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LCA methodology report - GRANAB subfloor system EPD: Update 2022 of the steel system and added a corresponding wood based system

As the basis for the publication of EPDs within The International EPD® System

Commissioned by Granab

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This report has been reviewed and approved in accordance with IVL's audited and approved management system.

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Electronic appendixes

The electronic appendixes are referred to and described within this LCA report. Below, there is a short list of these files.

File name	Format	Short description
Granab_Data_Steel based floor system.xlsx	Excel	Raw data collected by the company, IVL compilations and data documentation
Granab_Data_Wood based floor system.xlsx	Excel	Only the differences compared to the steel subfloor system are presented in this file
EPD_Metsä 2022_Wood.pdf	pdf	The EPD data applied for the wood in the wood subfloor system, from the supplier Metsä
EPD data_Metsä_Wood_Gabi import.xlsx	Excel	Recalculation by IVL of the Metsä EPD data from per m^3 to per kg.
Granab_Results_Steel based floor system.xlsx	Excel	Results file with tables for the report and EPD document as well as diagrams for interpretation
Granab_Results_Wood based floor system.xlsx	Excel	Results file with tables for the report and EPD document as well as diagrams for interpretation

1 Introduction

1.1 About this report

To communicate the environmental performance of a Subfloor System produced by Granab, IVL the Swedish Environmental Research Institute (referred to IVL onwards) has calculated the environmental performance using Life Cycle Assessment (LCA) which will form the basis of upcoming Environmental Product Declarations (EPDs) for external communication. This report provides details about the methodology and data used to produce the LCA results. This LCA-report is not public. Granab can however decide to communicate the report externally e.g. to a customer.

1.2 Update of an EPD from 2020

The first EPD on a steel-based sub floor system was published in 2020 and this updated report in 2022 is based on the 2020 report. In short, the following updates has been made:

- The 2020 EPD was based on the PCR according to EN15804+A1 and the current EPD is based on the PCR according to EN15804+A2, se section 1.3
- The 2020 EPD covered only one sub floor system made from steel, and the current EPD covers two sub floor systems (made from steel as well as from wood). The LCA report covers both products, but there are two separate EPD documents.
- The steel sub floor system has been updated concerning two aspects:
  - A reduction of about 30% of the amount of steel required
  - The particle board, which is actually a part of the final building application, has been removed since it is not a part of the product produced by Granab.
- A new sub floor system based on wood instead of steel has also been covered.
- The two sub floor systems will be represented by two separate EPD documents.

1.3 PCR and programme operator

The PCR applied outlines the methodology used. The PCR used in this EPD, the standards the PCR is based on as well as the programme operator is presented in Table 1.1.

Table 1.1: PCR, standards and programme operator.

PCR and standards	Programme operator
PCR 2019:14 Construction products. Version 1.2.3, date 2022-07-08	EPD International (The international EPD ® system)
EN15804:2012+A2:2019/AC:2021 (CEN 2021)	
ISO 14025, ISO 14040 and 14044 (ISO 2006 a,b,c).	

1.4 About the company

GRANAB manufactures subfloor systems for homes, offices, schools and public buildings.

1.5 About LCA

Life cycle assessments (LCA) investigates the environmental impacts related to a product or a system during its whole life cycle. This includes evaluating energy and resource consumption as well as emissions, from all life cycle stages including; material production, manufacturing, use and maintenance, and end-of-life (Figure 1.1).

LCA is a widely-used and accepted method for studies of environmental performance of various products and systems. The LCA in this report is performed in accordance with ISO 14040:2006 (European Committee for Standardization, 2006) and ISO 14044:2006 standards (European Committee for Standardization, 2006).

Figure 1.1: Illustration of an LCA-system.

2 Goal and scope

The goal of the study is to calculate and present the environmental performance of Granab Subfloor System to be published in EPDs for business to business communication. The LCA report may only be communicated to the third-party verifier and to Granab. Shall not be publicly available.

2.1 Declared unit

The declared unit is the unit that all the results in the study are related to. The declared unit for the LCA reported in this document is:

1 m^2 of Granab subfloor System.

- Steel subfloor system, corresponding to 2.3 kg
- Wood subfloor system, corresponding to 2.7 kg

2.2 Studied product system -life cycle stages

The scope of the EPDs generated corresponds to "Cradle to gate (A1-A3) with modules C1-C4, module D and with optional module A4". An overview of the life cycle stages included in the LCA study are presented in Table 2.1: .

Table 2.1: Life cycle stages included in this study.

Life cycle stage	Information module	Asset life cycle stages (EN15804+A2)	Mandatory or Optional?	Covered by the EPD? (1)
Upstream	Product stage	A1 Raw material supply	Mandatory	X
Core		A2 Transport		
		A3 Manufacturing		
Downstream	Construction Process stage	A4 Transport	Optional	X
		A5 Construction installation	*Optional*	*MND*
	Use stage	*B1 Use*	*Optional*	*MND*
		B2 Maintenance		
		B3 Repair		
		B4 Replacement		
		B5 Refurbishment		
		B6 Operational energy use		
		B7 Operational water use		
	End of life stage	C1 Deconstruction, demolition	Mandatory	X
		C2 Transport		
		C3 Waste processing	Mandatory	X
		C4 Disposal		
	Benefits and loads beyond the system boundary	D Future, reuse, recycling or energy recovery potentials	Mandatory	X

(1) Modules included in the EPD (X) and the modules not declared (MND).

Detailed flowcharts are presented in appendix A.

2.2.1 Information about the product

In the old EPD 2020, the particle board (a layer on top of the subfloor) was included, but in this EPD 2022 it was decided to exclude it since it is not produced by Granab and it is delivered separately by the manufacturer (Bygg Elit).

Steel subfloor system

The composition of the steel based subfloor system is presented in Table 2.2.

Table 2.2: Parts and materials in the Granab steel flooring system as well as packaging materials.

Parts	Raw material	Amount [kg per m2]	Composition [% of total]	Post-consumer recycled material [% of total]	Biogenic material [% of total]	Biogenic material [kg C/kg product]
Profiles	Galvanized steel	1.95	85%	2%	0%	0
Support block	Polypropylene (PP)	0.2	11%	0%	0%	0
Expandable screw	Steel	0.05	2.0%	0%	0%	0
Damping element	Polyurethane (PUR)	0.05	2.2%	0%	0%	0
	Total	2.3	100%	2%	0%	0

Packaging material	Amount [kg per m2]	Versus the product [%]	Biogenic material [kg C/kg bio mtrl]	Biogenic material [kg C per m2]	Biogenic material [kg C/kg product]
Plastic packaging	0.01	0.4%	0	0	0
Steel band	0.01	0.2%	0	0	0
Wood based packaging	0.02	0.7%	0.43	0.007	0.003
Corrugated board	0.005	0.2%	0.52	0.002	0.001
Total	0.04	1.6%	-	0.010	0.004

The steel corresponds to 85% and the total weight of the flooring system is about 2.3 kg per m². The post-consumer recycled material arise from the steel (around 2.6% in the steel from SSAB*85% of the product is steel) and there is no biogenic material in the product.

Per declared unit (1 m2 subfloor system), there is 0.01 kg of biogenic material from packaging and packaging as such corresponds to 1.6 w-% in relation to the product weight.

Wood subfloor system

The composition of the wood based subfloor system is presented in Table 2.3.

Table 2.3: Parts and materials in the Granab wood flooring system as well as packaging materials.

Parts	Raw material	Amount [kg per m2]	Composition [% of total]	Post-consumer recycled material [% of total]	Biogenic material [% of total]	Biogenic material [kg C/kg product]
Wood	LVL (Laminated Veneer Lumber)	2.40	88%	0%	88%	0.37
Support block	Polypropylene (PP)	0.24	9%	0%	0%	0
Expandable screw	Steel	0.05	1.6%	0%	0%	0
Damping element	Polyurethane (PUR)	0.05	1.8%	0%	0%	0
	Total	2.7	100%	0%	88%	0.37

Packaging material	Amount [kg per m2]	Versus the product [%]	Biogenic material [kg C/kg bio mtrl]	Biogenic material [kg C per m2]	Biogenic material [kg C/kg product]
Plastic packaging	0.01	0.3%	0	0	0
Steel band	0.01	0.2%	0	0	0
Wood based packaging	0.02	0.6%	0.43	0.007	0.003
Corrugated board	0.005	0.2%	0.52	0.002	0.001
Total	0.04	1.3%	-	0.010	0.003

The wood corresponds to 88% and the total weight of the flooring system is about 2.7 kg per m^2. The content of biogenic material is 88% (the LVL wood raw material), which corresponds to 0.37 kg of biogenic carbon per kg product. There is no post-consumer recycled material in the product.

Per declared unit (1 m2 subfloor system), there is 0.01 kg of biogenic material from packaging and packaging as such corresponds to 1.3 w-% in relation to the product weight.

The subfloor product

Granab subfloor systems are used in homes, offices, schools and public buildings: they are constructed with non-deformable galvanised steel floor girders and an effective sound-dampening resilient suspension system. The subfloor system is secured to the subflooring and set at the desired height. Surface flooring made from chipboard and parquet or carpet is laid over the system.

Figure 2.1: The steel and the wood subfloor systems.

2.2.2 Content declaration

For construction product EPDs compliant with EN 15804 (CEN 2013), the content declaration shall at least declare the substances contained in the product that are listed in the "Candidate List of Substances of Very High Concern for Authorization", in case their content exceeds the limits for registration with the European Chemicals Agency (0.1% of the weight of the product). Granab declares that their products do not contain substances of very high concern (SVHC) as defined and listed in the European Chemicals Agency (ECHA) Candidate List of substances of very high concern for Authorization, in levels above 0.01% by weight for the products that concern this LCA report.

2.2.3 Flowcharts

Steel subfloor system

A flowchart illustrating the LCA model for the steel subfloor system is presented in Figure 2.1.

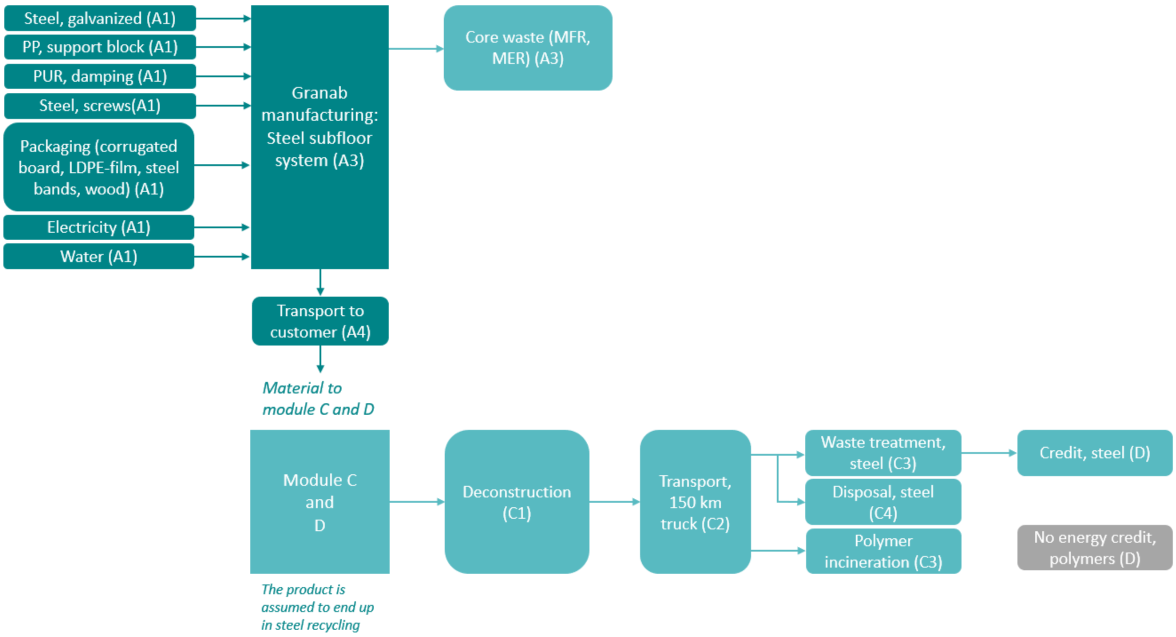


Figure 2.2: The steel subfloor system flowchart.

As described in section 2.2.1, the steel subfloor system mainly consists of steel and in addition some polymer materials. The core process (A3) only uses energy in terms of electricity, and since the electricity production is accounted for in A3, there is no impact for A3 in the LCA model, except for the core waste. The core waste corresponds to minor waste flows such as steel and plastics for recycling (MFR) and materials for energy recovery (MFR) and here only a transport of the core waste has been considered.

