Swedish Environmental Research Institute

Generic LCA report for an EPD generator: Sawmill products

Based on joint research from KTH, SIVL and Swedish wood

Swedish Environmental Research Institute

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[Environmental Product Declaration (EPD), Life Cycle Assessment (LCA), EPD tool, EPD generator, wood, wooden products, forestry, EN16485, EN 15804]

Summary

The audience for the report is primarily the LCA consultants developing a Life Cycle Assessment (LCA) (ISO 14040, ISO 14044), or a communication version of this methodology known as Environmental Product Declaration (EPD. The report is also for anyone else that wants to understand the implementation of mandatory environmental and sustainability standards for wood-based products. The core LCA methodology for all constructions products is defined in the standard EN 15804 for Product Category Rules (PCR). Those rules are then further specified in complementary PCR (cPCR) for wood product (EN16485).

One of the goals with developing this methodology report was to streamline the settings outlined in the above mentioned standards and thereby streamline the result. In order to streamline the LCA calculations, the physical wood properties have been defined for future use, in collaboration between IVL, Swedish Wood and Skogforsk. This report can be implemented either when an EPD is manually calculated or as part of a so-called EPD tool. In the latter case the report can be defined as a generic LCA report, that needs to be complimented with on-site collected data and related calculations. The latter is normally provided by the EPD tool and produced as an offprint from such tool.

The results presented in the report include the following:

- A 'state-of the art' on PCR development for construction products and for wood-based PCR specifically highlighting future development needs.
- A common list of wood specific material characteristics that are needed for LCA calculation. This concerns aspects such as moisture content variation, shrinkage, content of biogenic carbon, and densities.
- A calculation equation and default data that makes it possible to recalculate the average sawmill production related to the average moisture content and species to become a LCA result representative for a specific assortment for a given species and moisture class.
- A detailed description of the wood process chain from forestry, sawmill and any further processing, including specifications about allocations according to all the required standard rules (ISO 14044, EN 15804 and EN 16485).
- Generic input data for scenario settings on construction site A5 and end-of-life C1-C4.

- Generic figures for selected manufacturing steps including average of Swedish sawn and planed timber based on the methodology settings given and evaluated with the valid sectors EPDs from Swedish Wood.
- A list of generic data based on ecoinvent as database needed for a EPD tool is defined, and data quality is classified according to EN 15804

The report also addresses challenges related to data accessibility, digital integration, and international harmonization. It emphasizes the importance of resolving methodological inconsistencies to meet regulatory and consumer demands for transparency in environmental and sustainability reporting.

The report is based on a non-public version that was first published in January 2021 as part of development of a common sector EPD tool for the Swedish wood industry, supported by grants from Swedish Wood and the Foundation IVL (SIVL) as part of Martin Erlandsson associated professorship at KTH, Division of Building Materials.

Contents

REVISION LOG

In the table below are all changes made by IVL to the EPD Generator listed after the initial approval by third party verifier as part of the EPD tool approval. Such additions are documented here, and approvals are made by the same verifier as the original one.

LCA editing date:	Description of change	Approval date and signature

1 Introduction

While EPDs are for external communication, the related background LCA reports are normally for the company's internal use only. However, the present background report is made public in order to streamline the development of EPDs from sawmills products across the sector. This LCA report is designed to be implemented in an EPD Generator for sawmill products. This means that it will be combined with a supplementary product and company specific LCA report. Manufacturer-specific processes for an individual manufacturer will thus be described in the supplementary LCA report. The streamlined approach outlined here includes a Generic LCA report, a Supplementary LCA report and calculations made in an EPD-tool. Provided that the same verification team is used, results will be produced in a time efficient process for both the LCA consultant and the verifier.

This LCA-report is based on a restricted version that was first published in January 2021. The LCA report and the establishment of the EPD tool for the Swedish wood industry is a result of Martin Erlandsson associated professorship at KTH/ Division of Building Materials, supported by grants from Swedish Wood and The Swedish Institute for Water and Air Pollution Research (SIVL).

The major difference from the previous version is that this version is now adapted for using LCA data from ecoinvent. One of the goals with developing this methodology report was to streamline the settings outlined in the standards and thereby simplify the development of the LCA result. In order to further streamline the LCA calculations, the physical required wood characteristics have been defined, in collaboration between IVL, Swedish Wood and Skogforsk.

Environmental Product Declarations (EPDs) are used for external communication, based on third part verified information. An EPD includes the result from a Life Cycle Assessment (LCA) as given by ISO 14044:2006/AMD 1:2017 + AMD 2:2020 and follows defined Product Category Rules (PCR) and methodology for EPD and program operators, as outlined in ISO 14025:2006.

To develop such an EPD in a cost effective and quality insured way, IVL the Swedish Environmental Research Institute (referred to as IVL onwards) has developed an EPD generator that is used for the LCA calculation and the EPD developed for the Industry Association Swedish Wood

1.1 Product Category Rules for wood products: A State-of-the-Art of standardization, harmonization, and development needs"

The quantification and communication of a product's environmental performance have become central to sustainable procurement during building design, and the observance of environmental policy. Within this landscape, the framework for Type III environmental declarations, commonly known as Environmental Product Declarations (EPDs) plays a key role. This approach provides a structured, science-based methodology for communication. Governed by the International Organization for Standardization (ISO) standard ISO 14025, an EPD is a third-party verified and registered document that presents quantifiable environmental data over a product's life cycle. The scientific foundation of any credible EPD is a Life Cycle Assessment (LCA), a comprehensive analysis conducted in accordance with the principles and requirements of ISO 14040 and ISO 14044. However, for EPD to be meaningful for comparison, the underlying LCAs must be performed consistently. This necessity gives rise to the critical role of Product Category Rules (PCRs). Defined in ISO 14025, a PCR is a "set of specific rules, requirements, and guidelines" that standardizes the LCA methodology for a particular group of products fulfilling an equivalent function.

