Lifecycle Database User Guide

Transforming Timber

About the Lifecycle Database

The *Wood for Good Lifecycle Database* has been developed as part of a multi-stakeholder effort to gather and publish life cycle assessment (LCA) data on behalf of the whole UK timber industry. The Lifecycle Database aims to provide comprehensive, technical data on the environmental performance of wood products to stakeholders including architects, engineers and material specifiers as well as the wood industry itself.

The database is a free online resource of generic LCA datasets developed by PE INTERNATIONAL using a consistent methodology informed by existing LCA standards, including those for construction products and timber products used in the construction industry (see “Standards used in the Lifecycle Database” below). This guide has been created by Wood for Good and PE INTERNATIONAL to help users interpret the data and understand how these datasets can be adapted to estimate the potential impacts of specific timber products.

Introduction to LCA

Life cycle assessment (LCA) is widely considered to be the most appropriate tool for determining the environmental performance of products. LCA considers impacts throughout the product supply chain and addresses a range of different environmental impact categories. As such, LCA gives a rounded understanding of the environmental performance of products and can be used to illustrate the trade-offs associated with different design choices (e.g. selection of different materials).

According to the international standards (ISO 14040, ISO 14044) an LCA is comprised of four main stages. In the first stage the goal and scope of the life cycle assessment are defined. An LCA study is intended to consider a scope which includes the whole life cycle of a product ‘from cradle to grave’ but in some circumstances may have a more limited scope e.g. to calculate the ‘cradle-to-gate’ of the product, i.e. all environmental impact steps from raw materials extraction through the production process of a product (this is often useful in a business-to-business context where customers want to understand the upstream environmental impacts of their raw materials).

The second step is the calculation of the life cycle inventory (LCI). This is a list of all the inputs and outputs associated with the life cycle of the product (e.g. kg crude oil extracted, kg of carbon dioxide emissions, etc.). The LCI is developed based on primary data specific to the product being assessed (e.g. specifying energy consumption, or mass and type of materials used) linked to background data on the resources, emissions and removals associated with the use of electricity, fuels and production of different materials used in the production process.

The third stage is the life cycle impact assessment (LCIA), in which data in the LCI (which normally contains several hundred inputs/output flows) are aggregated into a few key impact categories. An example is the climate change impact category in which all greenhouse gas emissions are combined into a single carbon footprint value reported in terms of kg carbon dioxide equivalents.

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In the fourth stage the results are evaluated and interpreted in accordance with the goal of the study, e.g. to determine the product with the lowest overall impacts or to identify hot spots in the life cycle of the product system which can inform the development of improvement strategies.

Standards used in the Lifecycle Database

The data included in the Lifecycle Database have been developed based on the CEN/TR 15941:2010 *Environmental product declarations — Methodology for selection and use of generic data* as well as existing databases and EPD, data from UK industry and national statistics for UK timber products. The methods used to model the datasets are in line with the core Product Category Rules defined in BS EN 15804+A1: 2013 *Environmental product declarations — Core rules for the product category of construction products*, and further detailed in BS EN 16485:2014 *Round and sawn timber — Environmental Product Declarations — Product category rules for wood and wood-based products for use in construction* and BS EN 16449:2014, *Wood and wood-based products — Calculation of sequestration of atmospheric carbon dioxide*.

Using Generic Data

"Average data" based on primary data collected from a representative range of suppliers will more accurately represent a typical product than "generic data" based on secondary sources. Furthermore, there are limitations to the claims that can be made for the representativeness of generic data. As such, average data should always be used in preference if available.

However, given the number and geographical location of suppliers of wood products to the UK market, the costs and time required to collect data and generate average data for the number of products covered in the Database would be very high. Using generic data offers a practical way to estimate the potential impacts of timber products consumed in the UK market and we consider this to be appropriate considering the goals of the *Wood for Good Lifecycle Database*.

PE's approach to the generation of generic GHG and LCA data for the primary products uses existing underlying models and data from the LCA studies used to produce the highly regarded GaBi Life Cycle Database and existing published LCA/EPD data for timber products. Data have been adapted to fit the UK-specific supply-chain in terms of technology mix (e.g. electricity grid mix) and relevant regional data for the most sensitive input/output variables which has been provided by partners of the Wood for Good Lifecycle Database and from publicly available sources.

Specific data (for a particular manufacturer and product) such as a manufacturer specific EPD may be less suitable at the early design stage when particular products have not been selected. Once the overall design is optimised using generic data, then specific data can be used to compare different manufacturers and products and make a final product selection.

Carbon Sequestration

Trees absorb atmospheric carbon dioxide (CO_2) during growth, converting the carbon into the body of the tree as wood, bark, leaves and roots. Therefore wood used in durable products acts as a store of carbon throughout the lifetime of the product.

When forests are responsibly managed, the carbon stored in the forest (including soil, litter and the trees themselves) increases with new planting and reaches a stable average over time (although at the time of harvest there is a drop in stored carbon). The following charts (Matthews et al., 2012) illustrate the uptake and storage of carbon in a stand of trees (Figure 1) and in a forest (Figure 2).

