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Laminated Veneer Lumber (LVL)

Key Information

General Process Description	1 m^3 of laminated veneer lumber based on the UK consumption mix
Reference Flow/Declared Unit	1 m^3 of laminated veneer lumber, 12% wood moisture content (dry basis), average product density of 488 kg/m^3
Reference Year	2013

Methodological Approach

This generic dataset has been developed with reference to CEN/TR 15941:2010 *Environmental product declarations — Methodology for selection and use of generic data* and has made use of data from existing databases and EPD, compensated with data from UK industry and national statistics for the specific situation related to UK consumption of timber products. With regard to methodology, the datasets are in line with the core Product Category Rules given in EN 15804+A1: 2013 *Environmental product declarations — Core rules for the product category of construction products*, and further detailed in FprEN 16485:2013 *Round and sawn timber — Environmental Product Declarations — Product category rules for wood and wood-based products for use in construction* and the draft EN 16449, *Wood and wood-based products — Calculation of sequestration of atmospheric carbon dioxide*.

The generic dataset is intended for use as upstream data for UK consumed timber products within EPDs and building level LCA assessments to EN 15978:2011 *Assessment of environmental performance of buildings — Calculation method.*

Modelling & Assumptions

Laminated veneer lumber (LVL) is an engineered wood product consisting of multiple thin layers of wood held together with a synthetic adhesive. The individual layers in LVL, known as veneers, are obtained by peeling larger softwood pieces to thin layers around 3mm thick. The veneers are dried and then glued together with the grain in each layer oriented along the length of the LVL product. Once the adhesive has been applied, the LVL is hot pressed to give the required strength properties. As a final step, the LVL is cut to length and may be sanded prior to distribution. LVL products typically range from 30-90 mm in thickness and may be up to 12 m long.

The modelled product is a 45 mm thick LVL product manufactured from kiln-dried softwood with a moisture content of 12%. Several adhesives can be used to glue the layers together – in this study a mix of phenol formaldehyde

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(PF) and phenol resorcinol formaldehyde (PRF) has been used (PUR). The overall adhesive content of the product is 2.5%.

Exact statistics on LVL production and imports to the UK were not available. However, the market in Europe has been historically dominated by Finland and Sweden [UNECE 2000]. More recently, manufacturers in Europe have started to manufacture LVL and demand for LVL has increased in North America, although the level of export to the UK is unknown. In the absence of reliable data, it has been estimated that the main countries exporting LVL to the UK are Finland and Sweden, with small quantities arriving from Germany and North America.

The sawn softwood used in the LVL product is modelled using the same assumptions about forestry practices, sawmilling and kiln drying of the wood veneers as the "Kiln dried sawn softwood" dataset also produced as part of this project [Wood First 2014], with energy grids adapted to reflect the country of production.

Origin	Estimated Percentage of Consumption Mix
Finland	*40%*
Sweden	*40%*
Germany	*10%*
Canada	*5%*
USA	*5%*
Finland	*40%*

Laminated veneer lumber manufacture has been estimated based on information compiled by PE International and its industrial partners for the manufacture of engineered wood products in Germany [PE International 2012]. The adhesive mix has been modelled using information from the Environmental Product Declaration (EPD) for North American Laminated Veneer Lumber [APA 2013]. The overall mix of non-wood components is 2.41% PF adhesive, 0.02% PRF and 0.03% unspecified filler. The energy mix has been adapted to reflect the specific electricity and fuel mix in each production country. The manufacturing steps included are: sawmilling, peeling, drying, gluing, hot pressing and finishing.

Transport to UK customers was calculated based on:

- Truck transport from one of the country's largest sawmills listed in the online Sawmill Database [Sawmill DB 2014] to a large national port
- Sea transport from the designated port to Hull, Felixstowe,

Southampton or Liverpool (dependent on country of production)

- Transport of 130 km from port to customer [DfT 2005]

This yielded values for LVL transport of 2808 km by sea and 721 km by road.

Product use and maintenance have not been included due to the wide range of potential uses and consequently the high level of uncertainty surrounding this stage of the lifecycle.

End-of-life data are provided for three scenarios: 100% of wood waste to recycling, 100% of wood waste to incineration with energy recovery and 100% of wood waste to landfill. Wood transport distances to landfill and recycling of 25km and 21km were taken from survey data related to construction end of life practices in the UK compiled by BRE [BRE 2013]. Transport to wood energy recovery plants was estimated to be 46km based on average transport to one of an estimated 25 suitable biomass or waste-to-energy plants.

The composition of the waste (water content, adhesive content) is taken into account in the end-of-life modelling to reflect the characteristics of the waste in each scenario, with adhesives modelled as inert in landfill.

Landfill gas production is modelled based on the MELMod model for landfill emissions in the UK. The values used in this project take into account improvements to the assumptions regarding organic carbon degradation suggested by Eunomia as a result of their review of MELMod for DEFRA [Eunomia 2011]. Using typical values for cellulose, hemicellulose and lignin, an organic carbon conversion of 38.5% has been calculated. The landfill gas is assumed to have a 50:50 methane to carbon dioxide ratio by volume. The landfill is assumed to be a modern "Type 3" landfill (large modern landfill with comprehensive gas collection) with a landfill gas extraction efficiency of 50%.