A PCR ensures that all EPDs within a category are created using the same assumptions and calculation methods, thereby enabling the transparency and comparability that is the core objective of the standard.[4] For the construction sector, this standardization is further structured through a hierarchy of core PCRs, such as the standard ISO 21930 for global application and EN 15804 in Europe, and establishes the foundational rules for all construction products. A core PCR is– if needed – further supported by a complementary PCRs (c-PCRs) that provide product-specific rules for a specific material/product, such as EN 16485 for wood and wood-based products). This entire framework represents a structured cascade of increasing specificity, translating the complex science of LCA into a standardized, market-facing communication tool, with the PCR acting as the essential linchpin that ensures methodological consistency.

The evolution of PCRs for wood products has followed distinct trajectories in North America and Europe, creating two separate but parallel ecosystems for EPD development. In North America, the development has been largely led by industry and characterized by a multi-stakeholder, market-driven approach. An early milestone was the PCR for North American structural and architectural wood products, first developed by FPInnovations in 2011 (FPInnovation 2025). This was followed by PCRs for more specific product categories, such as the one for pressure-treated wood, which was initiated by the ICC-Evaluation Service (ICC-

ES) in 2013, and later renewed through a collaboration between ASTM International and ICC-ES (ASTM 2023). Other key program operators, including UL Solutions (formerly UL Environment) and SCS Global Services, have also been instrumental, developing PCRs for products like wooden pallets and market pulp (Lakeland Pallets 2025). This landscape has led to the common adoption of a "Part A/Part B" structure. In this model, a "Part A" document provides the core LCA calculation rules, often aligned with ISO 21930, while a "Part B" document contains the product-specific rules (UL Environment 2029). This flexible structure has become the standard for numerous industry-average EPDs published by organizations like the American Wood Council (AWC) and the Canadian Wood Council (CWC) (ASTM 2024).

In contrast, the European approach is more centralized and formally integrated within the European Committee for Standardization (CEN) framework and a common organization for all program operators, namely ECOplattform. The cornerstone of this system is EN 16485:2014, "Round and sawn timber – Environmental Product Declarations – Product category rules for wood and wood-based products for use in construction," which serves as the definitive c-PCR for the wood sector. This cPCR is developed by the technical committee CEN/TC 175, it functions as a single, harmonized set of rules for all European wood product EPDs.

Already in 2007 was the first PCR for a wood-based product in the world developed for treated timber from the program operator Swedish Environmental Management Council, MSR (currently named EPD International), PCR 2006:02 – 1 (Erlandsson 2007). This PCR was also the first cPCR developed based on the Core PCR for all construction Products developed by IVL "Product category rules (PCR) for building products on an international market - A PCR based on Life Cycle Assessment (LCA) methodology in compliance with ISO 14025" for MSR, PCR 2006:02 (Erlandsson, Lindfors, Ryding 2005). The cPCR standard EN 16485 is a milestone PCR work in Europe. It is explicitly designed to complement the core rules of EN 15804, providing the necessary vertical, branch-specific rules that are built upon the horizontal, common rules applicable to all construction products. Its primary function is to address aspects that differentiate wood other materials, namely its biogenic nature and manufacturing specific aspects combined with aspects related to sustainable forestry. The standard provides specific rules for modeling and assessing material-specific characteristics like biogenic carbon storage and the inherent energy content of wood.[23] Furthermore, it defines a sector adopted allocation procedures for multi-output processes, since sawmill not produce one product but several like; sawn and planed lumber, chips, bark, and sawdust simultaneously: ISO 15485 also includes some specifications on end-of-life scenarios including reuse, recycling, and energy recovery.

Despite the existence of a single European standard, the creation of a standard has not guaranteed standardization in practice. A critical issue has emerged from the ambiguity within EN 16485 and its parent standard, EN 15804, which has allowed for the development of two distinct methodological "schools" of interpretation (Næss 2023). This divergence is not trivial; it can lead to variations of 15-30% in reported Global Warming Potential excluding biogenic carbon stored in the product and its emission (GWP-GHG) for the same product system, severely undermining the comparability of EPDs and the purpose of the ISO 14025 framework (EPD Norway 2024). The core of the disagreement lies in the allocation of environmental burdens from upstream processes, particularly forestry and transport (Næss 2023). The current published PCR EN 16485 provides an option for allocation based on either physical properties such as mass or volume versus economic values. But the perhaps major problem is that school 2 (see Table 1) conflicts with basic LCA methodology (ISO 14044, EN 15804) meaning that forestry as well as transport to the sawmill is double accounted caused by allocation mass based on economical basis in combined by merging the system from forestry to a sawmill to one aggregated process. This is the opposite of what is the advised approach, namely the opposite to subdivide the value chain product system in different processes identified and make an allocation for each process separately. The consequence is illustrated in Table 1 where the reference flow is 1.14 m^3/m^3 when inherent physical cause effect mass balance is accounted for, and 1.7 m^3/m^3 when this allocation accounts for economical values in combination of a merge of the different processes from forestry to sawmill into one virtual common process. This used historical motivated allocation approach in school 2 that is allowed since it is a conservative approach compared to a proper allocation according to ISO 14044 and EN 1504 has led to two different, yet currently compliant, approaches, summarized in Table 1.

Table 1 Methodological divergence in the application of EN 16485 for sawn wood (EPD Norway 2024)

Methodological Aspect	School 1	School 2
Forestry Modeling	Forestry activities are allocated to roundwood as	Forestry activities are allocated to saw logs and
Transport Allocation	Modeled as a separate process and allocated based on mass (gate-to-gate).	Modeled as part of the forestry-to-sawmill value chain and allocated based on economic value (cradle-to-
Consequence	Allocates environmental impacts from ~1.15 m3 of roundwood per 1 m3 of sawn wood product.	Allocates environmental impacts from ~1.7 m3 of roundwood per 1 m3 of sawn wood product.