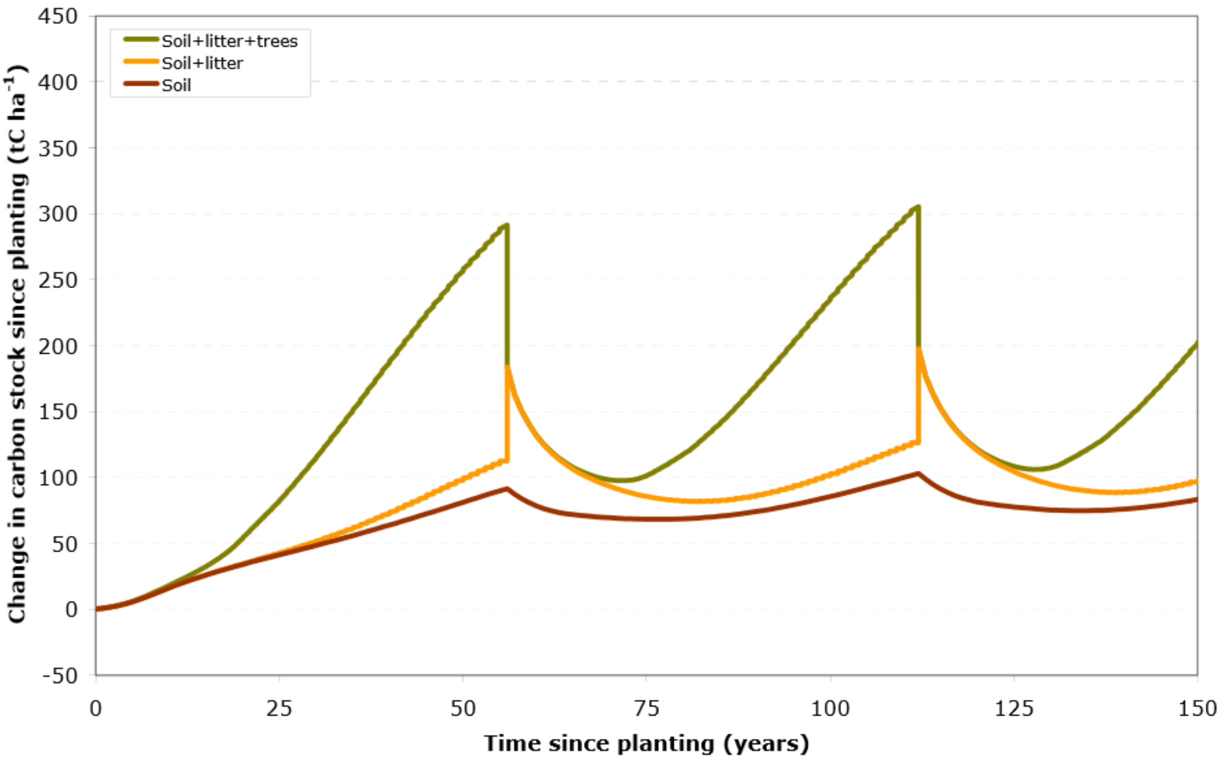

Figure 1 - An illustration of the change in tree, litter and soil carbon stocks that can occur on an area of land by planting a stand of conifer trees, managed for production by clearfelling every 56 years (from Matthews et al., 2012).

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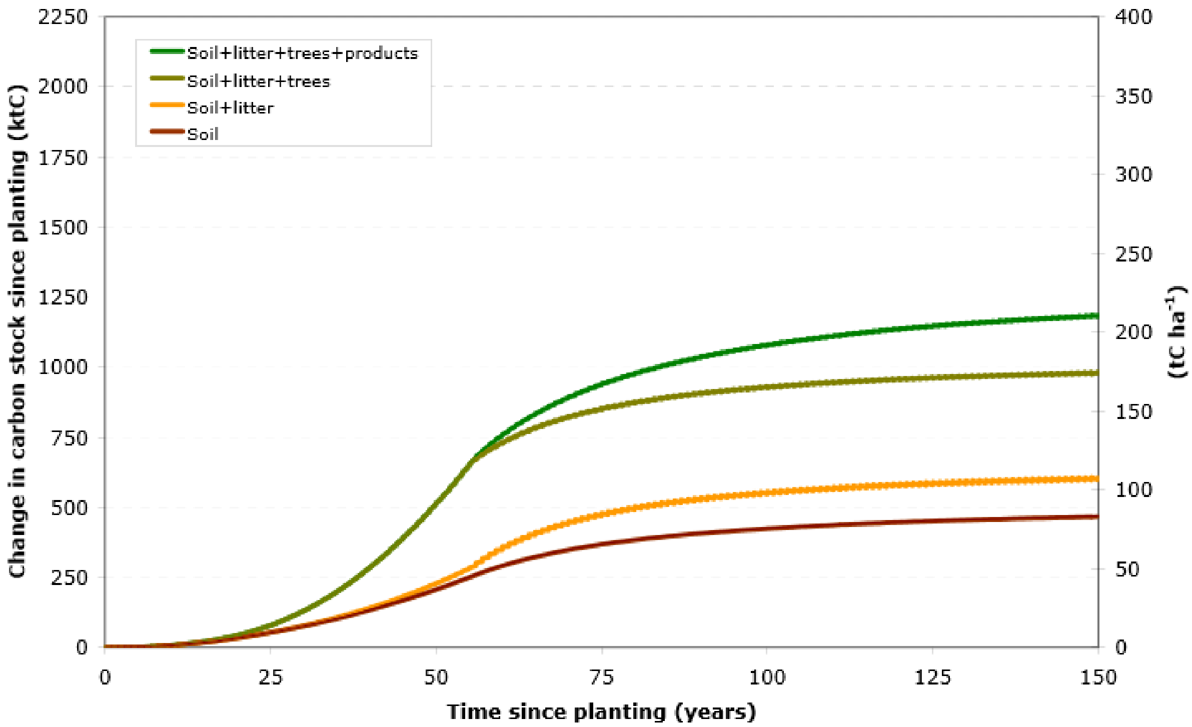


Figure 2 - Development of carbon stocks over time in trees, litter and soil forming the stands of the 5,600 hectare forest created from even aged Sitka spruce stands over 56 years. The contribution due to carbon stocks retained in harvested wood products is also shown. The left-hand y-axis shows the change in total carbon stocks for the 5,600 ha area, the right-hand y-axis shows the change in carbon stocks for the area expressed in tC ha^{-1} (from Matthews et al., 2012).

