources	MJ	5275 [-1224, 387]	60	MNR	-
Use of secondary material	kg	0	0	MNR	-
Use of renewable secondary fuels	MJ	0	0	MNR	-
Use of non renewable secondary fuels	kg	0	0	MNR	-
Net use of fresh water	m ³	2,56 [-0,019, 0,0060]	0	MNR	-
*Resource use in module A1 is based on RTS-EPD RTS_27_19 (dated 25.2.2019). Absolute deviations from the mean in the brackets					

Table 19.b Thermo-S treated Rough Thermo Timber, resource use per declared unit

Parameter	Unit	A1*-A3	C3	C4	D
Renewable primary energy resources used as energy carrier	MJ	27924 [-636, 3904]	23	MNR	-
Renewable primary energy resources used as raw materials	MJ	8354 0	0	MNR	-
Total use of renewable primary energy resources	MJ	36278 [-636, 3907]	23	MNR	-
Non-renewable primary energy resources used as energy carriers	MJ	4177 [-206, 1266]	60	MNR	-
Non renewable primary energy resources used as raw materials	MJ	4,61 [0,0]	0	MNR	-
Total use of non renewable primary energy resources	MJ	4182 [-206, 1266]	60	MNR	-
Use of secondary material	kg	0	0	MNR	-
Use of renewable secondary fuels	MJ	0	0	MNR	-
Use of non renewable secondary fuels	kg	0	0	MNR	-
Net use of fresh water	m ³	2,54 [-0,0035, 0,0215]	0	MNR	-
*Resource use in module A1 is based on RTS-EPD RTS_27_19 (dated 25.2.2019). Absolute deviations from the mean in the brackets					

Table 19.c Thermo-D treated Planed Thermowood®, resource use per declared unit

Parameter	Unit	A1*-A3	C3	C4	D
Renewable primary energy resources used as energy carrier	MJ	31163 [-3097, 978]	23	MNR	-
Renewable primary energy resources used as raw materials	MJ	7604 0	0	MNR	-
Total use of renewable primary energy resources	MJ	38767 [-3097, 978]	23	MNR	-
Non-renewable primary energy resources used as energy carriers	MJ	6565 [-1541, 487]	60	MNR	-
Non-renewable primary energy resources used as raw materials	MJ	4,61 [0, 0]	0	MNR	-
Total use of non-renewable primary energy resources	MJ	6570 [-1541, 487]	60	MNR	-
Use of secondary material	kg	0	0	MNR	-
Use of renewable secondary fuels	MJ	0	0	MNR	-
Use of non-renewable secondary fuels	kg	0	0	MNR	-
Net use of fresh water	m³	2,56 [-0,019, 0,0060]	0	MNR	-
*Resource use in module A1 is based on RTS-EPD RTS_27_19 (dated 25.2.2019). Absolute deviations from the mean in the brackets					

Table 19.d Thermo-S treated Planed Thermowood®, resource use per declared unit

Parameter	Unit	A1*-A3	C3	C4	D
Renewable primary energy resources used as energy carrier	MJ	28483 [-593, 3640]	20,9	MNR	-
Renewable primary energy resources used as raw materials	MJ	7605 0	0,0	MNR	-
Total use of renewable primary energy resources	MJ	36088 [-593, 3643]	20,9	MNR	-
Non-renewable primary energy resources used as energy carriers	MJ	5174 [-245, 1506]	54,5	MNR	-
Non-renewable primary energy resources used as raw materials	MJ	4,61 [0, 0]	00,	MNR	-
Total use of non-renewable primary energy resources	MJ	5179 [-245, 1506]	54,5	MNR	-
Use of secondary material	kg	0	0	MNR	-
Use of renewable secondary fuels	MJ	0	0	MNR	-
Use of non-renewable secondary fuels	kg	0	0	MNR	-
Net use of fresh water	m³	2,54 [-0,0035, 0,0215]	0	MNR	-
*Resource use in module A1 is based on RTS-EPD RTS_27_19 (dated 25.2.2019). Absolute deviations from the mean in the brackets					

20. End of life – Waste

Table 20. Rough Thermo Timber and Planed Thermowood®, waste per declared unit

Parameter	Unit	A1*-A3	C3	C4	D
Hazardous waste disposed	kg	0,117 [0,052, -0,028]	0	MNR	-
Non hazardous waste disposed	kg	11,4 [8,78, -4,80]	0	MNR	-
Radioactive waste disposed	kg	0	0	MNR	-

* Waste production in module A1 is based on RTS-EPD RTS_27_19 (dated 25.2.2019).
Absolute deviations from the mean in the brackets

21. End of life – Output flows

Table 21.a Rough Thermo Timber and Planed Thermowood®, output flows at the End of Life per declared unit

Parameter	Unit	A1*-A3	C3	C4	D
Components for re-use	kg	0	0	MNR	-
Materials for recycling	kg	2,84 [2,50, -1,37]	0	MNR	-
Materials for energy recovery	kg	8,91 [-7,98, 4,37]	430** 390***	MNR	-
Exported energy, thermal	MJ	287 [525, -287]	0	MNR	-
Exported energy, electricity	MJ	6,14E-07	0	MNR	-

* Output flows in module A1 are based on RTS-EPD RTS_27_19 (dated 25.2.2019).
** Rough Thermo Timber
*** Planed Thermowood®
Absolute deviations from the mean in the brackets

SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

22. Energy in the manufacturing phase

Object	Value	Data quality
A3 data quality of electricity and CO ² emissions kg CO ² eq./kWh	208	Based on Finnish fuel mix used for electricity production in years 2014-2018 (5 years average) from Statistics Finland. Imported electricity has been considered. The environmental impacts of fuels are based on Ecoinvent database. The impacts include all upstream processes as well as transmission losses. Environmental impacts of electricity produced from wood and peat are based on typical Finnish CHP-plant.
A3 data quality of heating and CO ² emissions kg CO ² eq./kWh	0,011	Based on Ecoinvent database process, Heat production softwood chips from forest at furnace 5000 kW adjusted to the real fuel and efficiency of the power plant of the mill
	0,309	Based on Ecoinvent database process, Heat production propane at industrial furnace >100kW adjusted to the real efficiency of the power plant of the mill

23. Transportation of products

Object	Value	Data quality
Vehicle type used for transport and CO ² emissions kg CO ² eq./tkm	0,089	Ecoinvent process: Transport, freight, lorry >32 metric ton, EURO4 {RER} market for Cut off
Transport distance, km	452	Average distance in Finland
Dry density of products, kg/m ³	430 390	Un-planed in 5% moisture content Planed in 5% moisture content
Volume capacity utilization factor	1	

24. End-of-life process

100% of the waste is collected separately and recovered as energy.

Processes	Unit (per declared unit)	Amount, kg/kg Data quality
Collection process specified by type	kg collected separately	1
	kg collected with mixed construction waste	-
Recovery system specified by type	kg for re-use	-
	kg for recycling	-
	kg for energy recovery	1

25. Additional information on release of dangerous substances to indoor air, soil and water during the use stage

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

26. Conversion table for the dimensions

Environmental impacts of the declared unit (m³) can be converted to linear meter of a specific product using the following conversion factors.

Planned Lunawood Thermowood® products			
Luna 14 x 140 Panel System Thermo-D Radiata	0,00285	Luna 26 x 118 HLL/L PP and LDR JA SY Thermo-D	0,0040
Luna 15 x 92 STP Thermo-D M	0,0019	Luna 26 x 140 SHP PF2, SHP Sauna and SHP Thermo-D	0,0048
Luna 16 x 92 SHP Thermo-D	0,002	Luna 26 x 142 Deck 78 and UTV 62 Dual Shadow Thermo-D	0,0048
Luna 19 x 117 Panel System, SHP, UTS and UTV Thermo-D	0,0031	Luna 26 x 92 HLL PP and SHP Sauna, Thermo-S	0,0032
Luna 19 x 140 LunaDrop and UTV Thermo-D	0,0038	Luna 26 x 92 LD2 PF2, SHP Sauna and SHP Thermo-D	0,0032
Luna 19 x 140 TGV Thermo-D	0,003749	Luna 32 x 140 Triple Thermo-D	0,0057
Luna 19 x 185 Panel System Thermo-D	0,005	Luna 42 x 140 SHP Thermo-D	0,0075
Luna 19 x 92 SHP Thermo-D	0,0025	Luna 42 x 42 SHP Thermo-D	0,0025
Luna 20 x 140 UYLS Thermo-D M	0,00375	Luna 42 x 68 SHP Thermo-D	0,00375
Luna 20 x 142 UTV HN Thermo-D	0,00375	Luna 42 x 92 SHP Thermo-D	0,005
Luna 21 x 142 UTV 62 Embossed PP and UTV Fine Roughened Thermo-D	0,0037	Luna 43 x 43 L-Lista Thermo-D	0,0025
Luna 26 x 117 LD2 PF2, LD2, LD2PF, SHP PF2 and HLL/LL PP Thermo-D	0,0040		
Lunawood Rough Thermo Timber			
22 X 100	0,0022	25 X 150	0,0038
22 X 125	0,0028	25 X 200	0,0050
22 X 225	0,0050	32 X 100	0,0032
23 X 200	0,0046	32 X 125	0,0040
25 X 100	0,0025	32 X 150	0,0048
25 X 125	0,0031	50 X 100	0,0050

27. Bibliography

Standards:

- ISO 14025:2010 Environmental labels and declarations. Type III environmental declarations. Principles and procedures
- ISO 14040:2006 Environmental management. Life cycle assessment. Principles and frameworks.
- ISO 14044:2006 Environmental management. Life cycle assessment. Requirements and guidelines.
- EN15804:2012+A1 Sustainability of construction works. Environmental Product Declarations. Core rules for the product category of construction products.
- RTS PCR 2.6.2016 RTS PCR protocol. Building Information Foundation sr, PT 18 RT EPD Committee

Others:

Frischknecht R., Jungbluth N., Althaus H.-J., Doka G., Dones R., Heck T., Hellweg S., Hischier R., Nemecek T., Rebitzer G. and Spielmann M., 2005, The ecoinvent database: Overview and methodological framework, International Journal of Life Cycle Assessment 10, 3–9.

Puutuoteollisuus ry , 25.2.2019. RTS EPD ENVIRONMENTAL PRODUCT DECLARATION, No. RTS_27_19, Finnish sawn dried timber of spruce or pine, In accordance with EN 15804 and ISO 14025.

Energiäteollisuus ry (Finnish Energy Association), 2019. Sähkötase 1970-2019, (Energy balance 1970-2018) Access method: https://energia.fi/files/1207/Tase_1930-2018.xlsx. referred 29.10.2019

Official Statistics of Finland (OSF): Production of electricity and heat [e-publication]. ISSN=1798-5099. Helsinki: Statistics Finland. Access method: https://www.stat.fi/til/salatuo/2018/index_en.html [referred: 20.11.2019]

Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., and Weidema, B., 2016. The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, 21(9), pp.1218–1230.

ThermoWood® Handbook (2003), International ThermoWood Association. www.thermowood.fi.