This systemic problem, where compliance does not ensure comparability, is a primary focus of the ongoing revision of EN 16485 by CEN/TC 175. Therefore, program operators like EPD Norway are issuing guidance requiring EPD owners to increase transparency by explicitly stating which methodological choices have been made (EPD Norway).

A more profound and global challenge lies in the accounting of biogenic carbon. Here, a fundamental divide exists between the North American and European PCR frameworks, rendering direct comparison of their EPDs impossible (Hoxha et. al. 2020). The European approach, codified in EN 16485, follows the "-1/+1" method. This involves reporting the uptake of biogenic CO2 as a negative emission (a benefit) in the product stage (A1-A3) and reporting its release at the product's end-of-life as a positive emission. This methodology allows for a net-negative GWP to be reported in cradle-to-gate EPDs, highlighting the carbon sequestration benefit of the wood product itself. The North American approach is more conservative, operating on the assumption that all stored carbon is eventually released back to the atmosphere, why it shall be direct balanced out in an LCA (if the wood source comes from a sustainable forestry)

Consequently, it does not permit a net-negative GWP to be reported in the cradle-to-gate EPD, effectively not crediting the temporary storage benefit within the primary GWP indicator (Woodworks 2025). These key differences are summarized in Table 1.

These different implementations are further complicated by a growing gap between these static LCA methods and the 'state-of-the-art' in climate science research. Academic studies increasingly critique both standard approaches for failing to account for the temporal dimension of carbon flows—the climate benefit of delaying emissions (Hoxha el. Al. 2020). Researchers have proposed more advanced methods, most notably Dynamic Life Cycle Assessment (DLCA), which uses time-dependent characterization factors to provide a more scientifically robust and transparent accounting of biogenic carbon's climate impact (Hoxha et. al. 2020). This creates a three-way tension between the North American model, the European model, and advanced academic models. Any harmonization achieved around the static "-1/+1" model may prove to be a temporary solution before more sophisticated climate policy demands the greater accuracy offered by dynamic approaches, forcing another major methodological shift on the industry.

The wood products sector is at a critical point in time where the future of its environmental declarations will be shaped by the convergence of policy, science, and commerce. The most significant current initiative is the revision of EN 16485 by CEN/TC 175, with an estimated publication in Q3 2025, which aims to resolve the "two schools" allocation problem.

In parallel, the European Union's Construction Products Regulation (CPR) and Green Claims Directive are moving toward making verified EPDs a mandatory component of product declarations and a prerequisite for making any environmental claims. The wood industry, an early leader in the adoption of EPDs, must now demonstrate a new phase of leadership to resolve its internal methodological inconsistencies to meet these pressing external demands. The success of the EN 16485 revision will be a key indicator of the sector's ability to adapt, transforming PCR development from a niche technical exercise into a high-stakes process at the intersection of international policy, climate science, and global market access.

The development and implementation of product-specific rules like PCR 16485 mark a major advancement for the wood industry's ability to communicate its environmental performance. By tailoring LCA methodology to wood's biological and production-specific realities, cPCR EN 16485 enables more accurate, credible, and comparable EPDs. As regulatory and consumer demands for environmental transparency grow, embracing robust PCR-based EPDs will be critical for maintaining competitiveness, meeting certification requirements, and supporting the broader decarbonization of construction. Comparable EPD across all sectors and materials is a prerequisite for EPDs to be used in legislation such as the Construction Products Regulation (CPR) and its mandatory Declaration of Performance and Conformity (DoPC, part of CE marking system) that will be mandatory in future and communicated digitally as a so called public Digital Product Passport.

Challenges in PCR and EPD

General challenges related to PCR and EPD remain around data access, digital integration, and international harmonization. These issues are not dealt with in this report. For more information, see Erlandsson et. al. (2023) and ongoing work by Smart Build Environment[1].

Wood PCR EN 16485

The draft version of the wood PCR EN 16485 will describe the common best understanding of LCA methodology settings, including sector implementation of co-product allocation problems. However, specifications are needed to ensure that the same result is achieved regardless of the LCA practitioner.

[1] https://www.smartbuilt.se/projekt/informationsinfrastruktur/digitala-datablad-datamallar/

Technical Specifications
Several technical specifications are not accounted for in EN 16485. These specifications must be made by the LCA practitioner. This report provides supporting information for the LCA practitioner and potential implementation in a wood cPCR when EN 16485 is implemented by any program operator or by EC CPR future EPD and their harmonized standard.

1.2 About this report

While the EPDs are for external communication, the background LCA report is normally for internal use only. However, this background report is made public to streamline the implementation of EPD for products made from sawmill products. The report consists of a goal and scope section, a section describing the data used in the Life Cycle Inventory (LCI), and a supplementary report per EPD, published with settings made and the results for each EPD developed by the EPD Generator. The supplementary report includes both the input data for the LCA as the final pdf-EPD, to be published by the program operator (named draft EPD in the xls file that constitutes the supplementary report).

The structure of this LCA report is developed specially designed for EPD tools in general. The report specifies how requirements in general are implemented, but also given by the program operator EPD Norway, since the tool is approved in this system. In future it is likely that tools based on the specifications given in this report for wooden based products are also approved by EPD International. The following alternative EPD tools are available in EPD Norway as a,

- 'background database'
- reference flow' or
- 'process certification' EPD tool.

This LCA report is designed to be implemented for an EPD Generator for sawmill products. The first step for such implementations follows the background database alternative, which means that an external verification has to made by a verifier that approves each individual EPD produced from the tool. However, since the same background LCA and basic settings are reused when additional EPDs are produced, the forthcoming EPD verifications will be limited to:

- a check of the inventory made for the individual sawmill
- a check and approval if new LCA data is added

- a check of the final EPD with respect to additions and specifications made for the individual EPD.