The latest product category rules for timber and sequestration standards (BS EN 16485: 2014 and BS EN 16449:2014) agree that the carbon from the atmosphere which remains stored in products should be included in EPD and this has been reviewed and agreed with CEN/TC 350 WG3 which developed EN 15804. Therefore, the LCIA reported in the *Wood for Good Lifecycle Database* account for this stored carbon.

For further information about the uptake and storage of carbon in trees, see the Forest Research report *Best use of wood fibre* (Matthews et. al., 2012).

What Information Does the Database Contain?

The products which have been studied include:

A. Sawn Timber (produced and consumed in the UK)

- Planed timber
- Fresh sawn softwood
- Kiln dried sawn softwood
- Kiln dried sawn hardwood

B. Panel Products (all UK consumed)

- Temperate Plywood
- Chipboard/particleboard
- Melamine coated particleboard
- Orientated strand board (OSB)
- Medium density fibreboard (MDF)
- High density fibreboard (HDF)

C. Engineered Timber (all UK consumed)

- Glulam (glued laminated timber)
- Laminated timber (laminated strand lumber (LSL), laminated veneer lumber (LVL), parallel strand lumber (PSL))
- Cross laminated timber (CLT)
- Typical Timber frame (both open and closed system)
- Trussed rafters

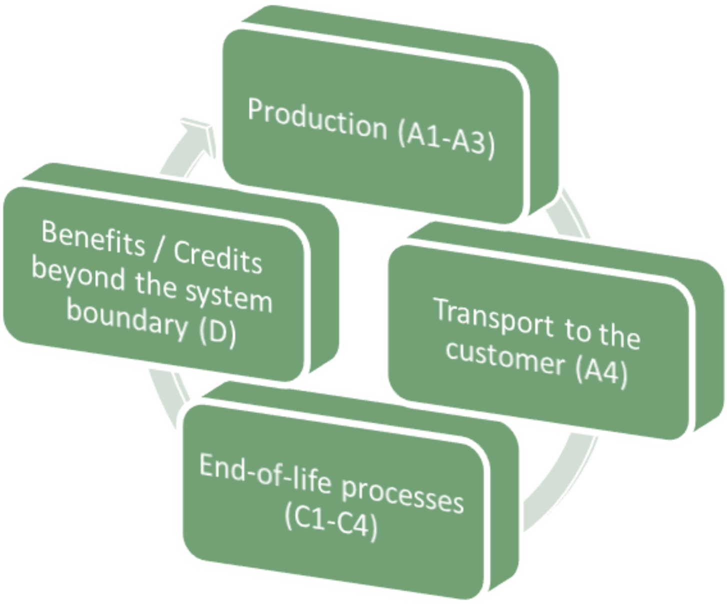
D. Proprietary Products (all UK consumed)

- Galvanised steel (for hangers, plates, joist webs, fixings)
- A typical joinery adhesive

The data represent the UK consumption mix for each product type. Each dataset provides LCIA data covering the full life cycle, from cradle to grave.

The lifecycle stages (and associated BS EN 15804 modules) included are

* Production (A1-A3)
* Transport to customer (A4)
* End-of-life processing (C1-C4)
* Benefits beyond the system boundary i.e. credits for recycling and energy recovery (D)



In each dataset, the production inventory represents all upstream materials and energy production.

Wood products may have a variety of fates at end of life (EoL), e.g., disposal to landfill, energy recovery or recycling. The LCIA for each of these scenarios is provided for every product to allow users to evaluate these various options. The LCIA for these different possibilities may be used to evaluate best and worst cases for the product when its end of life fate is uncertain. The EoL LCIA also allow an average case to be modelled. For example if a contractor typically sends construction wood waste to be used for energy recovery 50% of the time and sent to landfill 50% of the time this can be modelled using the data. The LCI are fully adaptable as data are available for each of the end of life possibilities for every product type.

In the section **Using the Data**, we will review how to use the EoL profiles in the Database, including how to combine the EoL LCIA to use in your own assessments.

Structure of the Datasets

Each dataset includes the following information:

The **Key Information** section indicates the amount and type of product represented in the data set, as well as the production year that the profile represents.

Kiln Dried Sawn Softwood	
Key Information	
General Process Description	1 m^3 of kiln dried softwood based on the UK consumption mix
Reference Flow/Declared Unit	1 m^3 of kiln dried softwood, 15% moisture content (dry basis), average product density of 483 kg/m^3
Reference Year	2013

The **Methodological Approach** section explains the standards and background data used as well as the calculations and modelling choices made.

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*.

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The section **Environmental Parameters Derived from the LCA** presents the environmental impact values associated with the product. This section is presented in two parts. The first set of impacts is for "Production" and "Distribution and Installation", the Cradle-to-Site stages.