An estimated average of 400 km by truck has been applied for the transport to customer (A4)

For end of life (module C), the steel subfloor system has been assumed to end up in steel recycling. After deconstruction (C1) and transport (C2), 95% of the steel is assumed to be sorted out for recycling (construction waste treatment (C3)) and the rest is disposed (C4). The polymers are assumed to burn in the steel recycling (EAF; electric arc furnace) (polymer incineration (C3)).

The steel is provided a credit in module D, while the energy generated at polymer incineration is not since this is no "valuable" energy that can be recovered.

Wood subfloor system

A flowchart illustrating the LCA model for the wood subfloor system is presented in Figure 2.3.

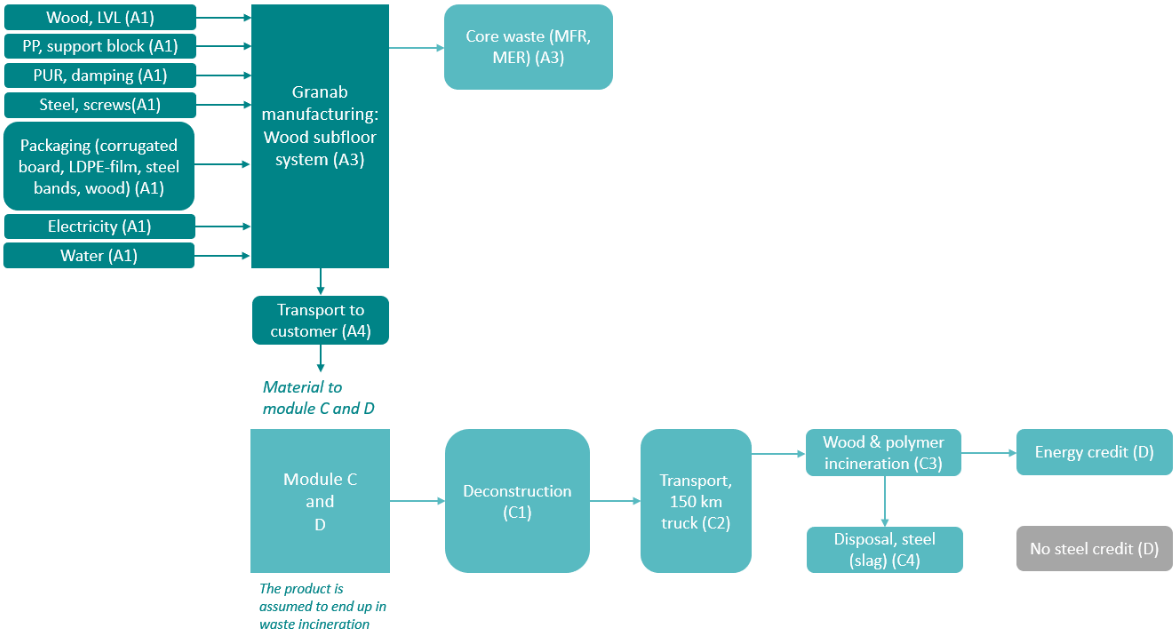


Figure 2.3: The wood subfloor system flowchart.

As described in section 2.2.1, the wood subfloor system mainly consists of wood and in addition some polymer materials. The core process (A3) only uses energy in terms of electricity, and since the electricity production is accounted for in A3, there is no impact for A3 in the LCA model. The core waste corresponds to minor waste flows such as plastics for recycling (MFR) and materials for energy recovery (MFR) and here only a transport of the core waste has been considered.

An estimated average of 400 km by truck has been applied for the transport to customer (A4)

For end of life (module C), the wood subfloor system has been assumed to end up in waste incineration. After deconstruction (C1) and transport (C2), the wood subfloor system is incinerated (C3) and the steel (minor parts such as screws) forms slag and is disposed (C4).

The energy (elctricity and heat) generated from incineration of the wood and polymers is provided a credit in module D.

2.3 Overall LCA methodology

Methodology aspects considered in this LCA, such as allocation procedures, cut-off criteria and other key assumptions, are described in this section.

2.3.1 System boundaries

2.3.1.1 Boundaries towards nature

This LCA is a cradle to gate with options. For inputs of fuels, electricity and raw materials the cradle of the life cycle is nature. The boundary between nature and the product life cycle is crossed when the natural resources (e.g. crude oil or uranium) are extracted from the ground. The "grave" of the life cycle is:

- the soil (after human activity has ceased, and landfill gas emissions and leakage production are minimal),
- the air (e.g. emissions from combustion of fuels) or
- water (e.g. water emissions from wastewater treatment).

2.3.1.2 Boundaries within the life cycle

The production, maintenance and after-use treatment of capital goods, such as machines, power stations, etc., "overhead" activities, such as heating of buildings and lighting, and the activities of the employees are not included in the life cycle.

Electricity production and the conversion of energy resources into fuels are included in the life cycle system. This means that emissions and natural resources demand from electricity and fuel production are included. Here, the inflows to the system are, instead of electricity, the energy resources including crude oil, coal, hydropower, and uranium etc., used for the electricity production.

2.3.1.3 Geographical boundaries

The study reflects production in Sweden at two site (Lidköping and Vårgårda) and a weighted average has been compiled.

For production of electricity, the residual mix for Sweden has been applied.

2.3.2 System expansion

In line with the EPD methodology, no system expansion has been applied.

2.3.3 Allocation

No co-product allocation has been applied since not relevant.

2.3.4 Cut-off criteria

The maximum cut-off criteria established by the PCR and EN 15804 standard is 1% of all material and energy flows to a single unit process and 5% of total inflows (mass and energy) to the upstream and core module. No cut-offs exceeding this limit have been made. Waste treatment of packaging material has been excluded due to very small amounts and has therefore been considered as negligible.

2.4 Data quality and representativeness

The type of data used to model the system may affect the relevance, reliability and accessibility of any LCA study. Relevance of the data is how the data represents what it is supposed to represent. The different aspects of relevance can for instance be temporal, geographical and technological representativeness, as well as completeness of the data. Reliability deals with the precision of the data, while accessibility deals with the ability to review and reuse the data.

Concerning the relevance of the data in the study, all data for module A3 (manufacturing at Granab) have been collected by Granab directly from the production sites and are average values for the year 2019.

Concerning A1 (upstream raw material production), specific data from 2017 have been applied from the steel supplier SSAB based on an EPD published 2020 according to EN15804+A1. However since IVL was the consultant to SSAB, the data valid for the EN15804+A2 versions of the indicators was available and used (for the steel in the steel subfloor system).

For the wood subfloor system, data based on an EPD published 2022 (EN15804+A2 - data from 2018) from the supplier Metsä has been applied.

Database data (Gabi/spehra database) were used for the other minor raw materials (PP, PUR and steel screws) as well as for production of electricity used in the core process and for transportation.

According to the PCR, the quality assessment shall cover at least 80% of the absolute impact of any core environmental indicators. Except for the main raw materials (steel in the steel subfloor system and wood in the wood subfloor system), the PP support block is the second material influencing the results for the core environmental indicators. The data quality for the data applied for PP (a combination of PlasticsEurope 2014 (EU average) and energy use at supplier (VIAB) is at least assessed to be fair.

As for the reliability of the data, they are assumed to be the most relevant data available. Finally, the study is sufficiently accessible and reproducible since all the data used, assumptions made, and datasets applied can be found in this report, in background data files and in the Gabi LCA models for the third-party verifier to review.

A summary of the assessment of the data quality can be found in Table 2.4.

Table 2.4: Data quality assessment for the study.

Aspect	Notes
Data quality assessment scheme	The data quality level and criteria from the EN15804+A2 standard (1) has been applied in this study. The classification levels according to these criteria are for representativeness and coverage; very good, good, fair, poor and very poor
Geographical coverage	Core module (A3): Very good (same data applied for both subfloor systems)
Technological representativeness	Core module (A3): Very good (same data applied for both subfloor systems)
Time-related coverage	Core module (A3): Very good (same data applied for both subfloor systems)
Geographical coverage, Technological representativeness and Time-related coverage	Upstream and downstream data: For the main raw materials steel and wood in the two subfloor systems, specific supplier data has been used, and the data quality is therefore assessed to be Very good Other data is based on data from LCA databases, primarily Gabi by sphera. The details valid in this study can be found in the electronic appendix for data collection and in chapter 3.
Validity	The technological and geographical coverage of the data chosen reflect the physical reality of the product system modelled.
Plausibility	The results and data used for the study have been checked for plausibility: The SSAB data for galvanized steel lies around the same level or just below when comparing to other EPDs and about 4% lower for fossil GWP than the EU average published by worldsteel. The LVL wood data applied (Metsä EPD) corresponds to 0.55 kg fossil CO_2 per kg. Comparing to simple wood (Swedish wood EPD, 0.3 kg fossil CO_2 per kg), which in this study was used for wood packaging, it seems logical that the more processed wood material by Metsä ends up at a much larger impact.
Precision	Material and energy flows quantified based on generic data from the sphera database, but these activities have a minor influence on the results.
Completeness	Data accounts for all known sub-processes. Some upstream processes were modelled using generic data from the sphera database, using country-specific datasets whenever available, otherwise using European datasets.
Consistency, allocation method, etc.	No co-product allocation has been applied since co-products are not relevant.
Completeness and treatment of missing data	No data is found missing.
Final result of data quality assessment	Data quality as required in EN15804+A2 is met.

(1) Table E.1 — Data quality level and criteria of the UN Environment Global Guidance on LCA database development.

For the modules declared, the geographical scope as well as the share of specific data (based on the GWP-GHG indicator) are presented in Table 2.5 - Table 2.6. If there is a variation of the GWP-GHG indicator concerning different products or production sites, this should also be declared. The product variation is not relevant in this case since only one product is analysed (steel based or wood based subfloor system) reported in separate EPD documents.

There are two production sites, for which a weighted average has been applied. The GWP-GHG impact from this "core process" (electricity use) is very small (less than 1% of A1-A3), which means that the variation between this weighted average and the site with the smallest and largest electricity use is by far lower than 10%, and this is stated in Table 2.5 - Table 2.6.

The background data can be found in the sheet SpecData etc in the results file (electronic appendix).

Concerning the variation between sites, some calculation checks and conclusions can be found in the data file for the steel subfloor system (sheet: Granab_Original).

Table 2.5: Steel subfloor system - Modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation.

Life cycle stage	Module		Modules declared (1)	Granab subfloor system: Steel		Variation - products	Variation - sites
				Geography	Specific data used		
Product stage	Raw material supply	A1	X	FI [(2)]	87%	Not relevant since only one product	Two sites, variation <10%
	Transport	A2	X	FI/SE [(3)]	1%		
	Manufacturing	A3	X	SE [(4)]	0%		
Construction process stage	Transport	A4	X	SE [(5)]	0%		
	Construction installation	A5	MND	-	-	-	-
Use stage	Use	B1	MND	-	-	-	-
	Maintenance	B2	MND	-	-	-	-
	Repair	B3	MND	-	-	-	-
	Replacement	B4	MND	-	-	-	-
	Refurbishment	B5	MND	-	-	-	-
	Operational energy use	B6	MND	-	-	-	-
	Operational water use	B7	MND	-	-	-	-
End of life stage	De-construction demolition	C1	X	SE	-	-	-
	Transport	C2	X	SE	-	-	-
	Waste processing	C3	X	SE	-	-	-
	Disposal	C4	X	SE	-	-	-
Resource recovery stage	Reuse-Recovery-Recycling-potential	D	X	SE	-	-	-
				Total	88%		

(1) Modules included in the EPD (X) and the modules not declared (MND).

(2) The raw material is mainly steel (corresponding to 85% of the raw materials) and the supplier is SSAB (Finland). For other raw materials (e.g. polymers) generic database data has been applied. The electricity production for the electricity used in the core process is included here as well, but this only corresponds to 0.3% of the GWP-GHG (A1-A3).

(3) The steel transportation data is specific in terms of distances and transport modes and this is the longest transport, for the other raw materials 500 km by truck has been assumed. The steel corresponds to 85% of the raw materials so 85% of the GWP-GHG for raw material transport has been applied here.

(4) In the manufacturing (core process) only electricity is used, but since electricity production is considered in A1, the core process beccomes zero.

(5) Since the transport to the customer has just been assumed (as 400 km by truck) the specific data is zero.

Table 2.6: Wood subfloor system - Modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation.