This streamlined approach outlined here includes a Generic LCA report, Supplementary LCA report and calculations made in a tool in combination with the fact that the same verification team is used, results in a time efficient process both for the LCA consultant and the verifier.

The EPD Generator and the LCA is performed in accordance with the general program instruction (GPI) from EPD Norway and NPCR Part A: Construction products and services, Version: 2.0 (24.03.2021) and Part B PCR Part B for wood and wood-based products for use in construction (10.04.2019). NPCR 015 version 4.0, which in turn is based on the standard EN 16485:2014. Round and sawn timber - Environmental Product Declarations - Product category rules for wood and wood-based products for use in construction. (CEN 2014). The EN 16485 standard is under revision and will be updated, and when published in 2025 this report will be updated. Please note that the EPD Generator is supporting both EN 15804 and the mandatory A2 characterisation factors EF 3.1 published by EC JRC and the CML chacaterisation factors chacaterisation factors as used in version A1, since those indicator results that are still asked for in building classification systems like LEED. characterization.

The EPD developed according to this LCA report is to be certified through the EPD Norway system and this report is therefore in line with their requirements in the general programme instructions (GPI). In future, with updates to this report it is possible to add additional aspects that are required by EPD International, so the LCA report can be used for both program operator verification systems.

This LCA-report is based on a non-public version that was first published in January 2021. The LCA report and the establishment of the EPD tool in the Swedish wood industry is a result of Martin Erlandsson associated professorship at KTH, supported by grants from Swedish Wood and the Foundation IVL (SIVL). The major difference to the previous version of the report is that this version of the report is now adopted for using LCA data from ecoinvent. One of the goals with developing this methodology report was to streamline the settings outlined in the standards and thereby streamline the result. Based on dialogue with Swedish industry and partners in the neighboring countries was it decided that a double accounting, as defined in EN 16485 for transport, is implemented in the LCA result (see section see section 3.2.2 in this report). In order to streamline the LCA calculations, the physical wood properties have been defined for future use, in collaboration between IVL, Swedish Wood and Skogforsk

1.3 About the association and product group

Swedish Wood represents the Swedish sawmill industry and is part of the Swedish Forest Industries Federation. In addition, Swedish Wood represents the Swedish glulam and packaging industries, who collaborates closely with Swedish builders' merchants and wholesalers of wood products. Swedish Wood's aim is to increase the size and value of the market for Swedish wood and wood products in construction, interior design and packaging. Swedish Wood is a department within The Swedish Forest Industries Federation. Swedish Wood is supported by the Swedish sawmill, CLT and glulam industries.

With 70 percent of its land covered in forest, Sweden is the third largest exporter of sawn timber in the world. In Europe, the Swedish sawmill industry holds a prominent position, as the second-largest producer and the largest exporter of sawn softwood. There are many sawmills in Sweden producing sawn wood products. Total Swedish production of sawn and planed timber stands at 18 million m^3, of which 13 million m^3 is exported. Large investments in the modernisation of the Swedish sawmills have resulted in automated high-speed manufacturing technology. This enables the sawmills to produce high quality products in accordance with customer demands in an efficient way

The Swedish sawmills produce a wide selection of different qualities of sawn and planed pine and spruce. The Swedish sawmills can also provide specially ordered grades of timber, and timber with special dimensions. Nearly all sawn timber from Sweden is kiln dried: 50 percent is dried in compartment kilns and 50 percent in progressive kilns. Compartment kilns are becoming more common.

1.4 About LCA and standards

Life cycle assessments (LCA) investigate 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 and their impact, from all life cycle stages including; material production, manufacturing, use and maintenance, and end-of-life.

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, the International Organization for Standardization; ISO 14040 and ISO 14044 and EN 15804, the so-called core construction product rules (PCR) for all construction production published by CEN (European Committee for Standardization). EN 15804 is related to the implementation of the upcoming mandatory environmental product declaration (EPD) for all construction products sold within the European Community (EC).

2 Goal and scope

This report gives the documentation of the methodology and generic settings of the calculations made for the environmental performance of Swedish sawmills and their products to be published in EPDs for business-to-business communication. The goal of the study has been to provide necessary data and documentation to produce an EPD according to the requirements of PCR NPCR 015 version 4.0, 07.10.2021, and to gain insight into the environmental impacts related to sawn timber and its by-products and further processed products.

The scope is cradle to gate with options, A1-A3, A4, A5, C1 to C4 and module D. An environmental product declaration (EPD) that can be used by third party as source data for a full LCA for any construction works. Results from the study will be published in an EPD type III for the product by a program operator after verification approval.

Target audiences of the study are customers and other parties with an interest in the environmental impacts from sawmill products. The EPD is therefore mainly intended to be used in business-to-business (B2B), but does not limit business-to- consumer communication. The internal use of the LCA result developed for an EPD highlights the relative significance of different manufacturing steps and is therefore also a useful source as basis for future improvements.

The EPD LCA indicator results support informed comparative assertions intended to be disclosed to the public following guidance in ISO 14025. The supplementary LCA report is often only communicated to the third-party verifier and within the company organisation that is the owner of the EPD.

2.1 Declared unit

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

1 m^3 'per product type X'

The 'product type X' is specified for each EPD and is for instance equal with; sawn timber, planned timber, timber components. Significant product properties like moisture content (u) according to EN 14298 and density as delivered shall be reported per product type to indicate the quality of the product, as well as the species used, or if relevant the mix of species. The specific declared unit used is specified in the supplementary LCA report. If volume is not an appropriate declared unit other units may be used if motivated for market reasons.