Environmental Parameters Derived from the LCA

Production & Distribution (Cradle-to-Site)

Parameters describing environmental impacts	Units	Production *(A1-A3)*	Distribution *(A4)*
Global Warming Potential	kg CO2 eq.	-679	22.0
Ozone Depletion Potential	kg CFC11 eq.	2.98E-09	7.68E-11
Acidification Potential	kg SO2 eq.	0.612	0.235
Eutrophication Potential	kg PO4 eq.	0.106	0.0321
Photochemical Ozone Creation Potential	kg Ethene eq.	0.0486	-0.0135
Abiotic Depletion Potential (Elements)	kg Sb eq.	7.81E-06	6.24E-07
Abiotic Depletion Potential (Fossil)	MJ	1390	292

Parameters describing primary energy	Units	Production *(A1-A3)*	Distribution *(A4)*
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	853	5.53
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	8120	0
Total use of renewable primary energy resources	MJ, net calorific value	8970	5.53
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value	1650	300
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	1650	300
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	0.578	0.00522

Other environmental information describing waste categories	Units	Production *(A1-A3)*	Distribution and Installation *(A4-A5)*
Hazardous waste disposed	kg	0.142	4.98E-04
Non-hazardous waste disposed	kg	1.92	0.0203
Radioactive waste disposed	kg	0.140	0.000350

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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The second part of the **Environmental Parameters Derived from the LCA section** presents the environmental impact values associated with the product's End of Life (EoL). Because the product may end up in different EoL situations, each possibility is presented: impacts for recycling, energy recovery and landfill.

Environmental Parameters Derived from the LCA

End-of-Life – 100% Recycling

Environmental Parameters Derived from the LCA

End-of-Life – 100% Energy Recovery

Environmental Parameters Derived from the LCA

End-of-Life – 100% Landfill

Parameters describing environmental impacts	Units	Demolition *(C1)*	Transport *(C2)*	Waste Processing *(C3)*	Disposal *(C4)*	Material and Energy Credits *(D)*
Global Warming Potential	kg CO2 eq.	12.6	1.70	0	929	-79.9
Ozone Depletion Potential	kg CFC11 eq.	8.69E-12	8.99E-13	0	3.48E-10	-4.80E-09
Acidification Potential	kg SO2 eq.	0.0257	0.00445	0	1.50	-0.274
Eutrophication Potential	kg PO4 eq.	0.00504	0.00101	0	0.100	-0.0230
Photochemical Ozone Creation Potential	kg Ethene eq.	0.00233	-0.00169	0	0.230	-0.0156
Abiotic Depletion Potential (Elements)	kg Sb eq.	1.40E-07	1.77E-08	0	6.46E-06	-2.30E-06
Abiotic Depletion Potential (Fossil)	MJ	174	22.5	0	495	-1020

Parameters describing environmental impacts	Units	Demolition *(C1)*	Transport *(C2)*	Waste Processing *(C3)*	Disposal *(C4)*	Material and Energy Credits *(D)*
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	0.148	0.0181	0	22.4	-73.8
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	0	0	0	0	0
Total use of renewable primary energy resources	MJ, net calorific value	0.148	0.0181	0	22.4	-73.8
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value	174	22.6	0	513	-1290
Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ, net calorific value	174	22.6	0	513	-1290
Use of secondary material	kg	0	0	0	0	0
Use of renewable secondary fuels	MJ, net calorific value	0	0	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0	0
Net use of fresh water	m³	0.000816	0.000103	0	-0.453	-0.305

For each disposal scenario data are presented for the "End of life processing" impacts and for the "Recovery loads and benefits" (e.g. due to recycling or energy recovery activities). As will be shown in the following section in this report, **Using the Data**, a combined scenario (e.g. of 50% recycling and 50% landfilling) may be represented using a combination of these results tables.

Using the Data

The data provided in the Lifecycle Database are intended for use as upstream data for UK consumed timber products within EPDs and building-level LCA studies which are being reported in accordance with BS EN 15978:2011 *Assessment of environmental performance of buildings — Calculation method*, and for embodied carbon assessments based on methods such as the RICS' information paper *Methodology to calculate embodied carbon of materials* (RICS 2012) or the GLA's *Construction Scope 3 (Embodied): Greenhouse gas accounting and reporting guidance* (GLA 2013)
provides an overview of the Cradle to Gate, Cradle to Site and Cradle to Grave embodied carbon data that can be used for sawn timber products in Embodied Carbon studies looking beyond cradle to gate, based on typical UK disposal routes for timber.

Please note: The Global Warming Potential impact data from the production phase (A1-A3) should be used in place of the data for timber given within version 2.0 of the Inventory of Carbon and Energy (ICE 2011) and (BSRIA 2011).

How to adapt to the Reference Unit of your LCA

Each product is modelled with a product-specific ***declared unit***. However, the LCI data can be adapted to a specific product or case for each product type as follows

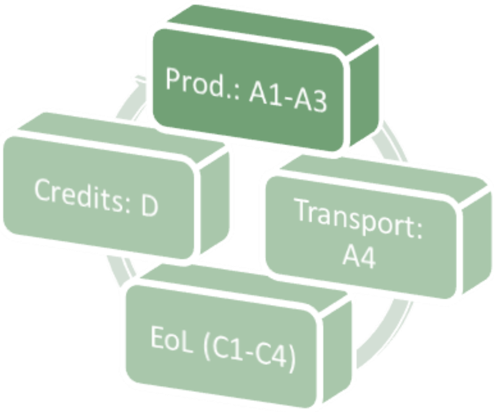
- For **solid and engineered timber**, the declared unit of product can be converted from 1 m^3 to another volume or, using the density given in the Key Information, a given mass
- For **panel products**, a given area can be recalculated to represent a larger area; the results can also be scaled up for panels of larger thickness
- For **structural timber products**, the reference unit can be adapted to another volume or mass

For timber frame **panel and rafter systems**, the panel system LCI should not be scaled by area or volume. Instead, use the masses of each component material of your product (kiln dried softwood, steel fixings etc.), and scale the associated material profile by mass.

