Wood for Good Lifecycle Database

PE INTERNATIONAL EXPERTS IN SUSTAINABILITY

Wood for Good

Glued Laminated Timber

Key Information

General Process Description	1 m^3 of glued laminated timber based on the UK consumption mix
Reference Flow/Declared Unit	1 m^3 of glued laminated timber, 12% wood moisture content (dry basis), average product density of 490 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

Glued laminated timber (glulam) is an engineered wood product consisting of a number of layers of wood held together with a synthetic adhesive. The first stages of glulam manufacture are the same as those for the production of kiln-dried sawn softwood timber, namely, logging, sawing and kiln drying. Kiln dried timber arriving at the manufacturing site is classified according to its strength properties. The ends of the individual pieces of timber are finger-jointed allowing them to be glued together to form the long laminate pieces required in the final product. Once the finger joints have been set and dried, the laminates are planed and glued together, with the grain in each layer oriented along the length of the beam. The multi-layer product is pressed and may be bent to obtain curved beams. Once the adhesive is hardened the beams are finished with a final planing/sanding process and may be trimmed to obtain the final product.

The modelled product is a three layer product manufactured from kiln-dried softwood with a moisture content of 12%. The overall adhesive content of the product is 2.1%.

Glulam consumed in the UK has been modelled as being imported from a selection of European countries based on an analysis of the European glulam market [Färlin 2009]. The largest European glulam producers are Austria and Germany followed by Finland, Italy and Sweden (see table). A number of other countries produce smaller quantities, but it is assumed that these will be for consumption in the domestic market. Glulam is also produced in other regions such as North America, although this is generally for domestic consumption.

Kiln-dried sawn softwood used in the glulam product is modelled using the same assumptions about forestry practices, sawmilling and kiln drying 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
Austria	*38%*
Germany	*38%*
Finland	*11%*
Italy	*7%*
Sweden	*6%*

Glulam manufacturing is based on information compiled by PE International and its industrial partners for the manufacture of engineered wood products, including glulam in Germany [PE International 2012]. Several adhesives can be used in glulam manufacture, so an average adhesive mix of 1.94% melamine urea formaldehyde (MUF), 0.09% phenol resorcinol formaldehyde (PRF) and 0.03% polyurethane (PUR) has been assumed as used in the Studiengemeinschaft Holzleimbau EPD for German glulam producers [BS Holz 2013]. The energy mix has been adapted to reflect the specific electricity and fuel mix in each production country. The manufacturing steps included are: Finger jointing, planing and gluing, pressing and finishing (planing and trimming).

Transport to UK customers was calculated based on:

- Truck transport from a major producer of CLT in the country to a large national port

- Sea transport from the designated port to Hull, Felixstowe, Southampton or Liverpool (dependent on country of production)
- Transport of 130km from port to customer [DfT 2005]

This yielded values for glulam transport of 643km by sea and 959km 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 work 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.	-488	37.2
Ozone Depletion Potential	kg CFC11 eq.	1.66E-08	1.5E-10
Acidification Potential	kg SO2 eq.	1.03	0.28
Eutrophication Potential	kg PO4 eq.	0.182	0.0466
Photochemical Ozone Creation Potential	kg Ethene eq.	0.089	-0.0433
Abiotic Depletion Potential (Elements)	kg Sb eq.	8.42E-05	1.21E-06
Abiotic Depletion Potential (Fossil)	MJ	3860	504

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	2140	15.1
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	8250	0
Total use of renewable primary energy resources	MJ, net calorific value	10400	15.1
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value	4760	505
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	4760	505
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	2.05	0.0112

Other environmental information describing waste categories	Units	Production *(A1-A3)*	Distribution and Installation *(A4-A5)*
Hazardous waste disposed	kg	0.852	0.000994
Non-hazardous waste disposed	kg	6.2	0.0483
Radioactive waste disposed	kg	0.364	0.000629

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.	819	-8.41	846	-593	934	-79.1
Ozone Depletion Potential	kg CFC11 eq.	2.44E-10	-2.30E-10	3.19E-10	-2.50E-08	3.56E-10	-4.70E-09
Acidification Potential	kg SO2 eq.	0.0451	-0.0420	0.801	-1.53	1.51	-0.271
Eutrophication Potential	kg PO4 eq.	0.00733	-0.00777	0.157	-0.136	0.106	-0.0228
Photochemical Ozone Creation Potential	kg Ethene eq.	0.00192	-0.00204	0.0804	-0.0949	0.228	-0.0154
Abiotic Depletion Potential (Elements)	kg Sb eq.	4.25E-07	-1.60E-07	2.06E-06	-1.40E-05	6.61E-06	-2.30E-06
Abiotic Depletion Potential (Fossil)	MJ	264	-109	296	-8280	691	-1010

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	-3.52	8260	-389	22.5	-73.1
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	-8250	0	-8250	0	0	0
Total use of renewable primary energy resources	MJ, net calorific value	-8250	-3.52	5.18	-389	22.5	-73.1
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value	277	-121	310	-9720	709	-1280
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	310	-9720	709	-1280
Use of secondary material	kg	0	490*	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	0.0167	-0.0140	0.585	-1.61	-0.454	-0.303

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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	0.00586	-0.00530	0.00663	-0.616	0.0158	-0.116
Non-hazardous waste disposed	kg	10.2	-0.101	2.39	-2.34	207	-0.370
Radioactive waste disposed	kg	0.00557	-0.00511	0.00603	-0.593	0.00750	-0.112

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	490	0	0	0	0	0
Materials for energy recovery	kg	0	0	0	0	0	0
Exported energy from Electricity	MJ	0	0	2700	0	510	0
Exported energy from Thermal Energy	MJ	0	0	2790	0	0	0

***Represents use of secondary material in next product system**

References

BRE 2013	Anderson, J., Adams, K. and Shiers, D., 2013. Personal communication: Survey of UK Construction Waste Sites. BRE, Watford, UK
BS Holz 2013	Studiengemeinschaft Holzleimbau, 2013. *Environmental Product Declaration - Glued laminated timber*. Declaration number EPD-SHL-20120017-IBG1-E. IBU, Königswinter, Germany.
DfT 2005	Department for Transport, 2005. Continuous Survey of Road Goods Transport. Department for Transport, London, UK.
Färlin 2009	Färlin, S., 2009. *Market analysis of glulam in Europe.* Master's thesis. Department of Packaging Logistics, Lund University, Sweden.
Eunomia 2011	Eunomia Research & Consulting 2011. *Inventory Improvement Project – UK Landfill Methane Emissions Model: Final Report to DEFRA.* Eunomia Research and Consulting Ltd., Bristol, UK.
PE International 2012	PE International, 2012. *GaBi 6 Software and Database for Life Cycle Engineering.* Data on the manufacture of glued laminated timber in Germany. LBP, University of Stuttgart and PE International, Stuttgart, Germany
Wood First 2014	PE International and Wood For Good. *Kiln dried sawn softwood*. Timber Trade Federation, London, UK