Life cycle stage	Module		Modules declared (1)	Granab subfloor system: Wood		Variation - products	Variation - sites
				Geography	Specific data used		
Product stage	Raw material supply	A1	X	FI (2)	57%	Not relevant since only one product	Two sites, variation <10%
	Transport	A2	X	FI/SE (3)	4%		
	Manufacturing	A3	X	SE (4)	0%		
Construction process stage	Transport	A4	X	SE (5)	0%		
	Construction installation	A5	MND	-	-	-	-
Use stage	Use	B1	MND	-	-	-	-
	Maintenance	B2	MND	-	-	-	-
	Repair	B3	MND	-	-	-	-
	Replacement	B4	MND	-	-	-	-
	Refurbishment	B5	MND	-	-	-	-
	Operational energy use	B6	MND	-	-	-	-
	Operational water use	B7	MND	-	-	-	-
End of life stage	De-construction demolition	C1	X	SE	-	-	-
	Transport	C2	X	SE	-	-	-
	Waste processing	C3	X	SE	-	-	-
	Disposal	C4	X	SE	-	-	-
Resource recovery stage	Reuse-Recovery-Recycling-potential	D	X	SE	-	-	-
				Total	62%		

(1) Modules included in the EPD (X) and the modules not declared (MND).

(2) The raw material is mainly wood (corresponding to 88% of the raw materials) and the supplier is located in Finland. Specific data in terms of an EPD has been applied and in this EPD it is stated that 90% of the data A1-A3 is specific. Therefore 90% of the GWP-GHG for the wood contribution is considered as specific data. For other raw materials (e.g. polymers) generic database data has been applied.

(3) The wood transportation data is specific in terms of distances and transport modes and this is the longest transport, for the other raw materials 500 km by truck has been assumed. The wood corresponds to 88% of the raw materials so 88% of the GWP-GHG for raw material transport has been applied here.

(4) In the manufacturing (core process) only electricity is used, but since electricity production is considered in A1, the core process beccomes zero.

(5) Since the transport to the customer has just been assumed (as 400 km by truck) the specific data is zero.

2.5 Limitations and key assumptions

An LCA studie is always based on certain assumptions, which limits the studie and its results.

This LCA and corresponding EPD are assessed to have no significant limitations worth mentioning, since for instance the main materials (steel or wood) are based on certified EPDs from the suppliers.

The transport to customer (A4) is based on a more or less representative average (400 km by truck) which in reality varies from customer to customer. Transport A4 corresponds to around 1.5% of the GWP-GHG A1-A4.

The assumptions made and the data used to model module C and D are the most uncertain.

2.6 Life cycle impact assessment

2.6.1 Impact assessment indicators

Life cycle impact assessment (LCIA) is where inventory results for all flows (material, energy and emissions) are used to evaluate each material and emissions impact on different impact categories.

In line with the requirements in the PCR the indicators described in this section have been applied in the life cycle impact assessment.

These indicators were already entered by sphera in the Gabi database. The indicators for the environmental impacts e.g. GWP and AP were however cross-checked to make sure the correct characterization factors were applied by sphera. The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.

The indicators are described in Appendix A and are based on the versions required in the EN15804+A2 standard.

2.6.2 Content of biogenic carbon

The content of biogenic carbon (as kg of carbon) shall be declared both for the product and for the packaging materials (Table 2.7: Content of biogenic carbon – steel subfloor system. - Table 2.8).

Steel subfloor system

Table 2.7: Content of biogenic carbon – steel subfloor system.

Biogenic carbon content	Unit per DU (1 m^2)	Amount
Biogenic carbon content in product	kg C	0
Biogenic carbon content in packaging	kg C	0.01

(1) 1 kg biogenic carbon is equivalent to 44/12 kg CO2.

The steel subfloor system does not contain any bio based materials. The biogenic carbon content in the packaging materials is based on the following:

- Corrugated board: Based on the Fefco/sphera data applied for production of corrugated board, there is 1.9 kg CO_2 uptake/kg. This corresponds to 1.9*12/44 = 0.52 kg of biogenic carbon stored in the paper product
- Wood used as packaging materials: Based on the EPD applied for the production of wood packaging (EPD (S-P-02537) published by Swedish wood 2021), the stored bio C in the wood is 0.43 kg CO_2/kg
- Plastic packaging and steel bands have no content of biogenic carbon

Wood subfloor system

Table 2.8: Content of biogenic carbon – wood subfloor system.

Biogenic carbon content	Unit per DU (1 m²)	Amount
Biogenic carbon content in product	kg C	1
Biogenic carbon content in packaging	kg C	0.02

The biogenic carbon content in the product arise from the wood raw material and is based on the EPD applied (Metsä 2022), which states 0.42 kg biogenic carbon per kg wood.

The same data as for the steel subfloor system has been applied for the biogenic carbon content in the packaging materials (see above) but also the biogenic carbon content in the packaging materials reported in the wood EPD by Metsä has been added (0.0027 kg kg biogenic carbon per kg wood).

2.6.3 Energy content of the product

The energy content of the product is useful information in the end-of-life management. For this reason, the PCR requires that the "energy content of the product" shall be declared (in MJ) based on the material composition of the product and by considering the upper heating value of the raw materials. Only the raw materials that are relevant for energy recovery at the end-of-life shall be considered.

Steel subfloor system

The calculation of the energy content in the steel subfloor system is presented in Table 2.9.

Table 2.9: Energy content – steel subfloor system.

Materials	Amount	Energy content per kg material		Energy content
	[kg/m2]	[MJ/kg]	Reference	[MJ/m2]
Steel profiles, galvanized	2.0	0	-	0
PP, support block	0.2	43.0	sphera	10.4
Steel, expandable screw	0.05	0	-	0
PUR, estimated with EPDM (damping element)	0.05	27.0	sphera	1.3
			TOTAL	**11.8**

Only the polymers contribute to the energy content and the heat values for these (PP and PUR) is based on data in the Gabi database (by sphera).

Wood subfloor system

The calculation of the energy content in the steel subfloor system is presented in Table 2.10.Table 2.10: Energy content – wood subfloor system.

Materials	Amount	Energy content per kg material		Energy content
	[kg/m2]	[MJ/kg]	Reference	[MJ/m2]
Wood, LVL (Laminated Veneer Lumber) (1)	2.4	18.9	-	45.4
PP, support block	0.2	43.0	sphera	10.4
Steel, expandable screw	0.05	0	-	0
PUR, estimated with EPDM (damping element)	0.05	27.0	sphera	1.3
			TOTAL	57.1

(1) The heat value of 18.9 MJ/kg is based on the value for PERM in the applied EPD for LVL wood (Metsä 2022)

For the wood subfloor system, the LVL wood contribute to the energy content (in addition to the polymers mentioned above).

2.7 Critical review procedure

David Althoff Palm at Ramboll has performed an independent external critical review of this report in order to ensure that the following criteria are met:

- The methods used to carry out the LCA are consistent with the ISO 14044:2006 standard and in line with the applied PCR.
- The methods used to carry out the LCA are scientifically and technically valid.
- The data used are appropriate and reasonable in relation to the goal of the study.
- The interpretations reflect the limitations identified and the goal of the study.
- The study report is transparent and consistent.

3 Life cycle inventory (LCI)

The life cycle inventory analysis describes the data collection in terms site specific data, database data used as well as other information such as statistics on which the study are based.

3.1 Raw materials (A1)

The data for production of raw materials are presented in Table 3.1 - Table 3.3. The input data is provided to Granab as Excel files (electronic appendix).

3.1.1 Steel subfloor system

Table 3.1: Data for production of raw materials – steel subfloor system.

Raw material	Data applied and reference	Comment	GWP-fossil [kg CO_2eq/kg]
Galvanized steel	EPD: SSAB, Metal Coated Coil, EPD International 2020 (data from 2017) + Energy use at supplier (Boxholms Profil)	SSAB is the supplier of the steel. Data from SSABs EPD were applied and the electricity use from the supplier of the profiles was added (modelled with Swedish average electricity production mix) (1).	2.4

(1) The electricity use at the supplier corresponds to only 0.02% of the impact.

For the galvanized steel, specific data from 2017 have been applied from the steel supplier SSAB based on an EPD published 2020 according to EN15804+A1. However since IVL was the consultant to SSAB, the results valid for the EN15804+A2 versions of the indicators was possible to compile since based on the original LCA model.

3.1.2 Wood subfloor system

Table 3.2: Data for production of raw materials – wood subfloor system.

Raw material	Data applied and reference	Comment	GWP-fossil [kg CO_2eq/kg]
Wood, LVL (Laminated Veneer Lumber)	EPD: Metsä, Kerto LVL (Laminated Veneer Lumber), EPD International, 2022 (data from 2018)	Metsä is the supplier of the LVL wood. Data from Metsäs EPD were applied. The EPD is according to En15804+A2.	0.55

3.1.3 Both subfloor systems

The raw materials in Table 3.3 are common for both subfloor systems.

Table 3.3: Data for production of raw materials – both subfloor system.

Raw material	Data applied and reference	Comment	GWP-fossil [kg CO_2eq/kg]
Polypropylene (PP)	PP (PlasticsEurope 2014, EU) + Energy use at supplier (VIAB)	To the generic database data for PP, the electricity use from the supplier of the PP support block was added (modelled with Swedish average electricity production mix) (1).	1.7
Steel (for screws etc.)	Steel Engineering steel (Worldsteel 2018, EU)	Generic database data for production of steel via the Electric arc furnace route, which has a lower impact than blast furnace-based steel.	1.1
Polyurethane (PUR)	Ethylene Propylene Diene Elastomer (EPDM), 2017(Gabi/sphera database)	Supplier data were asked for but were not available. It was however assessed that the material is quite similar to EPDM, which is why an estimation with generic database data for EPDM was made.	3.5

(1) The electricity use at the supplier corresponds to 3% of the impact.

3.2 Transport of raw materials (A2)

The data used and assumptions made for raw material transport are presented in Table 3.4. SSAB is the supplier of the galvanized steel, produced in Hämeenlinna, Finland. The fact that the profiles are transported via the sub-supplier Boxholms profil has been assmed as negligible. For all truck transport, a load factor of 85% has been applied.

Table 3.4: Transport of raw materials.

Raw material	Type of transport	Supplier site (city, country)	One way distance [km]
Galvanized steel	Truck	SSAB, Hämeenlinna, FI (1)	550
Galvanized steel	Ship, coastal	SSAB, Hämeenlinna, FI (2)	344
Wood, LVL	Truck	Metsä, Varkaus, FI (3)	740
Wood, LVL	Ship, coastal	Metsä, Varkaus, FI (4)	439
Polypropylene (PP)	Truck	Tier 1 is close, but tier 2 unknown. An assumed distance of 500 km has been applied.	500
Steel	Truck		500
Polyurethane (PUR)	Truck		500
Other - such as pack materials etc.	Truck	-	200

(1) The routes Hämeenlinna - Åbo and Nynäshamn-Vårgårda by truck are assumed.

(2) Åbo - Nynäshamn by ship.

(3) The routes Varkaus - Helsingfors and Stockholm-Vårgårda by truck are assumed.

(4) Helsingfors - Stockholm by ship.

The truck fuel is assumed to be Swedish "reduktionspliktsdiesel" (see further details in section 3.5.2) since a vast majority of the truck transports occur in Sweden. A small part actually occurs in Finland (for both the galvanized steel and the LVL wood), but this small error has been considered as negligible.

3.3 Manufacturing (A3)

Granab has two manufacturing sites located in Lidköping and Vårgårda, Sweden. The production of flooring systems at the two sites in 2019 was 300 000 m² (270 000 m² in Lidköping and 30 000 m² in Vårgårda).

3.3.1 Product composition

The compositions of the two flooring systems presented in Table 3.5 - Table 3.6 were provided by Granab [Granab 2022]. A more detailed illustration of material composition, content of post-consumer material and biogenic material was presented in Table 2.2 - Table 2.3.

Table 3.5: Parts and materials in the Granab steel subfloor system per m².

Parts	Raw material	Amount [kg per m2]	Composition [% of total]
Profiles	Galvanized steel	1.95	85%
Support block	Polypropylene (PP)	0.2	11%
Expandable screw	Steel	0.05	2.0%
Damping element	Polyurethane (PUR)	0.05	2.2%
	Total	**2.3**	**100%**

The following changes have been made compared to the old EPD 2020:

- The particle board, which is actually a part of the final building application, has been removed since it is not a part of the product produced by Granab
- Granab has now reduced the amount of steel from 2.88 kg to 1.95 kg

Except for the steel profiles, there is no scrap generated. There is about 2% of steel scrap, corresponding to 0.04 kg per m². These losses have not been added to the raw material consumption of steel, since this high-quality scrap can be used as raw material in production of other products. The losses also correspond to a quite small part. A transport of the scrap to material recycling is considered though, see end of life of core waste below.

Table 3.6: Parts and materials in the Granab wood subfloor system per m².