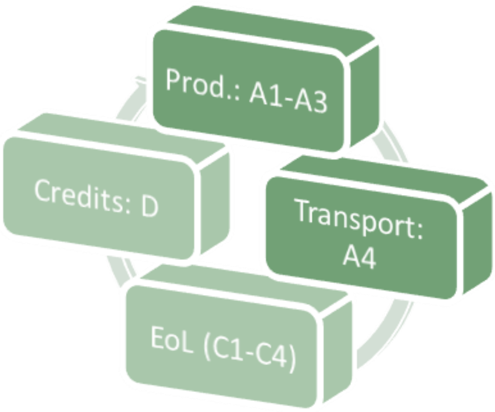
How to match the Scope of your LCA

The scope of your LCA may include some or all of the life cycle stages reported in each dataset. The data for each product may be combined to meet your specific requirements.

For "cradle to gate" LCA: Include Production only (A1-A3).

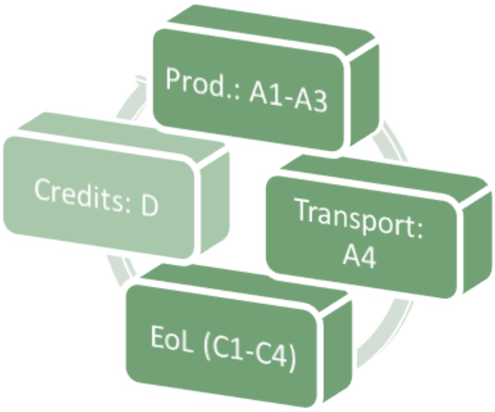


For “cradle-to-site”: include Production and Distribution (A1-A3 and A4). The datasheet provides details of the typical shipping and road transport distances associated with each product. These cannot be scaled to represent particular distances as they combine both shipping and road distances which have very different impacts.

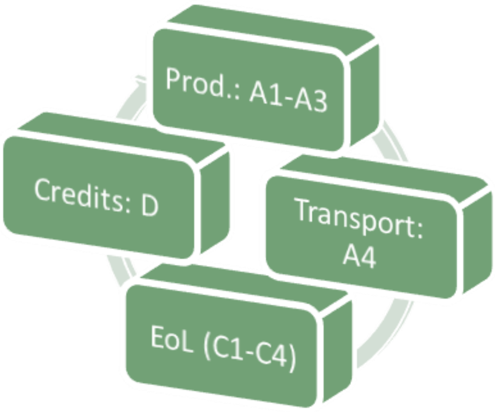


For “cradle-through-construction”: include production and distribution as above. For installation on site, take account of any installation waste generated by using data for “cradle to site” (A1-A4) to account for production of the waste generated and the relevant end of life impact (C1-C4) to account for disposal of the waste in Module A5 - Installation.

For “cradle-to-grave”: include Production, Distribution and the relevant EoL Processing (A1-C4) to account for all the material used and disposed of through the life cycle. If the product is replaced a number of times through the life of the building, then the relevant impacts for the end of life product data can be generated using data from C2-C4 and as with “cradle-through-construction”, you can model the production for the replacement product. Together these data are combined to model replacement and/or refurbishment through the life cycle (B4 and B5).



For "cradle-to-grave plus load and benefits beyond the system boundary": include all stages (A1-C4 + Module D). Note that from the loads and benefits of material or energy recovery arising from any modules beyond the factory gate are always aggregated in Module D – so for example, if timber cladding replacement is modelled in B5, the loads and benefits beyond the system boundary from the recycling of this EoL timber would be included in Module D, not Module B5.



Example calculations

In each of these cases, you will be calculating a scaling factor of (Reference Flow/Declared Unit), where the reference flow is the amount of your product and the declared unit is the reported unit of product in the Database.

Example 1: 10 kg of Kiln Dried Softwood, Cradle-to-Site Scope

Reference Flow: 10 kg of kiln dried softwood, 15% moisture content (dry basis)

Declared Unit: 1 m^3 of kiln dried softwood, 15% moisture content (dry basis); average product density of 483 kg/m^3

Table 1: Data for declared unit

Parameters describing environmental impacts	Units	Production *(A1-A3)*	Distribution *(A4)*
Global Warming Potential	kg CO_2 eq.	-679	22.5
Ozone Depletion Potential	kg CFC_{11} eq.	2.98E-09	7.88E-11
Acidification Potential	kg SO_2 eq.	0.612	0.241
Eutrophication Potential	kg PO_4 eq.	0.106	0.0329
Photochemical Ozone Creation Potential	kg Ethene eq.	0.0486	-0.0139
Abiotic Depletion Potential (Elements)	kg Sb eq.	7.81E-06	6.40E-07
Abiotic Depletion Potential (Fossil)	MJ	1390	300