A functional unit is not relevant for this EPD and therefore not included in the LCA report. For this reason, is it not mandatory to report a reference service life based on the factor method or likewise methods. Instead, it can be assumed "Reference service life is normally the same as the building when not exposed to weathering, which is typically set to 50 or 60 years" (see 2.3.1).

2.2 Area of application

Planed timber is used for structural purposes, cladding and as components in wood-based products. Swedish pine is often used for wall panelling, floorboards and mouldings, as well as for doors and windows.

Today sawmills are increasingly investing in processing in their end products in order to create added value through a range of products adapted to customers' needs. It can in the simplest case be about precisely cut lengths, customized dimensions or planed timber. But also products such as roof openings (takluckor), packaging materials, finger-jointed timber, structural timber, window or other wooden based components including furniture components, and painted or treated wood in different ways. Sawn or planed timber is also used downstream as raw materials for other products like pressure treated wood for outdoor use, edge glued boards (limfog), glulam, CLT etc.

2.3 Studied product system — life cycle stages

The scope of the EPDs generated by the tool corresponds to "Cradle to gate with options". An overview of the life cycle stages included in the LCA study is presented in Table 2.

Table 2 Life cycle stages included in this study.

System boundaries (X=included, MND= module not declared, MNR=module not relevant)																
Product stage			Construction process stage		Use stage							End of life stage				Beyond the system boundary
Raw materials	Transport	Manufacturing	Transport	Construction, installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
x	x	x	x	x	MND	MND	MND	MND	MND	MND	MND	x	x	x	X	x
SE	SE	SE	SE	SE	—	—	—	—	—	—	—	SE	SE	SE	SE	SE

Modules included in the EPD (X) and the modules not declared (MND). Major geographical representative is added in a separate row.

An overview of the process steps studied for the products covered by the EPD is presented in Figure 1. A process is related to a specific life cycle module and its stage included in the LCA result and is further described in this report. Manufacturer-specific processes for an individual manufacturer are described in the supplementary LCA report. It should be noted that not all processes are illustrated in detail in the figure, which is only schematic.

The manufacturing of wooden products from sawmills uses round timber from forestry. Why forestry is the starting point when the life cycle shall be described, see Figure 1.

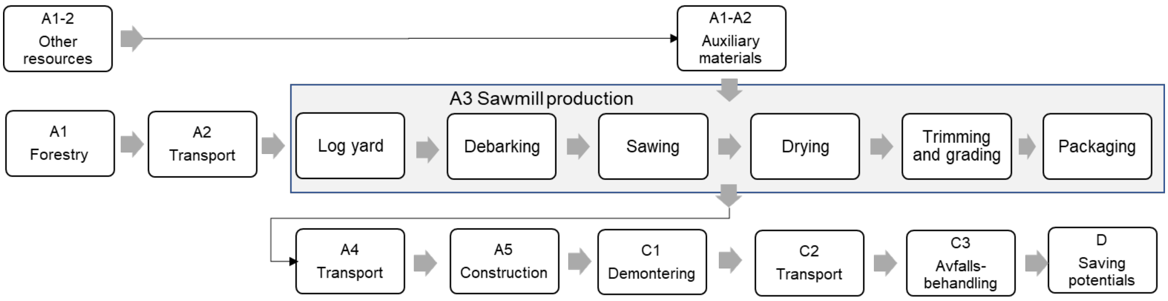

Figure 1 Overview of the studied system and the life cycle stages (where C4 disposal is not included since this is not a legal option)

Forestry includes the practice of planting, managing, caring for forests and cutting. All forestry activities from planting nursery and construction of forest roads are accounted for (see Table 8). The rotation period for a tree is normally between 75 to 100 years. In an LCA the forestry, harvesting and all its related activities are assumed to occur simultaneously when the cutting is made, meaning that nursery, harvesting, thinning etc. is attributed with current practices and technology representative for the actual region. This is a common approach applied by all LCA practitioners for forestry. The forest harvested products can in simple terms be divided into round wood for sawmill, round wood to sawmills or other use like plywood, poles etc. and for energy use. The harvested roundwood is stored at the roadside and then transported to the sawmill.

At the sawmill the round wood is sorted and stored at the log yard. The logs then enter the sawmill processing via the intake where a laser scanner is typically used to improve further processing, that starts with the debarking where bark is a by-product. The sawing of the debarked round timber is then made in two steps, where the first step either includes reducing milling of the stock or a block sawing. In the second step the stock is then split by sawing to planks and side boards. The first sawing step generates chips and the second step (if planed) generates shavings and final step (cutting, trimming, and splitting of boards) generates dry sawdust as by-products. The boards are then sorted in stacks and then artificially dried.

The heat for the wood drying process is often obtained from a local combustion biobased heat plant that uses low-value by-products like bark as major energy source. In simple terms this is about 15% of the input of the round timber used for the sawmill heat use that is dominated by the drying of the wood (see appendix 3 and 4). The dried timber is destacked, sorted, trimmed and graded. Finally, the boards are wrapped to be protected from weathering and stored in a warehouse before being transported to the customers. The round timber is internally transported and handled with machinery that uses diesel, natural gas or batteries etc.

A general description of the processes from the forestry to sawn timber is found here:

https://www.swedishwood.com/wood-facts/about-wood/from-log-to-plank/

And more specific information on wood drying can be found here:

https://www.swedishwood.com/wood-facts/about-wood/wood-and-moisture/

Please note that in the EPD generator the supplied electricity use is in A3, and its environmental impact is attributed to A3 in the inventory, which is in line with ISO 21930 but not according to EN15804 where it is attributed to A1. However, since the result is never reported separately for A1, A2 and A3 respectively in the EPD, and only as the integrated result A1-3, this approach in the generator is not considered as a problem. The choice made here is based on experience on what the end-user finds most relevant why the interface in the EPD Generator follows this pedagogy.