Parts	Raw material	Amount [kg per m2]	Composition [% of total]
Wood	LVL (Laminated Veneer Lumber)	2.4	88%
Support block	Polypropylene (PP)	0.24	9%
Expandable screw	Steel	0.05	1.6%
Damping element	Polyurethane (PUR)	0.05	1.8%
	Total	**2.7**	**100%**

In the wood based subfloor system, the steel (1.95 kg) has been replaced by LVL wood (2.4 kg).

3.3.2 Manufacturing

The data for the manufacturing of the flooring system were provided per year for each of the two sites; about 54 000 kWh of electricity per each site [Granab 2020]. The figures were added and divided with the total production at the two sites, 300 000 m^2 (Table 3.7).

Table 3.7: Granab manufacturing per m^2.

Granab manufacturing	Unit	Amount [Unit per m2]
Electricity	kWh	0.36
Water	m3	0.001

Most of the manufacturing occurs in Lidköping although there are more office spaces and employees at Vårgårda which is the reason that approximately the same energy is consumed at both sites.

The production of the electricity is modelled according to the Swedish residual mix (section 3.5.1).

3.3.3 Packaging materials

The data for the use of packaging materials were provided by Granab [Granab 2020]. The data applied for the production of packaging materials are presented in Table 3.8.

Table 3.8: Production of packaging materials.

Packaging material	Amount [kg per m2]	Data applied and reference	Comment	GWP-fossil (1) [kg CO_2eq/kg]
Plastic packaging	0.009	LDPE film (PlasticsEurope 2014 & sphera, EU)	Gabi model by IVL based on PlasticsEurope and Gabi/sphera database (film production).	2.1
Steel band	0.006	Steel Engineering steel (Worldsteel 2018, EU)	Generic database data for production of steel via the Electric arc furnace route.	1.0
Wood based packaging	0.017	Swedish sawn dried timber of spruce or pine	EPD by Swedish wood 2021 (2)	0.06 (GWP-f) -1.6 (GWP-tot)
Corrugated board	0.005	Corrugated board box (Fefco 2018)	Gabi model by IVL based on Fefco.	0.9 (GWP-f) -1.6 (GWP-tot)

(1) For the wood-based materials, the GWP is presented for both GWP-fossil and GWP-tot. For the other materials, GWP-fossil.

(2) The revised version published 210325, since the first version had errors for GWP bio, GWP tot, Biogenic carbon content and density.

3.3.4 End of life of core waste

Steel subfloor system

The core waste consists of plastics and combustible waste as well as some steel scrap (as mentioned above).

The generated core process waste (to energy recovery) only corresponds to 0.4% of the total raw material inputs to Granabs manufacturing. The end of life management has therefore been assumed as negligible and has not been included. A transport though (200 km by truck) was considered in the LCA modelling.

For steel and plastics to recycling a cut off is made, which is according to EPD rules, a transport though (200 km by truck) was considered in the LCA modelling.

Wood subfloor system

The same is valid for the wood subfloor system, except that no steel scrap is generated.

3.4 Transport to average customer (A4)

When declaring the life cycles stages A1-A3 in an EPD, the A4 transport shall not be included. The reason however for including this transport is to be comparable with the Norwegian EPD system, since this transport is required in this EPD system.

An average distance of 400 km by truck was estimated by Granab [Granab 2020], see Table 3.9.

Table 3.9: A4 transportation.

Additional technical information			
Scenario	**Parameter**	**Units**	**Value**
A4 Transport to site (to an average customer)	Vehicle type used for transport	-	Truck, Euro 6
	Vehicle load capacity	tonnes per vehicle	22
	Fuel type	-	Diesel
	Fuel consumption	Litre of fuel per km	0.35
	Distance to construction site	km	400
	Capacity utilization (empty return not relevant)	%	60
	Bulk density of transported products	kg/m^3	Unknown
	Volume capacity utilization factor	Not applicable	-

The bulk density of the actual transport is unknown. However, a low load factor (Capacity utilization) of 60% was assumed as a conservative approach. This transport also corresponds to a rather small impact on the total results (0.04 kg CO_2eq per DU for fossil GWP, which can be compared with the total A1-A3 for the steel subfloor system of 5.5). The fuel mix for this truck transport is "reduktionspliktsdiesel 2022" since the customer transport is within Sweden.

3.5 Generic data for energy and transport

3.5.1 Electricity production

The data for the production of electricity applied in the core phase as well as for the supplier operations (steel profiles and PP support block) represent Swedish residual mix (Gabi/sphera).

Table 3.10: Swedish residual mix (Gabi/sphera).

Energy source	Share
Hydro power	15.73%
Wind power	5.00%
Biomass	10.00%
Photovoltaics	1.30%
Renewable unspecified	0.54%
Nuclear power	62.64%
Fuel oil	0.30%
Natural gas	0%
Hard coal	0.80%
Lignite	0%
Fossil unspecified	3.72%

The electricity mix corresponds to a climate change impact of 44 g CO2 per kWh.

3.5.2 Transport data

Transport data from the Gabi/sphera database has been applied. The following data sets were used:

- GLO: Truck, 28-32 t tot weight, MPL 22 t, Euro 6
- Bulk commodity ship, 1,500 to 20,000 dwt payload capacity, coastal going

The truck fuel is assumed to be Swedish "reduktionspliktsdiesel", which according to the legislation in 2022 means that the GWP fossil shall be reduced by 30.5% compared to 100% diesel. This in turn means that the bio fuel share needed to be 36.3%. Since the RME is constant at 6% (the maximum legislated limit for RME is 7%, but most fuel suppliers has about 1% less), this means that the HVO is 30.3%.

In the EPD 2020, the truck fuel was instead based on 5% RME. Furthermore, there were some errors in the truck modelling, which made the GWP bio results for truck transport negative. The error, which has now been corrected, was due to that the data used for fuel production (the "uptake" of CO_2 bio for the bio fuel component) was larger than the CO_2 bio emission from the fuel combustion in the actual transport.

3.6 End of life (C) and Benefits (D)

3.6.1 End of life (module C)

Steel subfloor system

For the end of life (module C) generic data has been used to estimate C1 Deconstruction, C2 Transport (150 km by truck), C3 Waste processing and C4 Disposal. The generic data used and the corresponding GWP impact can be found in the Excel data file for the steel subfloor system (sheet: Module C & D).

The steel subfloor is considered to end up at steel recycling due to the large content of steel, and before that the product is probably not sorted out into the different material parts. This in turn means that the other materials than steel (polymers) is burned in the electric arc furnace (EAF) when the steel is melted.

- About 95% of the steel subfloor is assumed to end up at steel recycling (going through C3), while the rest ends up in C4.
- Since about 3% of the steel is based on external scrap in the first place (SSAB), the amount of steel to be credited in module D is decreased by 3% and furthermore a yield loss of 10% is assumed in the EAF, resulting in that 82% of the steel is credit in module D.
- The polymers (PP and PUR) are as mentioned assumed to burn in the EAF and for the incineration (C3) data (Gabi/sphera) has been applied. This data has been considered as sufficient enough even though based on incineration in a waste incineration plant.

Wood subfloor system

The wood subfloor is assumed to end up at waste incineration.

The same generic data as for the steel subfloor system has been applied for C1 Deconstruction and C2 Transport (150 km by truck) and C4 Disposal.

For C3 Waste processing data for incineration of the wood, PP and PUR has been applied (Gabi/sphera). The small part of the product consisting of steel screws is considered as intert material and has been left out from the C3 modelling. This part has been considered to end up in C4 Disposal since becomes slag.

The generic data used and the corresponding GWP impact can be found in the Excel data file for the wood subfloor system (sheet: Module C & D).

3.6.2 Benefits (module D)

Steel subfloor system

For the steel part, the credit in module D is made by applying the "value of scrap" published by worldsteel (1.6 kg CO_2eq per kg steel).

Since the polymer parts end up together with the product in steel recycling, module D (i.e. credit for generated energy) is not relevant since no "valuable" energy is generated.

Wood subfloor system

The credit applied in module D is associated with the generated electricity and heat in the waste incineration of the wood and the polymers in the product.

The generic data used and the corresponding GWP impact can be found in the Excel data file for the wood subfloor system (sheet: Module C & D).

4 Life cycle impact assessment (LCIA)

4.1 Results for all indicators

The results is provided to Granab and to the verifier as one separate Excel file for each of the two subfloor systems.

The indicators required in the applied PCR for this LCA and EPD were described in section 2.6. The results are presented per declared unit (1 m² of subfloor system) and per life cycle stage (Table 4.1 - Table 4.2).

4.1.1 Remarks for some indicators

The material resources with energy content

The two resource indicators reflecting material resources with an energy content PERM (renewable) and PENRM (non-renewable) OFTEN provide a zero result since input data to the LCA-models (i.e. database data such as production of a materials e.g. fossil based polymer) generally does not distinguish between an energy carrier used as fuel and as material. Therefore, it is often not possible to calculate the results into these two categories (even though this is required). It is however not impossible to model this in Gabi, but require some efforts and the calculation has therefore instead been made afterwards in the Excel results file. PERM and PENRM have also been "equalized" in C3.

Steel subfloor system

For the steel sub floor system, the main material is steel which is not relevant for PERM or PENRM since has no energy content. The only relevant materials are the PP (11 w-%) and the PUR (2 w-%)

Instead of modelling this in Gabi, manual adjustments were made in the result Excel file, see the sheet Table for report. Here the PENRM and PERE have been adjusted by adding the energy content in the polymers to PENRM and withdrawing the same value from PERE.Wood subfloor system

For the wood sub floor system, the main material is wood which is relevant for the PERM (renewable) indicator and this has been considered already in the Gabi model.

And in the same way as for the steel sub floor system, a manual adjustment has been made in the result Excel file for the energy content in the PP and PUR materials relevant for the PENRM and PERE indicators, see the sheet Table for report.

EEE and EET

Wood subfloor system

The electricity generated in incineration of the product has been added in the EEE indicator and the heat in the EET indicator, see the sheet Table for report.

Table 4.1: Steel subfloor system - Results per declared unit (DU); 1 m² of subfloor system corresponding to 2.3 kg.