The declared unit has a mass of 483 kg. To adapt to 10 kg: Multiply data for the declared unit by 10/483

Table 2: Resulting data for reference flow

Parameters describing environmental impacts	Units	Production *(A1-A3)*	Distribution *(A4)*
Global Warming Potential	kg CO_2 eq.	-14.1	0.466
Ozone Depletion Potential	kg CFC_{11} eq.	6.17E-11	1.63E-12
Acidification Potential	kg SO_2 eq.	0.0127	0.00499
Eutrophication Potential	kg PO_4 eq.	0.00219	0.000681
Photochemical Ozone Creation Potential	kg Ethene eq.	0.00101	-0.000288
Abiotic Depletion Potential (Elements)	kg Sb eq.	1.62E-07	1.33E-08
Abiotic Depletion Potential (Fossil)	MJ	28.8	6.21

The cradle-to-site total for the kiln-dried softwood product is the sum of the two columns shown in the table above:

Table 3: Cradle-to-site total – Sum of A1-A3 and A4

Parameters describing environmental impacts	Units	Cradle-to-site total *(A1-A4)*
Global Warming Potential	kg CO_2 eq.	-13.6
Ozone Depletion Potential	kg CFC_{11} eq.	6.33E-11
Acidification Potential	kg SO_2 eq.	0.0177
Eutrophication Potential	kg PO_4 eq.	0.00288
Photochemical Ozone Creation Potential	kg Ethene eq.	0.000718
Abiotic Depletion Potential (Elements)	kg Sb eq.	1.75E-07
Abiotic Depletion Potential (Fossil)	MJ	35.0

Example 2: 1 m^2 of Particleboard, 18 mm thick, Cradle-to-grave scope with 50% Energy Recovery, 50% Landfill

Reference Flow: 1 m^2 of Particleboard, 18 mm thick

Declared Unit: 1 m^2 of 25 mm-thick P5 particleboard, 8.5% moisture content (dry basis), average product density of 640 kg/m3.

Table 4 Data for the Declared Unit

Parameters describing environmental impacts	Units	Production *(A1-A3)*	Distribution *(A4)*
Global Warming Potential	kg CO_2 eq.	-15.4	0.263
Ozone Depletion Potential	kg CFC_{11} eq.	4.92E-10	5.15E-13
Acidification Potential	kg SO_2 eq.	0.0263	0.00129
Eutrophication Potential	kg PO_4 eq.	0.00304	2.22E-4
Photochemical Ozone Creation Potential	kg Ethene eq.	0.00374	-2.30E-4
Abiotic Depletion Potential (Elements)	kg Sb eq.	2.06E-06	5.08E-09
Abiotic Depletion Potential (Fossil)	MJ	138	3.52

In this case, we are scaling based on the thickness of the panel.

To adapt to 18 mm from 25 mm: Multiply data for the declared unit by (18/25) mm/mm

Table 5 Resulting data for the reference flow

Parameters describing environmental impacts	Units	Production *(A1-A3)*	Distribution *(A4)*
Global Warming Potential	kg CO_2 eq.	-11.1	0.189
Ozone Depletion Potential	kg CFC_{11} eq.	3.55E-10	3.71E-13
Acidification Potential	kg SO_2 eq.	0.0190	9.27E-4
Eutrophication Potential	kg PO_4 eq.	0.00219	1.60E-4
Photochemical Ozone Creation Potential	kg Ethene eq.	0.00269	-1.70E-4
Abiotic Depletion Potential (Elements)	kg Sb eq.	1.48E-06	3.65E-09
Abiotic Depletion Potential (Fossil)	MJ	99.5	2.53

To include the end of life (EoL) scenario, we need to add the EoL impacts to represent the mix of energy recovery and landfill. The profile for each of the two EoL scenarios are scaled and added to the total.

Table 6 100% Energy Recovery profile for the declared unit

Parameters describing environmental impacts	Units	Demolition *(C1)*	Transport *(C2)*	Waste Processing *(C3)*	Disposal *(C4)*	Material and Energy Credits *(D)*
Global Warming Potential	kg CO_2 eq.	0.416	0.104	28.9	0	-20.4
Ozone Depletion Potential	kg CFC_{11} eq.	2.87E-13	5.51E-14	1.85E-11	0	-8.40E-10
Acidification Potential	kg SO_2 eq.	8.48E-4	2.73E-4	0.0246	0	-0.0512
Eutrophication Potential	kg PO_4 eq.	1.66E-4	6.18E-05	0.00475	0	-0.00459
Photochemical Ozone Creation Potential	kg Ethene eq.	7.70E-5	-1.00E-4	0.00257	0	-0.00321
Abiotic Depletion Potential (Elements)	kg Sb eq.	4.62E-09	1.09E-09	2.57E-07	0	-4.90E-07
Abiotic Depletion Potential (Fossil)	MJ	5.74	1.38	3.63	0	-286

To adapt the Energy Recovery profile we need to scale to 18 mm and EoL fraction ((50%): Multiply EoL results by (18/25) kg/kg and 0.5