Wood waste sent for recycling is assumed to be used as woodchips and is assigned credits related to the avoided production of woodchips from virgin softwood. The adhesive component is assumed to be lost during recycling.

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Environmental Parameters Derived from the LCA

Production & Distribution (Cradle-to-Site)

Parameters describing environmental impacts	Units	Production *(A1-A3)*	Distribution and Installation *(A4-A5)*
Global Warming Potential	kg CO2 eq.	-537	44.3
Ozone Depletion Potential	kg CFC11 eq.	1.9E-08	1.65E-10
Acidification Potential	kg SO2 eq.	1.15	0.7
Eutrophication Potential	kg PO4 eq.	0.171	0.0841
Photochemical Ozone Creation Potential	kg Ethene eq.	0.105	-0.00248
Abiotic Depletion Potential (Elements)	kg Sb eq.	5.81E-05	1.29E-06
Abiotic Depletion Potential (Fossil)	MJ	3540	579

Parameters describing primary energy	Units	Production *(A1-A3)*	Distribution and Installation *(A4-A5)*
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	2410	11.1
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	8200	0
Total use of renewable primary energy resources	MJ, net calorific value	10600	11.1
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value	5200	580
Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value	0	0
Total use of non-renewable primary energy resources	MJ, net calorific value	5200	580
Use of secondary material	kg	0	0
Use of renewable secondary fuels	MJ, net calorific value	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0
Net use of fresh water	m^3	2.99	0.00927

Other environmental information describing waste categories	Units	Production *(A1-A3)*	Distribution and Installation *(A4-A5)*
Hazardous waste disposed	kg	0.607	0.000952
Non-hazardous waste disposed	kg	6.63	0.0351
Radioactive waste disposed	kg	0.689	0.000712

Other environmental information describing output flows	Units	Production *(A1-A3)*	Distribution and Installation *(A4-A5)*
Components for re-use	kg	0	0
Materials for recycling	kg	0	0
Materials for energy recovery	kg	0	0
Exported energy	MJ per energy carrier	0	0

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Environmental Parameters Derived from the LCA

End-of-Life

Parameters describing environmental impacts	Units	100% Recycling		100% Energy Recovery		100% Landfill	
		End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)
Global Warming Potential	kg CO2 eq.	814	-8.35	845	-592	928	-78.6
Ozone Depletion Potential	kg CFC11 eq.	2.43E-10	-2.30E-10	3.32E-10	-2.50E-08	3.54E-10	-4.70E-09
Acidification Potential	kg SO2 eq.	0.0451	-0.0417	0.797	-1.52	1.50	-0.269
Eutrophication Potential	kg PO4 eq.	0.00733	-0.00772	0.156	-0.136	0.105	-0.0226
Photochemical Ozone Creation Potential	kg Ethene eq.	0.00193	-0.00203	0.0799	-0.0947	0.227	-0.0153
Abiotic Depletion Potential (Elements)	kg Sb eq.	4.33E-07	-1.60E-07	2.37E-06	-1.40E-05	6.58E-06	-2.30E-06
Abiotic Depletion Potential (Fossil)	MJ	263	-108	297	-8270	687	-1000

Parameters describing environmental impacts	Units	100% Recycling		100% Energy Recovery		100% Landfill	
		End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	4.53	-3.49	8200	-388	22.4	-72.6
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	-8200	0	-8200	0	0	0
Total use of renewable primary energy resources	MJ, net calorific value	-8190	-3.49	5.30	-388	22.4	-72.6
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value	277	-121	311	-9700	706	-1270
Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value	0	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ, net calorific value	277	-121	311	-9700	706	-1270
Use of secondary material	kg	0	488*	0	0	0	0
Use of renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0
Net use of fresh water	m^3	0.0154	-0.0139	0.594	-1.61	-0.452	-0.300

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Parameters describing environmental impacts	Units	100% Recycling		100% Energy Recovery		100% Landfill	
		End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)
Hazardous waste disposed	kg	0.00584	-0.00526	0.00675	-0.614	0.0157	-0.115
Non-hazardous waste disposed	kg	12.1	-0.100	2.84	-2.33	208	-0.368
Radioactive waste disposed	kg	0.00554	-0.00507	0.00608	-0.591	0.00745	-0.111

Parameters describing environmental impacts	Units	100% Recycling		100% Energy Recovery		100% Landfill	
		End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)
Components for re-use	kg	0	0	0	0	0	0
Materials for recycling	kg	488	0	0	0	0	0
Materials for energy recovery	kg	0	0	0	0	0	0
Exported energy from Electricity	MJ	0	0	2690	0	506	0
Exported energy from Thermal Energy	MJ	0	0	2790	0	0	0

*Represents use of secondary material in next product system

References

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