Indicator	Unit per declared unit	A1 Raw material supply	A2 Transport	A3 Manufacturing	TOTAL A1-A3	A4 Transport to customer	C1 Deconstruction	C2 Transport	C3 Waste processing	C4 Disposal: Steel	D Benefits
Environmental indicators according to EN15804+A2											
Global warming potential (GWP), excl biogenic carbon	kg CO2 eq	5.40E+00	6.25E-02	4.45E-04	**5.47E+00**	3.92E-02	7.49E-04	1.47E-02	8.53E-01	1.46E-03	-2.70E+00
Climate Change - total	kg CO2 eq	5.52E+00	6.48E-02	4.63E-04	**5.58E+00**	4.08E-02	7.66E-04	1.53E-02	8.53E-01	1.44E-03	-2.82E+00
Climate Change - fossil	kg CO2 eq	5.53E+00	6.33E-02	4.50E-04	**5.59E+00**	3.96E-02	7.58E-04	1.48E-02	8.53E-01	1.49E-03	-2.82E+00
Climate Change - biogenic	kg CO2 eq	-6.71E-03	9.07E-04	7.54E-06	**-5.79E-03**	6.65E-04	3.23E-06	2.50E-04	1.94E-05	-4.40E-05	-1.60E-03
Climate Change - land use and land use change	kg CO2 eq	1.49E-03	6.01E-04	5.07E-06	**2.09E-03**	4.47E-04	4.27E-06	1.68E-04	2.52E-05	2.74E-06	-6.17E-05
Ozone depletion	kg CFC-11 eq	5.50E-09	6.23E-16	8.44E-20	**5.50E-09**	7.44E-18	4.59E-17	2.79E-18	3.80E-14	3.49E-15	-6.71E-15
Acidification	mole H+ eq	1.55E-02	2.57E-04	5.90E-07	**1.57E-02**	5.20E-05	4.43E-06	2.01E-05	2.64E-04	1.05E-05	-5.01E-03
Eutrophication aquatic freshwater	kg P eq	1.88E-05	4.75E-07	3.99E-09	**1.93E-05**	3.51E-07	2.29E-09	1.32E-07	2.86E-08	2.52E-09	-6.13E-07
Eutrophication aquatic marine	kg N eq	3.81E-03	1.17E-04	1.81E-07	**3.93E-03**	1.60E-05	2.17E-06	6.29E-06	9.24E-05	2.69E-06	-9.68E-04
Eutrophication terrestrial	mole N eq	4.11E-02	1.33E-03	2.43E-06	**4.24E-02**	2.14E-04	2.40E-05	8.39E-05	1.34E-03	2.96E-05	-9.78E-03
Photochemical ozone formation	kg NMVOC eq	1.18E-02	3.07E-04	4.36E-07	**1.21E-02**	3.84E-05	4.19E-06	1.50E-05	2.42E-04	8.19E-06	-4.32E-03
Depletion of abiotic resources - minerals and metals	kg Sb eq	3.44E-04	5.95E-09	4.68E-11	**3.44E-04**	4.12E-09	6.40E-11	1.55E-09	6.61E-09	1.52E-10	-6.99E-06
Depletion of abiotic resources - fossil fuels	MJ	8.47E+01	8.12E-01	5.71E-03	**8.55E+01**	5.03E-01	1.02E-02	1.89E-01	2.54E-01	1.95E-02	-2.76E+01
Water use	m3	-8.41E-02	9.63E-04	3.64E-02	**-4.68E-02**	7.02E-04	6.87E-06	2.64E-04	8.01E-02	1.63E-04	-7.68E+00
Particulate Matter emissions	Disease incidences	1.47E-07	3.62E-09	3.80E-12	**1.51E-07**	3.35E-10	1.54E-11	1.28E-10	1.58E-09	1.30E-10	-9.53E-08
Ionizing radiation, human health	kBq U235 eq	3.23E-01	2.59E-04	2.00E-06	**3.23E-01**	1.76E-04	1.85E-06	6.63E-05	1.43E-03	2.41E-05	5.20E-02
Eco-toxicity (freshwater)	CTUe	1.55E+01	5.63E-01	3.96E-03	**1.61E+01**	3.49E-01	7.10E-03	1.31E-01	1.18E-01	1.09E-02	-1.78E+00
Human toxicity, cancer effects	CTUh	9.27E-10	1.43E-11	1.06E-13	**9.42E-10**	9.34E-12	1.43E-13	3.51E-12	1.07E-11	1.66E-12	-1.53E-09
Human toxicity, non-cancer effects	CTUh	4.20E-08	1.06E-09	8.27E-12	**4.31E-08**	7.28E-10	8.00E-12	2.73E-10	7.56E-10	1.84E-10	-3.43E-08
Land use related impacts/ Soil quality	Pt	6.81E+00	6.28E-01	5.29E-03	**7.44E+00**	4.66E-01	3.52E-03	1.75E-01	5.92E-02	4.05E-03	4.13E-01
Other indicators according to EN15804+A1 and A2											
Use of renewable primary energy excluding renewable primary energy resources used as raw materials (PERE)	MJ	6.40E+00	8.45E-02	7.09E-04	**6.49E+00**	6.25E-02	5.82E-04	2.35E-02	4.31E-02	2.92E-03	1.73E+00
Use of renewable primary energy resources used as raw materials (PERM)	MJ	2.28E-01	0.00E+00	0.00E+00	**2.28E-01**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	MJ	6.63E+00	8.45E-02	7.09E-04	**6.72E+00**	6.25E-02	5.82E-04	2.35E-02	4.31E-02	2.92E-03	1.73E+00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials (PENRE)	MJ	7.29E+01	8.13E-01	5.72E-03	**7.37E+01**	5.04E-01	1.03E-02	1.89E-01	2.54E-01	1.95E-02	-2.76E+01
Use of non-renewable primary energy resources used as raw materials (PENRM)	MJ	1.18E+01	0.00E+00	0.00E+00	**1.18E+01**	0.00E+00	0.00E+00	0.00E+00	-1.18E+01	0.00E+00	0.00E+00
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	MJ	8.47E+01	8.13E-01	5.72E-03	**8.55E+01**	5.04E-01	1.03E-02	1.89E-01	-1.15E+01	1.95E-02	-2.76E+01
Use of secondary material (SM)	kg	1.09E-01	0.00E+00	0.00E+00	**1.09E-01**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels (RSF)	MJ	1.66E-22	0.00E+00	0.00E+00	**1.66E-22**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non renewable secondary fuels (NRSF)	MJ	1.95E-21	0.00E+00	0.00E+00	**1.95E-21**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water (FW)	m3	5.16E-03	1.12E-04	8.48E-04	**6.12E-03**	8.28E-05	6.58E-07	3.11E-05	1.91E-03	4.95E-06	-1.79E-01
Hazardous waste disposed (HWD)	kg	2.85E-06	4.45E-11	3.72E-13	**2.85E-06**	3.28E-11	4.91E-14	1.23E-11	1.35E-11	1.00E-12	6.03E-09
Non-hazardous waste disposed (NHWD)	kg	6.09E-02	2.88E-04	2.32E-06	**6.12E-02**	2.05E-04	1.47E-06	7.69E-05	1.01E-02	9.97E-02	3.51E-01
Radioactive waste disposed (RWD)	kg	2.88E-03	1.99E-06	1.56E-08	**2.89E-03**	1.37E-06	1.26E-08	5.15E-07	1.21E-05	2.17E-07	2.99E-06
Components for re-use (CRU)	kg	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (MFR)	kg	1.00E-04	0.00E+00	4.33E-02	**4.34E-02**	0.00E+00	0.00E+00	0.00E+00	1.66E+00	0.00E+00	0.00E+00
Material for energy recovery (MER)	kg	6.68E-05	0.00E+00	9.33E-03	**9.40E-03**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported electrical energy (EEE)	MJ	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported thermal energy (EET)	MJ	8.60E-04	0.00E+00	0.00E+00	**8.60E-04**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Remarks

The value for PENRM is the energy content of the product (from the fossil based polymers). PENRM has been "equalized" in C3

The value for SM arise from the galvanized steel (50%) and from the steel screws (50%), the latter used in much smaller amount, but is however based on scrap

Table 4.2: Wood subfloor system - Results per declared unit (DU); 1 m² of subfloor system corresponding to 2.7 kg.

Indicator	Unit per declared unit	A1 Raw material supply	A2 Transport	A3 Manufacturing	TOTAL A1-A3	A4 Transport to customer	C1 Deconstruction	C2 Transport	C3 Waste processing	C4 Disposal: Steel	D Benefits
Environmental indicators according to EN15804+A2											
Global warming potential (GWP), excl biogenic carbon	kg CO2 eq	1.97E+00	9.78E-02	1.07E-04	**2.07E+00**	4.68E-02	8.94E-04	1.75E-02	1.78E+00	6.41E-04	-5.43E-01
Climate Change - total	kg CO2 eq	-1.15E+00	1.01E-01	1.11E-04	**-1.05E+00**	4.87E-02	9.14E-04	1.82E-02	4.82E+00	6.33E-04	-5.66E-01
Climate Change - fossil	kg CO2 eq	1.99E+00	9.90E-02	1.08E-04	**2.08E+00**	4.73E-02	9.05E-04	1.77E-02	1.78E+00	6.51E-04	-5.60E-01
Climate Change - biogenic	kg CO2 eq	-3.14E+00	1.42E-03	1.81E-06	**-3.14E+00**	7.93E-04	3.85E-06	2.98E-04	3.04E+00	-1.93E-05	-6.04E-03
Climate Change - land use and land use change	kg CO2 eq	1.77E-03	9.40E-04	1.22E-06	**2.71E-03**	5.33E-04	5.10E-06	2.00E-04	8.90E-06	1.20E-06	-6.87E-04
Ozone depletion	kg CFC-11 eq	5.50E-09	9.79E-16	2.03E-20	**5.50E-09**	8.88E-18	5.48E-17	3.34E-18	1.73E-13	1.53E-15	-3.72E-13
Acidification	mole H+ eq	6.90E-03	4.04E-04	1.42E-07	**7.30E-03**	6.21E-05	5.29E-06	2.41E-05	2.36E-03	4.62E-06	-3.33E-03
Eutrophication aquatic freshwater	kg P eq	1.66E-05	7.43E-07	9.60E-10	**1.73E-05**	4.20E-07	2.73E-09	1.58E-07	9.98E-08	1.10E-09	-2.81E-05
Eutrophication aquatic marine	kg N eq	2.26E-03	1.83E-04	4.36E-08	**2.44E-03**	1.91E-05	2.59E-06	7.52E-06	1.04E-03	1.18E-06	-1.23E-03
Eutrophication terrestrial	mole N eq	2.45E-02	2.09E-03	5.85E-07	**2.66E-02**	2.56E-04	2.87E-05	1.00E-04	1.28E-02	1.30E-05	-9.88E-03
Photochemical ozone formation	kg NMVOC eq	7.19E-03	4.82E-04	1.05E-07	**7.67E-03**	4.58E-05	5.00E-06	1.79E-05	2.68E-03	3.59E-06	-2.62E-03
Depletion of abiotic resources - minerals and metals	kg Sb eq	1.68E-06	9.31E-09	1.13E-11	**1.69E-06**	4.92E-09	7.64E-11	1.85E-09	7.07E-09	6.67E-11	-1.81E-07
Depletion of abiotic resources - fossil fuels	MJ	2.77E+01	1.27E+00	1.37E-03	**2.89E+01**	6.01E-01	1.22E-02	2.26E-01	1.28E+00	8.53E-03	-1.81E+01
Water use	m3	-7.04E-02	1.51E-03	3.64E-02	**-3.26E-02**	8.38E-04	8.20E-06	3.15E-04	5.14E-01	7.14E-05	-2.06E-01
Particulate Matter emissions	Disease incidences	2.13E-08	5.68E-09	9.14E-13	**2.70E-08**	4.00E-10	1.84E-11	1.53E-10	7.70E-09	5.68E-11	-3.07E-08
Ionizing radiation, human health	kBq U235 eq	2.07E-01	4.05E-04	4.82E-07	**2.07E-01**	2.11E-04	2.21E-06	7.92E-05	1.07E-02	1.06E-05	-6.07E-01
Eco-toxicity (freshwater)	CTUe	4.63E+00	8.81E-01	9.52E-04	**5.51E+00**	4.16E-01	8.48E-03	1.56E-01	4.05E-01	4.78E-03	-8.48E+00
Human toxicity, cancer effects	CTUh	1.35E-10	2.24E-11	2.55E-14	**1.57E-10**	1.11E-11	1.71E-13	4.19E-12	6.68E-11	7.29E-13	-4.20E-10
Human toxicity, non-cancer effects	CTUh	6.23E-09	1.66E-09	1.99E-12	**7.89E-09**	8.70E-10	9.55E-12	3.26E-10	5.38E-09	8.08E-11	-2.49E-08
Land use related impacts/ Soil quality	Pt	2.01E+00	9.82E-01	1.27E-03	**3.00E+00**	5.57E-01	4.20E-03	2.09E-01	2.97E-01	1.77E-03	-8.71E+01
Other indicators according to EN15804+A1 and A2											
Use of renewable primary energy excluding renewable primary energy resources used as raw materials (PERE)	MJ	1.82E+01	1.32E-01	1.70E-04	**1.83E+01**	7.46E-02	6.95E-04	2.80E-02	2.72E-01	1.28E-03	-2.38E+01
Use of renewable primary energy resources used as raw materials (PERM)	MJ	4.55E+01	0.00E+00	0.00E+00	**4.55E+01**	0.00E+00	0.00E+00	0.00E+00	-4.55E+01	0.00E+00	0.00E+00
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	MJ	6.36E+01	1.32E-01	1.70E-04	**6.38E+01**	7.46E-02	6.95E-04	2.80E-02	-4.52E+01	1.28E-03	-2.38E+01
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials (PENRE)	MJ	8.37E+01	1.27E+00	1.38E-03	**8.49E+01**	6.02E-01	1.22E-02	2.26E-01	1.28E+00	8.54E-03	-1.81E+01
Use of non-renewable primary energy resources used as raw materials (PENRM)	MJ	1.44E+01	0.00E+00	0.00E+00	**1.44E+01**	0.00E+00	0.00E+00	0.00E+00	-1.44E+01	0.00E+00	0.00E+00
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	MJ	9.80E+01	1.27E+00	1.38E-03	**9.93E+01**	6.02E-01	1.22E-02	2.26E-01	-1.31E+01	8.54E-03	-1.81E+01
Use of secondary material (SM)	kg	5.85E-02	0.00E+00	0.00E+00	**5.85E-02**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels (RSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non renewable secondary fuels (NRSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water (FW)	m3	1.07E-02	1.75E-04	8.47E-04	**1.17E-02**	9.89E-05	7.86E-07	3.72E-05	1.23E-02	2.17E-06	-1.25E-02
Hazardous waste disposed (HWD)	kg	2.95E-06	6.96E-11	8.95E-14	**2.95E-06**	3.91E-11	5.87E-14	1.47E-11	1.19E-10	4.39E-13	-2.69E-09
Non-hazardous waste disposed (NHWD)	kg	3.03E-02	4.50E-04	5.59E-07	**3.07E-02**	2.44E-04	1.76E-06	9.18E-05	3.88E-02	4.37E-02	-2.53E-02
Radioactive waste disposed (RWD)	kg	3.72E-03	3.12E-06	3.74E-09	**3.72E-03**	1.64E-06	1.51E-08	6.15E-07	9.34E-05	9.50E-08	-5.23E-03
Components for re-use (CRU)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (MFR)	kg	1.00E-04	0.00E+00	3.33E-03	**3.43E-03**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Material for energy recovery (MER)	kg	6.68E-05	0.00E+00	9.33E-03	**9.40E-03**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported electrical energy (EEE)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.20E+00	0.00E+00	0.00E+00
Exported thermal energy (EET)	MJ	8.60E-04	0.00E+00	0.00E+00	**8.60E-04**	0.00E+00	0.00E+00	0.00E+00	4.05E+01	0.00E+00	0.00E+00

Remarks

The value for PERM in A1 is from the energy content of the LVL wood raw material as well as from renewable packaging materials (the latter a very small part though). PERM has been "equalized" in C3 for the energy in the product (not in the packaging)

The value for PENRM is the energy content of the product (from the fossil based polymers) and actually also from some fossil based adhesive in the LVL wood raw material. PENRM has been "equalized" in C3

The value for SM arise entirely from the steel screws, which are made from scrap based steel

The values for EEE and EET arise from the amount of electricity and thermal energy generated in the incineration (C3) of wood and polymers and for which a credit is provided in module D

Disclaimers to Table 4.1 - Table 4.2.