2.3.1 Reference service life (RSL)

A reference service life (RSL) is only valid if a full life cycle is accounted for and the LCA result is based on a functional unit. Nevertheless, the timber, or the object it is part of, can be set to the same as the construction works design life if protected from weather exposure. This implies normally a RSL to 50 or 60 years. The actual service life will in practice be far longer. The default specification of RSL is therefore in the EPD as follows:

> "Reference service life is normally the same as the building, when not exposed to weathering, which is typically set to 50 or 60 years"

If the declared product type is used in ground contact and not used in a weather protected environment etc., and this makes it likely that the service life does not fulfil 50 or 60 years;

then a specific RSL relevant for the most frequent intended use of the specific product type shall be used in the EPD instead of the default text suggested above.

2.4 Calculation rules for averaging data

The first choice is an LCA and EPD that is representative of a given sawmill and its products that are manufactured in the same location, and therefore, no averaging is made. If several sawmills are used to produce an "average" EPD this will be based on a weighted average based on the yearly manufacturing from the respective manufacturing sites. In this case the variation must be calculated and reported in the EPD, including at least the variation in respect to GWP-fossil A1-3. This implies that a calculation must be performed for each manufacturing site before an averaging can be made.

In the case where an EPD is declared as an average environmental performance for a number of products, a description in the EPD will be added that describes the range/ variability of the LCIA results if significant (> +/-10%). Note that according to EN 15804 there is no requirement on describing the variation when averaging manufacturing sites or products to a product group, but this needs to be reported according to the PCR in EPD Norway and EPD International.

2.5 Overall LCA methodology

General methodology aspects considered in this LCA, such as allocation procedures, cut-off criteria and other key assumptions, are described in this section. If specific settings are made for an individual product, this must be reported in the supplementary LCA report and (if significant to the result) reported in the EPD.

2.5.1 System boundaries

2.5.1.1 Boundaries towards nature

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 natural resources (e.g. crude oil, or uranium) are extracted from the ground. The boundaries towards nature are:

- 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).

2.5.1.2 Boundaries within the life cycle and infrastructure

Inherent properties like biogenic carbon and energy content of the declared product or its packing material stay with the material when recycled or energy recovery. 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. This is in line with EN 15804 principle that inherent properties cannot be allocated away.

As a general rule, the production, maintenance and after-use treatment of capital goods, such as machines, power stations, etc., and the activities of the employees, are not included in the life cycle. For processes where the infra structure are significant (EN 15805, 6.3.6), for example, wind power and photovoltaic, such upstream impact are accounted for. In the generation of electricity or heat, energy resources used as fuels are always included in the life cycle system.

2.5.1.3 Geographical boundaries

The study reflects production in a Swedish sawmill and the Swedish context for stage A to C and D.

For forestry currently, only the national average used, but in the future, it may be possible to use data from forestry with a higher geographical resolution when digital traceability is fully introduced. For production of electricity in A3 a location-based, or a market-based approach can be used. When location-based electricity is used, the LCA data is representative for the country grid average including net export and export for Sweden. The market-based approach includes certificates with guarantee of origin (GoO), and if such are not available the national residual mix is used. EPD Norway include double reporting in the EPD concerning electricity used in A3 as additional information.

2.5.2 System expansion

In line with the EPD methodology, no system expansion has been applied from A to C. Module D includes a substitution approach, as defined in rules given for module D in EN 15804.

2.5.3 Multi-output allocation

Data used for an EPD follows allocation procedures, as outlined in EN 15804. The rule that inherent properties cannot be allocated away is kept throughout the whole inventory. According to the general co-product allocation approach in EN 15804, which is valid in A1-3, the co-products are responsible for their own upstream impact and downstream impact when leaving the sawmill.

The forestry is allocated on economical premises since the low value by-products differ significantly to the main product of round timber. A conservative economic allocation approach is used for forestry products, where no impact is allocated to the tops and branches (GROT), except forestry operations aimed for GROT (forwarding and shipping).

For the sawmill and its multiple co-products with different economic values, impact is allocated in provisions according to EN 15804. A conservative approach is used for transport of round timber (module A2) to the sawmill, based on economic allocation factors set by the sawmill (see 3.2.4.1). The economic value of the different parts of the stock is attributed using the market value for the of the part final products/co-products. An exception to this is the wood drying process that is attributed to the intermediate products on physical premises. The economical allocation approach is conservative for sawn timber compared to if a value was set on the intermediate products flows that goes to the next process step in the sawmill. However, such an allocation would require that an internal cost allocation approach is used on the sawmill that is almost never the case.

If further processing occurs at the sawmill (such as planing) all of the impact from this final process is allocated to the main products. However, the shavings etc., that are sold from this process step are still attributed to the upstream impact from this previous process, according to the general applicable co-product allocation approach used in A1-3.

2.5.4 End-of-Life allocation

Following EN 15804 and PCR part A and B, the cut-off method is applied at the system boundary (modules A-C) between different product systems. This approach is also known as the 100/0 method, cut-off method or recycled content method. This method follows the attributional LCA approach describing the impact to the real world, meaning that if this approach is applied and combined with global consumption it will ideally be equal to the total impact, following the 100% rule, and therefore also known as bookkeeping LCA.

Concerning Module D, another approach is used, not following the 100% real world approach, but the so-called avoided burden method is applied to calculate environmental benefits and loads beyond the system boundary (module D). Since a different methodology is applied, the result from A to C cannot be added to the result from module D. Module D describes the environmental impact when recovered materials substitute an alternative material. A negative figure in module D describes a benefit compared to the replaced material, and a numerical positive figure describes additional impact when the recovered material under study is replacing the analysed substituted material. Only material flows outside A1-3 are subject for calculation of the net flow accounted for in module D (since co-product allocation is accounted for in A1-3).