Table 7 Resulting EoL profile for 50% Energy Recovery for the reference flow

Parameters describing environmental impacts	Units	Demolition *(C1)*	Transport *(C2)*	Waste Processing *(C3)*	Disposal *(C4)*	Material and Energy Credits *(D)*
Global Warming Potential	kg CO_2 eq.	0.150	0.0374	10.404	0	-7.34
Ozone Depletion Potential	kg CFC_{11} eq.	1.03E-13	1.98E-14	6.66E-12	0	-3.02E-10
Acidification Potential	kg SO_2 eq.	3.05E-4	9.83E-05	0.00886	0	-0.0184
Eutrophication Potential	kg PO_4 eq.	5.98E-05	2.23E-05	0.00171	0	-0.00165
Photochemical Ozone Creation Potential	kg Ethene eq.	2.77E-05	-3.60E-5	9.25E-4	0	-0.00116
Abiotic Depletion Potential (Elements)	kg Sb eq.	1.66E-09	3.92E-10	9.25E-08	0	-1.76E-07
Abiotic Depletion Potential (Fossil)	MJ	2.07	0.497	1.3068	0	-102.96

Table 8 100% Landfill profile for the Declared Unit

Parameters describing environmental impacts	Units	Demolition *(C1)*	Transport *(C2)*	Waste Processing *(C3)*	Disposal *(C4)*	Material and Energy Credits *(D)*
Global Warming Potential	kg CO_2 eq.	2.87E-13	2.97E-14	0	1.07E-11	-1.50E-10
Ozone Depletion Potential	kg CFC_{11} eq.	8.48E-4	1.47E-4	0	0.0462	-0.00845
Acidification Potential	kg SO_2 eq.	1.66E-4	3.33E-05	0	0.00303	-7.10E-4
Eutrophication Potential	kg PO_4 eq.	7.7oE-5	-5.60E-05	0	0.00709	-4.80E-4
Photochemical Ozone Creation Potential	kg Ethene eq.	4.62E-09	5.85E-10	0	2.01E-07	-7.20E-08
Abiotic Depletion Potential (Elements)	kg Sb eq.	5.74	0.745	0	15.1	-31.5
Abiotic Depletion Potential (Fossil)	MJ	2.87E-13	2.97E-14	0	1.07E-11	-1.50E-10

To adapt the Landfill profile, we need to scale to 18 mm and the 50% EoL fraction: Multiply EoL results by (18/25) kg/kg and 0.5

Table 9 Resulting EoL Profile for 50% landfill of the reference flow

Parameters describing environmental impacts	Units	Demolition *(C1)*	Transport *(C2)*	Waste Processing *(C3)*	Disposal *(C4)*	Material and Energy Credits *(D)*
Global Warming Potential	kg CO_2 eq.	0.150	0.0202	0	10.3	-0.889
Ozone Depletion Potential	kg CFC_{11} eq.	1.03E-13	1.07E-14	0	3.85E-12	-5.40E-11
Acidification Potential	kg SO_2 eq.	3.05E-4	5.29E-05	0	0.0166	-0.00304
Eutrophication Potential	kg PO_4 eq.	5.98E-05	1.20E-05	0	0.00109	-2.56E-4
Photochemical Ozone Creation Potential	kg Ethene eq.	2.77E-05	-2.012E-05	0	0.00255	-1.73E-4
Abiotic Depletion Potential (Elements)	kg Sb eq.	1.66E-09	2.11E-10	0	7.24E-08	-2.59E-08
Abiotic Depletion Potential (Fossil)	MJ	2.07	0.268	0	5.44	-11.3

To provide the complete profile for the reference flow, sum the above three profiles (Table 5, Table 7 and Table 9) for each of the information modules A1-D) to create the total profile for the product as used in your study. Table 10 below shows combined results for example particleboard products for three scopes: Cradle-to-site, cradle-to-grave and cradle-to-grave with benefits beyond the system boundary.

Table 10 Cradle-to-grave environmental profile for example particleboard product

Parameters describing environmental impacts	Units	Cradle-to-site (A1-A3 + A4)	Cradle-to-grave (A1-A3 + A4 + C1-C4)	Cradle-to-grave with Module D mat. and energy credits (A1-A3 + A4 + C1-C4 + D)
Global Warming Potential	kg CO_2 eq.	-10.9	10.2	1.92
Ozone Depletion Potential	kg CFC_{11} eq.	3.55E-10	3.66E-10	1.01E-11
Acidification Potential	kg SO_2 eq.	0.0199	0.04615	0.0247
Eutrophication Potential	kg PO_4 eq.	0.00235	0.00530	0.00340
Photochemical Ozone Creation Potential	kg Ethene eq.	0.00252	0.00599	0.00466
Abiotic Depletion Potential (Elements)	kg Sb eq.	1.48E-06	1.65E-06	1.45E-06
Abiotic Depletion Potential (Fossil)	MJ	102	114	-0.578

Example 3: Creating an alternative panel system (cradle-to-gate scope)

Reference flow: Open panel system

- 16 kg of kiln dried softwood timber
- 0.5 kg of steel screws/fixings (hot dip galvanised steel)
- 7 kg of OSB

Panel/rafter systems included in the Lifecycle Database provide representative values for those designs. For significantly different panel or rafter configurations, combine and scale masses of the component materials.