ILCD classification	Indicator	Disclaimer
ILCD Type 1	Global warming potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
ILCD Type 2	Acidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD Type 3	Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans (HTP-c)	2
	Potential Comparative Toxic Unit for humans (HTP-nc)	2
	Potential Soil quality index (SQP)	2
Disclaimer 1 – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.		
Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.		

4.2 Steel subfloor system

4.2.1 Fossil climate change

The result in terms of fossil climate change for the steel subfloor system is presented in Figure 4.1.

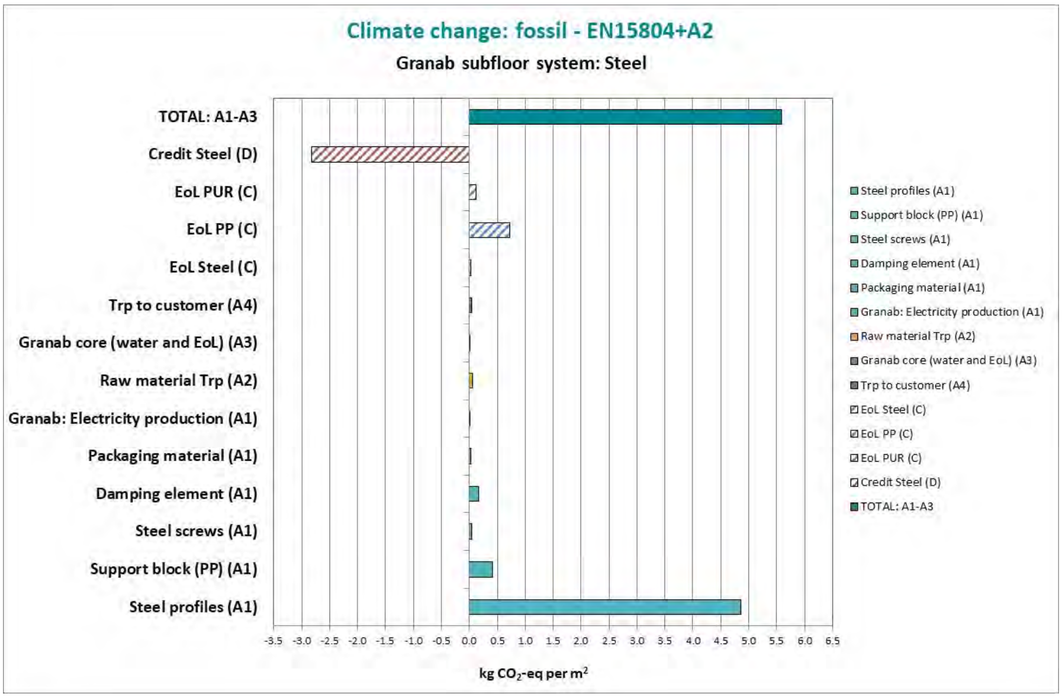


Figure 4.1: Fossil climate change (kg CO_2 equivalents per m²) divided on sub-processes for the life cycle stages A1-A3, A4, module C and D.

The diagram illustrates all life cycle stages, but a total has only been made for A1-A3 since not allowed to make a total for all. The production of the steel corresponds to 87% of A1-A3, the PP support block to 7% and the damping element to 3%. All other activities have minor influence (Figure 4.2).

The credit for the steel in module D corresponds to -2.5 kg CO_2 equivalents per m², which can be compared with the total from A1-A3 of 5.5 kg CO_2 equivalents per m².

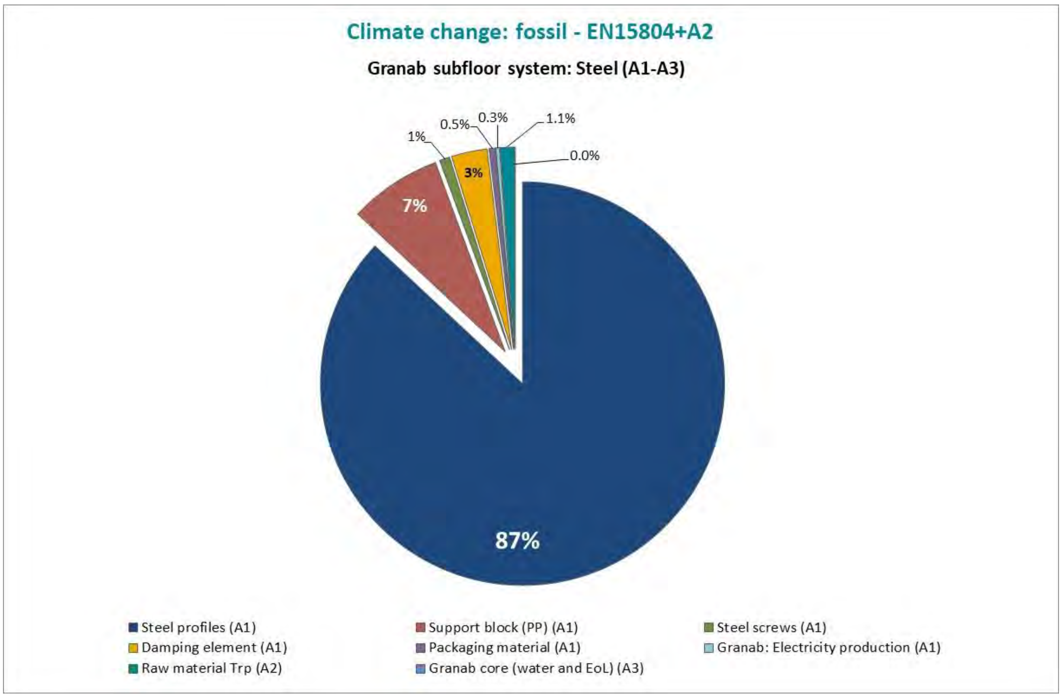


Figure 4.2: Relative contributions for fossil climate change (%) divided on sub-processes for the life cycle stages A1-A3.

4.2.2 Biogenic climate change

The result in terms of biogenic climate change for the steel subfloor system is presented in Figure 4.3.

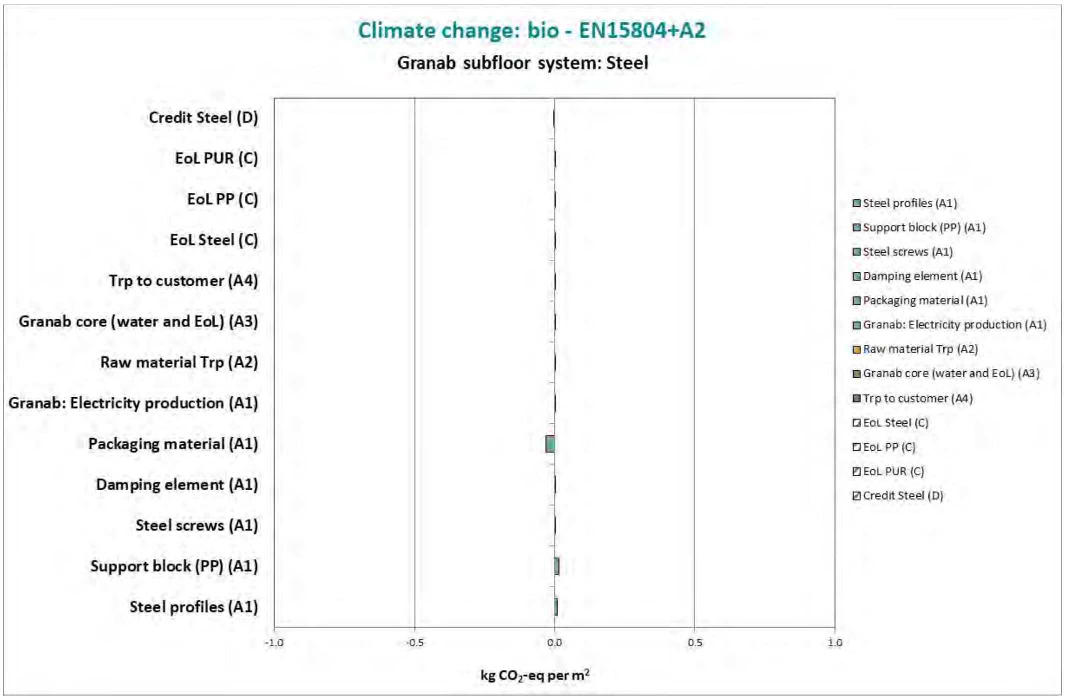


Figure 4.3: Biogenic climate change (kg CO_2 equivalents per m²) divided on sub-processes for the life cycle stages A1-A3, A4, module C and D.

Biogenic carbon stored in a bio based material (accounted for as an "uptake" showing a minus value), will sooner or later be equalized by the release of the same amount of biogenic carbon when the material is incinerated. If the material is recycled, the release of the biogenic carbon is prolonged until the material is incinerated.

In this LCA, the biogenic climate change is more or less equalized over the life cycle. The production of packaging material (such as corrugated board and wood) shows a small minus which is due to the "uptake" (stored) biogenic carbon in these materials. These packaging materials has been assumed to be recycled and therefore there is a net minus over the life cycle (even though very small).

4.3 Wood subfloor system

4.3.1 Fossil climate change

The result in terms of fossil climate change for the wood subfloor system is presented in Figure 4.4.

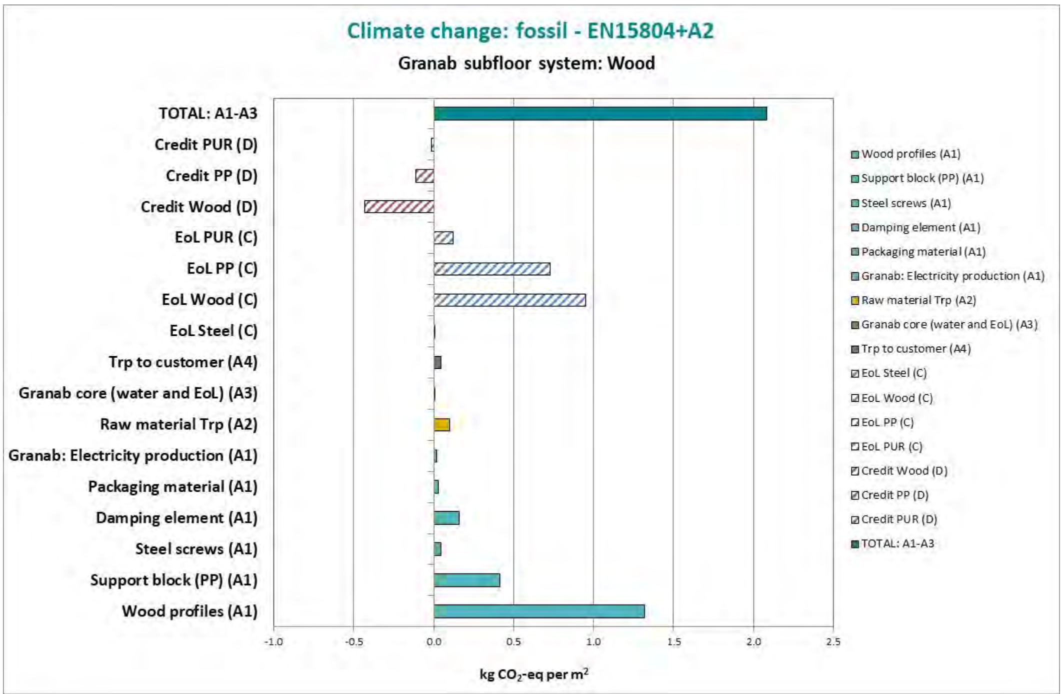


Figure 4.4: Fossil climate change (kg CO_2 equivalents per m²) divided on sub-processes for the life cycle stages A1-A3, A4, module C and D.