2.5.4.1 Environmental information describing output flows

EN 15804 LCA indicator result is a bit odd since also included reporting of inherent properties like biogenic carbon stored and energy content, as part of GWP indicator result respective cumulative energy use. This rule is then combined with the requirement that inherent properties cannot be allocated away (as outlined in EN 15804, 6.4.3.1). Output flows derived from LCI shall be included in each module declared in the EPD (EN 15804, 7.2.4.4) as listed below:

- CU: Components for re-use, kg
- MR: Materials for recycling, kg
- MER: Materials for energy recovery, kg
- EEE/EET: Exported energy, MJ divided into exported electricity respectively thermal energy

In order to assign a flow to the CU, MR, MER indicator results, the appropriate EoW criteria (EN 15804, 7.2.4.4, note 2) must be met. For energy flows, EN 15804 states that the energy efficiency shall be greater than 60% to be regarded as energy recovery. If this or other EoW criteria are not met, (such as the waste flow is classified as hazardous waste), means that the impact from waste treatment is accounted for the product under study and if combusted, then these flows are reported as EEE/EET.

Since co-products shall be applied in module A1-3 (EN 15804, (6.3.5.2) is it interpreted here that flows like CU, MR, MER is subject for co-product allocation in A1-3. Consequently, CU, MR, MER cannot be reported as flows leaving the system in module (A1-A3), since they always shall be allocated as co-products (see 6.4.3.2). Moreover, EN 15804 states that loads and benefits from allocated co-products shall not be declared in Module D (6.3.5.6).

The Waste framework directive (WFD, EC 2150/2002), as referred to in EN 15804, defines materials for energy recovery are based on the thermal energy efficiency rate of the power station which is not less than 60 % or 65 % for installations after 31st of December 2008. Besides this requirement for energy recovery to meet the EoW criteria, there are additional market demands requirements to be fulfilled given by "Manual for the Implementation of Regulation (EC) No 2150/2002 on Waste Statistics" (2022), as listed below:

- The main purpose of the operation must be to use the waste as a means of generating energy, replacing the use of a source of primary energy.
- The energy generated by, and recovered from, combustion of the waste must be greater than the amount of energy consumed during the combustion process (net energy production).
- The surplus energy must effectively be used, either immediately in the form of the heat produced by incineration or, after processing, in the form of electricity.
- The greater part of the waste must be consumed during the operation and the greater part of the energy generated must be recovered and used.

Besides this EN 15804 (see section 6.3.5.5 and sentence starting with "*The presence of any hazardous substances…*") defines waste flows as classified as hazardous waste as not fulfil the specific EoW criteria "- *the use of the recovered material, product or construction element will not lead to overall adverse environmental or human health impacts*".

EN 15804 also defined a general EoW market demand requirement as "- *a market or demand, identified e.g. by a positive economic value, exists for such a recovered material, product or construction element*". In the case of district heating, the generated electricity and heat is paid for in the downstream system, which is why this requirement is fulfilled.

Altogether, all wooden based waste flows from A5 to C4 are most likely used as fuel in any district heating when discarded where the energy efficiency is greater than 60%. Therefore, if so, if not classified as hazardous waste, and these waste flows fulfil all the other requirements listed above, they shall therefore be reported as MER (material for energy recovery), e.g. in modules A5 and C3. If classified as hazardous waste and combusted, the discarded wood used in district heating, such waste flows must be reported as EEE and/or EET in e.g. A5 and C4.

2.5.5 Collection and selection of data

Data specified in the PCR:

There is no requirement to use predefined LCA data in c-PCR EN 16485.

Primary data:

As a rule, the first choice is to use specific LCI data whenever possible which is derived from specific production processes, or averaged data derived from specific production processes. Methods for the selection and collection of core process data are described in section 3.3.4 for

Manufacturing at the sawmill (A3) and include references to background data used. Specific source data used for the core process is described in the supplementary LCA report see sheet "Manufacturing A3". Data for the core process A3 is data from the manufacturer based on a 1-year average (see complementary LCA report for valid inventory year).

Background for selection and collection of background data for forestry processes (A1) is described in section 3.3.1, section 3.3.2 and 3.3.3 for sawmill (A2), section 3.3.5 for transport (A4), section 3.3.6 for the construction site (A5), 3.3.7 for stage C and section 3.3.8 for module D.

Background data:
Generic data used for electricity, transportation including so called reduction diesel used in Sweden, is described in section 3.3.4 and is not older than 10 years. Data for all other raw materials, packaging etc. are mostly from ecoinvent 3.10. The reference year for the data ranges from 2017-2024 and is therefore all datasets are within the 10-year limit allowable for generic data under EN 15804 and the PCR.

A summary of documentation on primary and background data used concerning data quality, plausibility and validity is reported in Appendix: Data quality and documentation.

2.5.6 Omissions of processes and exclusion of inputs and outputs — cut-off rules

The general 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 these limits have been made, see Table 2. Waste treatment of packaging material has been excluded along with its potential loads and not accounted for any benefits in module D, due to very small amounts and has therefore been considered as negligible.

Table 3 List of excluded processes

Process excluded from study	Module	Assumed contribution from process
Waste processing of packaging materials in module A5	A5	Assumed to be less than <<1% A1-5
Substitution of packaging materials in module D	D	<< 1% A to D (We consider the interest of the EPD is to assess the potential benefit of the end of life of the product itself)

According to the cut-off rule given in EN 15804 (section 6.4.4) concerning packaging material inherent biogenic carbon and stored energy in packaging material can be balanced out directly if the contribution of these is less than 5% of the total mass of the packaging A1-3. This cut-off rule is followed here and stated in the EPD. This 5% cut-off rule is adopted for reporting biogenic carbon in packaging materials and affects the indicator results for GWP biogenic as well as energy stored as material. The environmental impact related to packaging material is however accounted for.