Kiln dried Softwood

Declared Unit: 1 m^3 of kiln dried softwood, 15% moisture content (dry basis); average product density of 483 kg/ m^3

To adapt softwood LCI to 16 kg from declared unit (483 kg): Multiply softwood results by (16/483) kg/kg

Table 11 Environmental profile for 16kg of softwood (cradle-to-site)

Parameters describing environmental impacts	Units	Production *(A1-A3)*	Distribution *(A4)*
Global Warming Potential	kg CO_2 eq.	-22.5	0.745
Ozone Depletion Potential	kg CFC_{11} eq.	9.87E-11	2.61E-12
Acidification Potential	kg SO_2 eq.	0.0203	0.00798
Eutrophication Potential	kg PO_4 eq.	0.00351	0.00109
Photochemical Ozone Creation Potential	kg Ethene eq.	0.00161	-0.000460
Abiotic Depletion Potential (Elements)	kg Sb eq.	2.59E-07	2.12E-08
Abiotic Depletion Potential (Fossil)	MJ	46.0	9.94

Steel

Declared Unit: 1 kg of hot dip galvanised steel

To adapt steel LCI to 0.5 kg from declared unit (1 kg): Multiply steel results by (0.5/1) kg/kg

Table 12 Environmental profile for 0.5kg of galvanised steel

Parameters describing environmental impacts	Units	Production *(A1-A3)*	Distribution *(A4)*
Global Warming Potential	kg CO_2 eq.	1.13	0.00376
Ozone Depletion Potential	kg CFC_{11} eq.	1.86E-11	2.00E-15
Acidification Potential	kg SO_2 eq.	0.00402	1.54E-05
Eutrophication Potential	kg PO_4 eq.	0.000348	3.67E-06
Photochemical Ozone Creation Potential	kg Ethene eq.	0.000560	-6.50E-06
Abiotic Depletion Potential (Elements)	kg Sb eq.	7.15E-05	3.93E-11
Abiotic Depletion Potential (Fossil)	MJ	12.8	0.0500

Oriented Strand Board

Declared Unit: 1 m^2 of 12 mm-thick oriented strand board, 5% moisture content (dry basis), average product density of 548 kg/m^3

Here you will need to calculate the mass of the declared unit and scale to the required mass. First determine the volume of one square metre of OSB.

Volume of 12 mm-thick OSB: 0.012 m^3/m^2Mass of declared unit: 0.012*548 = 6.58 kg

To adapt OSB LCI to 7 kg from declared unit (6.58 kg): Multiply OSB results by (7/6.58) kg/kg.

Table 13 Environmental profile for 7kg of OSB

Parameters describing environmental impacts	Units	Production *(A1-A3)*	Distribution *(A4)*
Global Warming Potential	kg CO_2 eq.	-9.53	0.312
Ozone Depletion Potential	kg CFC_{11} eq.	4.83E-11	1.11E-12
Acidification Potential	kg SO_2 eq.	0.00845	0.00274
Eutrophication Potential	kg PO_4 eq.	0.00121	0.000409
Photochemical Ozone Creation Potential	kg Ethene eq.	0.000773	-0.000277
Abiotic Depletion Potential (Elements)	kg Sb eq.	3.24E-07	9.07E-09
Abiotic Depletion Potential (Fossil)	MJ	41.4	4.18

Sum the resulting above three profiles for the reference flows of kiln dried softwood, steel and OSB to create the total profile for the open panel system as used in your study. In the above example adding together the values from Table 11, Table 12 and Table 13 gives the cradle-to-site values for the panel system shown in Table 14.

Table 14 Environmental profile for alternative panel system – cradle-to-site

Parameters describing environmental impacts	Units	Cradle-to-site *(A1-A3 + A4)*
Global Warming Potential	kg CO_2 eq.	-29.8
Ozone Depletion Potential	kg CFC_{11} eq.	1.69E-10
Acidification Potential	kg SO_2 eq.	0.0435
Eutrophication Potential	kg PO_4 eq.	0.00658
Photochemical Ozone Creation Potential	kg Ethene eq.	0.00220
Abiotic Depletion Potential (Elements)	kg Sb eq.	7.21E-05
Abiotic Depletion Potential (Fossil)	MJ	114

Embodied Carbon (GWP) data for Sawn Timber

Table 15 provides a summary of the Embodied Carbon data for Sawn Timber. The Global Warming Potential (GWP) indicator results are presented for each product and should be used in place of the ICE data for embodied carbon assessments.

Table 15: Embodied Carbon data for sawn timber products, based on current UK timber disposal routes

Embodied Carbon or Global Warming Potential (kg CO_2 eq)	**Cradle to Gate (Production) *(A1-A3)***	Distribution *(A4)*	**Cradle to Site *(A1-A4)***	End of Life *(C1-C4)*	**Cradle to Grave *(A1-C4)***	Material and Energy Credits *(D)*
Planed Softwood	**-646**	22	**-624**	844	**220**	-176
Fresh Sawn Softwood	**-713**	8	**-705**	849	**9.87E-11**	-176
Kiln Dried Softwood	**-679**	23	**-656**	849	**192**	-177
Kiln Dried Hardwood	**-878**	103	**-775**	1158	**384**	-259

Data for the end of life stages C1, C2, C3 and C4 have been aggregated to give a single end of life embodied carbon figure. These data have been calculated based on the end of life routes for the 4,100 ktonnes of timber waste produced in 2011, as described DEFRA 2012, particularly Table 9-7. Animal bedding, equine surfaces, mulches and paths have been modelled as recycling. Exported wood waste has been assumed to go 25% to recycling and 75% to energy recovery. The resulting percentages used to model the current mix of end of life routes for sawn timber in the UK are shown in Table 16.

Table 16 Waste routes for timber in 2011

Waste Route	**Recycling, including panelboard, equine and animal bedding etc**	**Energy Recovery (in UK and exports)**	**Landfill or other disposal**
% mix of end of life routes for Sawn Timber	43%	26%	31%

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