The diagram illustrates all life cycle stages, but a total has only been made for A1-A3 since not allowed to make a total for all. The production of the wood corresponds to 63% of A1-A3, the PP support block to 20%, the damping element to 8% and the raw material transport to 5%. All other activities have minor influence (Figure 4.5).

The end of life processes (module C) stands out, especially the incineration of the wood (0.9 kg CO_2eq), which is due to the fact that the wood is the major material and that the data applied is based on processed wood (0.4 kg CO_2eq per kg wood), otherwise the fossil climate change would have been zero. This might have been a too conservative assumption, but was made since the LVL wood contains phenol formaldehyde adhesive (about 7%). The other two materials shown in C3 are the polymers (PP and PUR), and this result is expected since incineration of fossil based polymers has a CO_2 high impact.

The energy credit for the wood in module D corresponds to -0.4 kg CO_2 equivalents per m^2, which can be compared with the total from A1-A3 of 2.1 kg CO_2 equivalents per m^2.

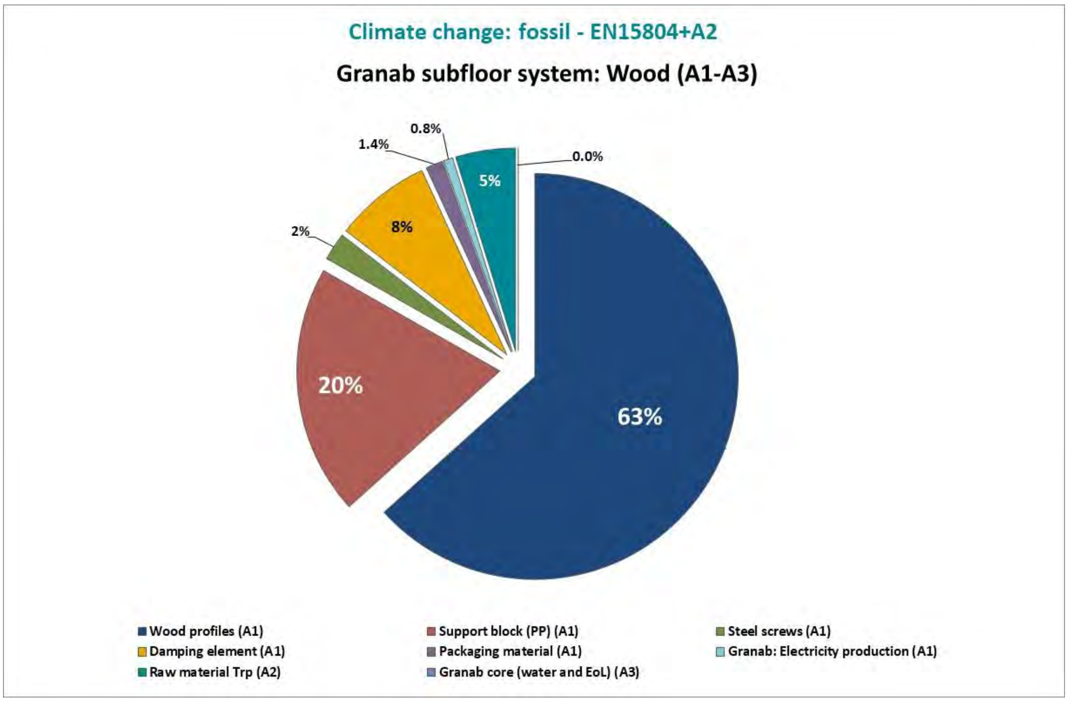


Figure 4.5: Relative contributions for fossil climate change (%) divided on sub-processes for the life cycle stages A1-A3.

4.3.2 Biogenic climate change

The result in terms of biogenic climate change for the steel subfloor system is presented in Figure 4.6.

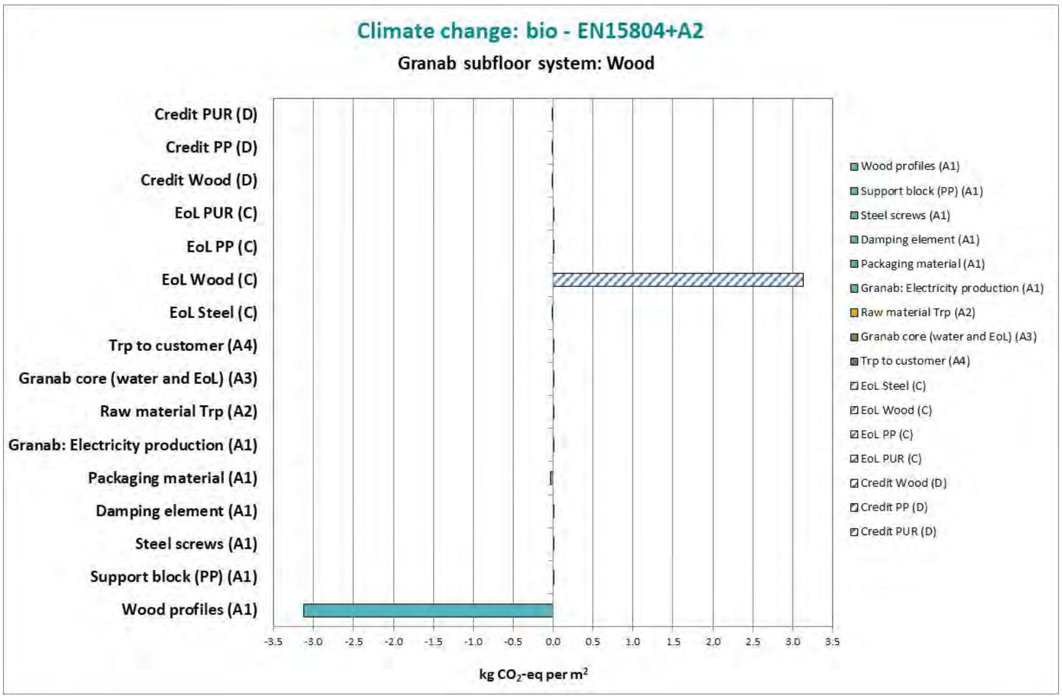


Figure 4.6: Biogenic climate change (kg CO_2 equivalents per m^2) divided on sub-processes for the life cycle stages A1-A3, A4, module C and D.

Biogenic carbon stored in a bio based material (accounted for as an "uptake" showing a minus value), will sooner or later be equalized by the release of the same amount of biogenic carbon when the material is incinerated. If the material is recycled, the release of the biogenic carbon is prolonged until the material is incinerated.

In this LCA, the biogenic climate change is equalized over the life cycle. The production of the LVL wood shows a minus of 3.1 CO_2 equivalents per m^2, which is due to the "uptake" (stored) biogenic carbon in the material. The wood is assumed to be incinerated (module C), which generates 3.1 kg of biogenic CO_2 emissions.

4.4 Other indicators: Energy content in the product

Steel subfloor system

The calculation of the energy content of the product (steel subfloor system) is presented in Table 4.3.

Table 4.3: Energy content of the product – steel subfloor system.

Materials	Amount	Energy content per kg material		Energy content
	[kg/m2]	[MJ/kg]	Reference	[MJ/m2]
Steel profiles, galvanized	2.0	0	-	0
PP, support block	0.2	43.0	sphera	10.4
Steel, expandable screw	0.05	0	-	0
PUR, estimated with EPDM (damping element)	0.05	27.0	sphera	1.3
			TOTAL	**11.8**

Wood subfloor system

The calculation of the energy content of the product (wood subfloor system) is presented in Table 4.4.

Table 4.4: Energy content of the product –wood subfloor system.

Materials	Amount	Energy content per kg material		Energy content
	[kg/m2]	[MJ/kg]	Reference	[MJ/m2]
Wood, LVL (Laminated Veneer Lumber)	2.4	18.9	-	45.4
PP, support block	0.2	43.0	sphera	10.4
Steel, expandable screw	0.05	0	-	0
PUR, estimated with EPDM (damping element)	0.05	27.0	sphera	1.3
			TOTAL	**57.1**

4.5 Other indicators: Biogenic carbon content

The biogenic carbon content shall be declared both for the product and for the packaging materials.

Steel subfloor system

The steel based subfloor system does not contain any biobased materials and the biogenic carbon content is therefore zero, but there is some biogenic carbon from the packaging materials (corrugated board and wood) (Table 4.5).

Table 4.5: Biogenic carbon content – steel subfloor system.

Biogenic carbon content (1)	Unit per DU	Amount
Biogenic carbon content in product	kg C	0
Biogenic carbon content in packaging	kg C	0.01

(1) 1 kg biogenic carbon is equivalent to 44/12 kg CO_2.

Wood subfloor system

The biogenic carbon content associated with the wood based subfloor system is presented in Table 4.6.

Table 4.6: Biogenic carbon content – wood subfloor system.

Biogenic carbon content (1)	Unit per DU	Amount
Biogenic carbon content in product	kg C	1.0
Biogenic carbon content in packaging	kg C	0.02

(1) 1 kg biogenic carbon is equivalent to 44/12 kg CO_2.

The amount of LVL wood used in the subfloor system is 2.4 kg per m^2. The biogenic carbon content of 1 kg per m^2 corresponds to about 0.4 kg carbon per kg wood (1.5 kg or in terms of biogenic CO_2). This is based on the data in the EPD applied for the LVL wood production (Metsä 2022).

The reason for the 50% larger biogenic carbon content for packaging materials (compared to the steel subfloor system) is due to biogenic carbon content in the packaging materials used for the LVL wood (based on the applied EPD data from Metsä).

References

CEN European Committee for Standardisation (2021). EN15804:2012+A2:2019/AC:2021 (CEN 2021), Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
Remark: This updated version of the standard (2021-07-21) corrects that the unit for Eutrophication aquatic freshwater was stated to be PO4-eq, but it was P eq (just a typo error was corrected).

CML, Institute of Environmental Sciences Faculty of Science University of Leiden, Netherlands.

CML 2012: IA version 4.1, dated October 2012, Institute of Environmental Sciences Faculty of Science University of Leiden, Netherlands.

PCR 2019:14 Construction products and Construction Services. Version 1.2.3, date 2022-07-08. The international EPD system, http://www.environdec.com/.

Fefco, European Federation of Corrugated Board Manufacturers, European Database for Corrugated Board Life Cycle Studies, 2018.

Gabi/spehra database. The Gabi database 2022.1 was used.

Gabi LCA software. The Gabi LCA software and corresponding database are provided by spehra in Leinfelden-Echterdingen, Germany. Gabi version 10 was used.

GPI, General Programme Instructions of the International EPD® System, Version 4.0.

Granab 2020 and 2022, the company producing the subfloor system studied. The data have been provided by Fredrik Blom.

ISO (2006a). ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedures.

ISO (2006b). ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework.

ISO (2006c). ISO 14044: 2006, Environmental management – Life cycle assessment – Requirements and guidelines.

Metsä EPD, Kerto LVL (Laminated Veneer Lumber), Environmental Product Declaration (EPD) - In accordance with ISO 14025 and EN 15804:2012+A2:2019, S-P-02202, The International EPD® System, 2022-01-21.

PlasticsEurope, Association of Plastics Manufacturers, Eco-profiles and Environmental Product Declarations of the European Plastics Manufacturers, High-density Polyethylene (HDPE), Low-density Polyethylene (LDPE), Linear Low-density Polyethylene (LLDPE), PlasticsEurope, April 2014.

Spehra (former thinkstep). The provider of the Gabi LCA software and database.

SSAB EPD, Metal coated steel sheets and coils, Environmental Product Declaration (EPD) - In accordance with ISO 14025 and EN 15804 +A1, S-P-01921, version 1.0, UN CPC 412, The International EPD® System, 2020-03-31.

Swedish wood EPD, Swedish sawn dried timber of spruce or pine - In accordance with ISO 14025, EN15804:2012+A2:2019, The International EPD® System, 2021-01-22, revised 2021-03-25.

World Steel Association (worldsteel) is an industry association, with members in every major steel-producing country, representing steel producers, national and regional steel industry associations, and steel research institutes.

Appendix A: Life cycle impact assessment indicators

Environmental indicators describing environmental impacts according to EN15804+A2

Indicator	Unit	Method
Environmental impacts		
Global warming potential total, GWP - total	kg CO_2 eq.	IPCC baseline, 100 years, 2013
Global warming potential fossil, GWP – fossil	kg CO_2 eq.	IPCC baseline, 100 years, 2013
Global warming potential biogenic, GWP – biogenic	kg CO_2 eq.	IPCC baseline, 100 years, 2013
Global warming potential land use and land use change, GWP – LULUC	kg CO_2 eq.	IPCC baseline, 100 years, 2013
Indicator for climate impact, GWP – GHG (greenhouse gases)	kg CO_2 eq.	Excluding biogenic carbon dioxide emissions and uptakes, and biogenic carbon stored in the product. Version AR5
Depletion potential of the stratospheric ozone layer, ODP	kg CFC-11 eq.	Steady-state ODPs, WMO 2014
Acidification potential, Accumulated Exceedance, AP	Mol H^+ eq.	Accumulated Exceedance, Seppälä et al. 2006, Posch et al., 2008
Eutrophication potential, fraction of nutrients reaching freshwater end compartment, EP-freshwater	kg P eq.	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe
Eutrophication potential, fraction of nutrients reaching freshwater end compartment, EP - marine	kg N eq.	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe
Eutrophication potential, Accumulated Exceedance, EP-terrestrial	mol N eq.	Accumulated Exceedance, Seppälä et al. 2006, Posch et al. 2008
Formation potential of tropospheric ozone, POCP	kg NMVOC eq.	LOTOS-EUROS ,Van Zelm et al., 2008, as applied in ReCiPe
Abiotic depletion potential for non-fossil resources, ADP- minerals & metals	kg Sb eq.	CML 2002, Guinée et al., 2002, and van
Abiotic depletion potential for fossil resources, ADP-fossil fuels	MJ, net calorific value	CML 2002, Guinée et al., 2002, and van
Water (user) deprivation potential, deprivation weighted water consumption, WDP	m^3 world eq. deprived	Available WAter REmaining (AWARE), Boulay et al., 2016

Optional indicators describing environmental impacts according to EN15804+A2

These indicators are optional in the EPD document, but mandatory in the LCA report.

Indicator	Unit	Method
Additional indicators		
Potential incidence of disease due to PM emissions, PM	Disease incidence	SETAC-UNEP, Fantke et al. 2016
Potential Human exposure efficiency relative to U235, IRP	kBq U235 eq.	Human health effect model as developed by Dreicer et al. 1995 update by Frischknecht et al., 2000
Potential Comparative Toxic Unit for ecosystems, ETP-fw	CTUe	Usetox version 2 until the modified USEtox model is available from EC-JRC
Potential Comparative Toxic Unit for humans (cancer effects), HTP-c	CTUh	Usetox version 2 until the modified USEtox model is available from EC-JRC
Potential Comparative Toxic Unit for humans (non-cancer effects, HTP-nc	CTUh	Usetox version 2 until the modified USEtox model is available from EC-JRC
Potential Soil quality index, SQP	na	Soil quality index based on LANCA

Resource use, waste and output flows

These indicators are the same irrespective of PCR applied.

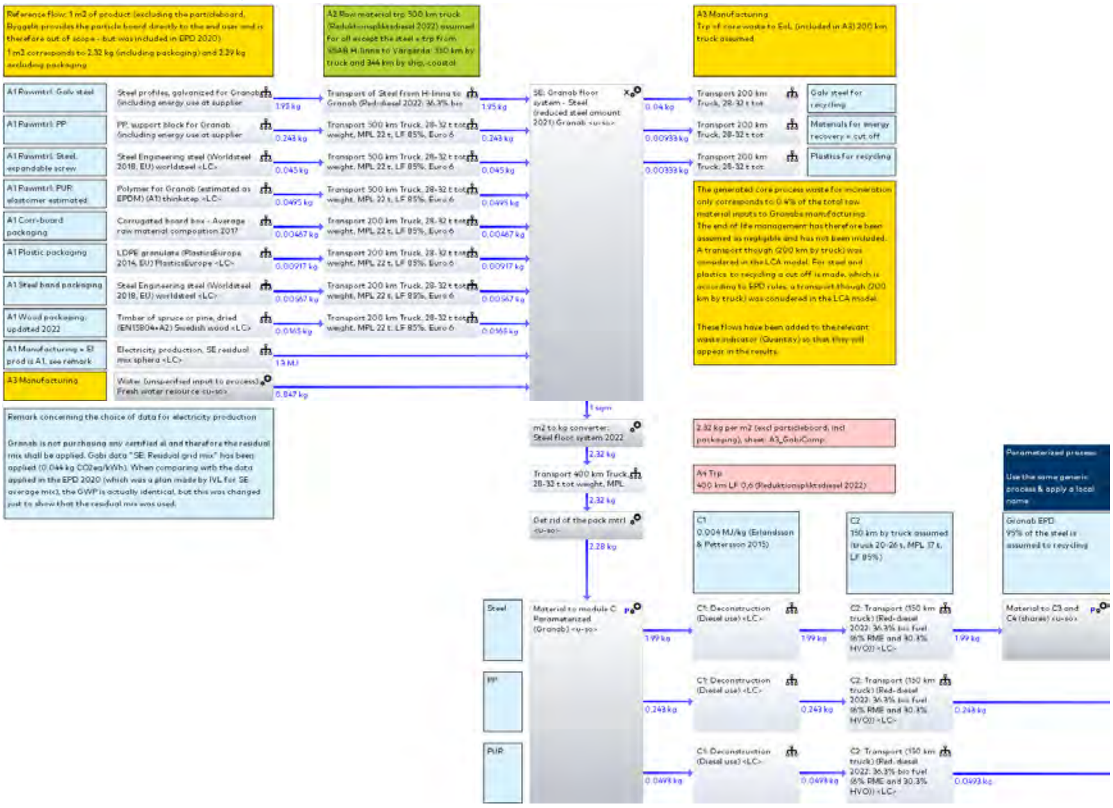
Indicator	Unit	Method
Use of resources		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials (PERE)	MJ, net calorific value	Based on LCI data
Use of renewable primary energy resources used as raw materials (PERM) (1)	MJ, net calorific value	Based on LCI data
Total use of renewable primary energy resources (PERT)	MJ, net calorific value	Based on LCI data
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials (PENRE)	MJ, net calorific value	Based on LCI data
Use of non-renewable primary energy resources used as raw material (PENRM) (1)	MJ, net calorific value	Based on LCI data
Total use of non-renewable primary energy resources (PENRT)	MJ, net calorific value	Based on LCI data
Use of secondary material (SM)	kg	Based on LCI data
Use of renewable secondary fuels (RSF)	MJ, net calorific value	Based on LCI data
Use of non-renewable secondary fuels (NRSF)	MJ, net calorific value	Based on LCI data
Net use of fresh water (FW)	m^3	Based on LCI data
Waste		
Hazardous waste disposed (HWD)	kg	Based on LCI data
Non-hazardous waste disposed (NHWD)	kg	Based on LCI data
Radioactive waste disposed (RWD)	kg	Based on LCI data
Output flows		
Components for re-use (CRU)	kg	Based on LCI data
Materials for Recycling (MFR)	kg	Based on LCI data
Material for Energy Recovery (MER)	kg	Based on LCI data
Exported electrical energy (EEE)	MJ	Based on LCI data
Exported thermal energy (EET)	MJ	Based on LCI data

(1) The impact category might provide a zero result since input data to the LCA-models (i.e. database data such as production of fuels, electricity, materials etc.) often does not distinguish between an energy carrier used as fuel and as material. Therefore, it is often not possible to present the results into these two categories (even though this is required). However, this can be done by adjusting this in the Excel results file and this has been done in this LCA.

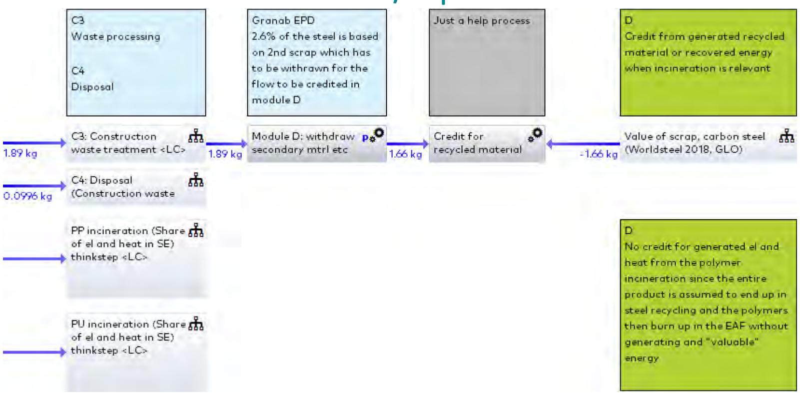
Appendix B: Flowcharts from Gabi

The studied subfloor product systems are illustrated in detail below (as a print screen from the Gabi LCA software).

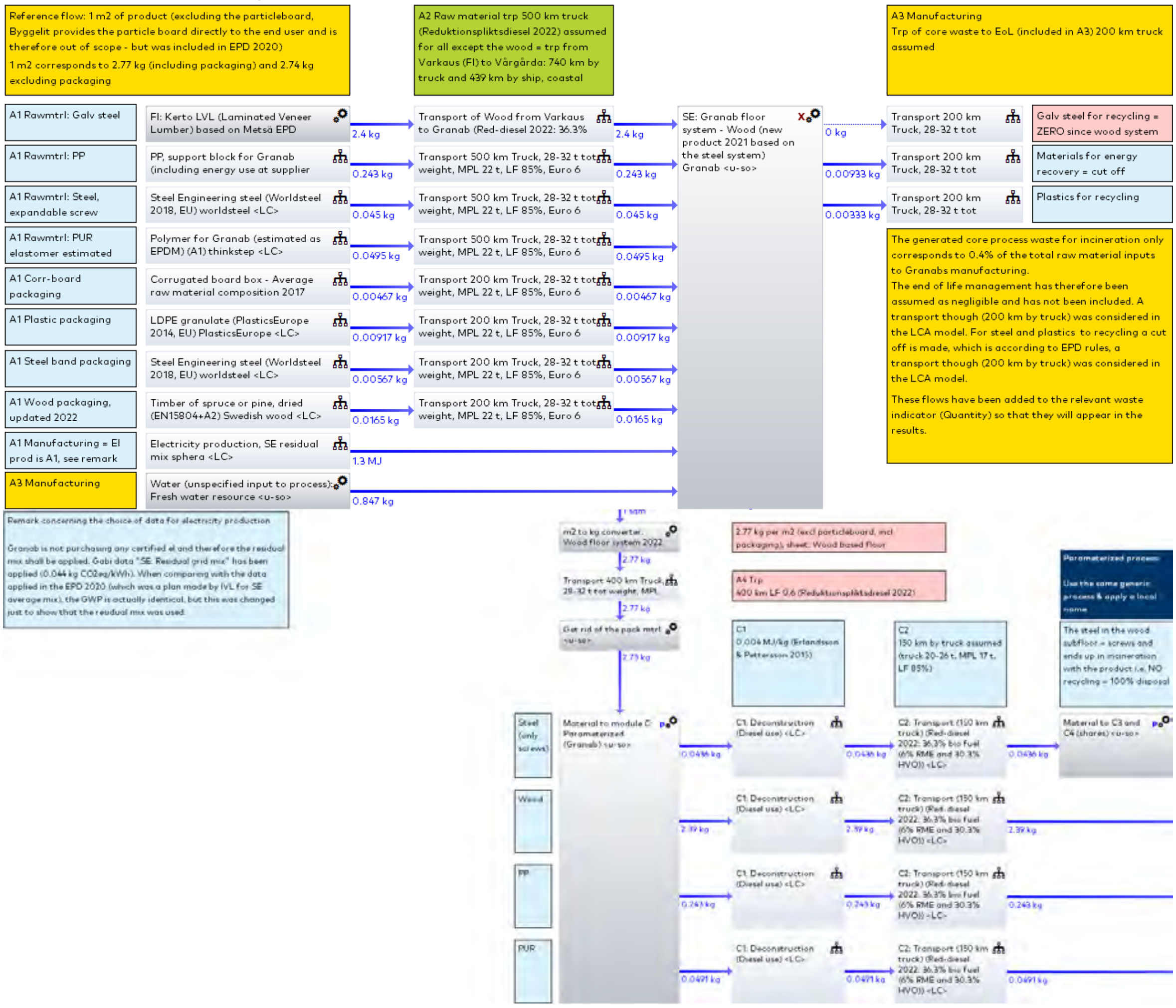
Steel subfloor system



Continuation of module C/D part...



Wood subfloor system



Continuation of module C/D part...

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