2.5.7 Product system boundaries A1-3

Flows leaving the system at the end-of-waste boundary of the product stage (A1-A3) are allocated as co-products (see 6.4.3.2). Loads and benefits from allocated co-products from A1-3 is therefore not to be declared in Module D. In the case of input of secondary materials or energy recovered from secondary fuels, the system boundary between the system under study and the previous system (providing the secondary materials) is set where outputs of the previous system, e.g. materials, products, building elements or energy, reach the end-of-waste state. Waste generated in A1-3 is therefore included to the point having reached the "end-of-waste" that as a minimum include handling and transport to waste or recycling site.

2.6 Life cycle impact assessment

In line with the requirements in the PCR the following indicator categories have been applied in the life cycle impact assessment as listen in Table 3 and Table 4. EN 15804:2012+A2:2019 require that "…characterization factors from EC-JRC shall be applied". This is interpreted here to use the latest available version, namely EF3.1. The background LCA database also included LCIA indicator result according to the older EF 3.0 that is recommended not to use. The background LCA database also included indicator results for the LCIA indicators based on CML (CML 2012) as was required in EN 15804:2012+A1:2013 standard (CEN 2013), and still used in some building classification systems, see section 1.1, this is because it is still is allowed to be included in the EPD as supplementary LCIA indicator results and is reported separately.

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 mandatory indicators according to the EN 15804+A2 standard (CEN 2019) are presented in Table 3, Table 4 and Table 5.

2.6.1 Environmental impacts

The indicators described below are used in the LCA calculations in order to report the results for the EPD.

2.6.1.1 Life cycle impact category indicators

The indicator results are based on the latest JRC characterization factors adopted for EN 15804 A2. The LCA database also includes older versions, namely EF3.0 and CML characterization factors as was used in the first implementation of EN 15804 A1.

Table 4 Mandatory categories describing environmental impacts according to EN 15804 A2.

Impact category	Category indicator
GWP-total: Global Warming Potential	kg CO_2 equivalents
GWP-fossil: Global Warming Potential fossil fuels	kg CO_2 equivalents
GWP-biogenic: Global Warming Potential biogenic	kg CO_2 equivalents
GWP-LULUC: Global Warming Potential land use and land use change;	kg CO_2 equivalents
GWP-IOBC or GWP-GHG (equal to GWP-total excluding uptake and emission of biogenic carbon in the product or packaging materials) *	kg CO_2 equivalents
ODP: Depletion potential of the stratospheric ozone layer;	kg R11 equivalents
AP: Acidification potential, Accumulated Exceedance	mol H^+ e
EP-freshwater: Eutrophication potential, fraction of nutrients reaching freshwater end compartment;	kg P equivalents
EP-marine; Eutrophication potential, fraction of nutrients reaching freshwater end compartment	kg N equivalents
EP-terrestrial: Eutrophication potential, Accumulated Exceedance;	mol N equivalents
POCP: Formation potential of tropospheric ozone;	kg NMVOC equivalents
ADP-M&M: Abiotic depletion potential for non-fossil resources (minerals and metals);	kg Sb equivalents
ADP-fossil: Abiotic depletion potential for fossil resources;	MJ
WDP: Water depletion potential, depletion (weighted water consumption)	m^3

* This GWP indicator is mandatory supplementary LCA result in EPD Norway and EPD International (and required in legislation in at least Sweden, Finland and Norway). See also section 2.6.2.

Table 5 Optional categories describing environmental impacts according to EN 15804 A2 (not required to be reported in the EPD but in the LCA report).

Impact category	Category indicator
PM: Particulate matter emissions;	Disease incidence
IRP: Ionising radiation, human health;	kBq U235 e
ETP-fw: Ecotoxicity (freshwater);	CTUe
ETP-c: Human toxicity, cancer effects;	CTUh
HTP-nc: Human toxicity, non-cancer effects;	CTUh
SQP: Land use related impacts / soil quality	Dimensionless

Table 6 Categories describing environmental impacts according to EN 15804 A1.

Impact category	Category indicator
Global warming potential (GWP-BIOBC), excl biogenic carbon (1)	kg CO_2 equivalents
GWP biogenic	kg CO_2 equivalents
Global warming potential (GWP-TOT)	kg CO_2 equivalents
Ozone depletion potential (ODP)	kg R11 equivalents
Acidification potential (AP)	kg SO_2 equivalents
Eutrophication potential (EP)	kg PO_4^{3-} equivalents
Photochemical ozone creation potential (POCP)	kg Ethene equivalents
Abiotic depletion potential for non-fossil resources (ADPE)	kg Sb equivalents
Abiotic depletion potential for fossil resources (ADPF)	MJ

(1) This indicator has been added compared to the requirement in the EN15804 standard since it provides valuable additional information. The reference is CML2001, April 2013. See also section 2.7.2 Additional environmental indicators.

Biogenic carbon stored in the product will be zero over the life cycle A to C that is manually corrected in module C.

LCIA indicators are reported in the EPD including mandatory ILCD disclaimers are given in EN 15804 Table 5 Classification of disclaimers to the declaration of core and additional environmental impact indicators. An EPD produced in accordance with EN 15804 version A2 includes a non-mandatory environmental indicator for the assessment of land use. This environmental indicator is typically calculated and reported per country and raw material extraction. In the figure used for Swedish forestry, 5.79E+04 Pt/m^3 roundwood representing 'SE - medium management' (see report figure "Figure 23: Scenario comparison - Land Use"), is calculated by the same team that developed the impact assessment method (LANCA) and is here used (et al 2021).

2.6.1.2 Resource use

The reporting of resource use related inventory flows in the EPD are listed below.

Table 7 Parameters describing resource use.

Parameter	Unit
Renewable primary energy resources used as energy carrier	MJ, net calorific value
Use of renewable primary energy resources used as raw materials (PERM)	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	MJ, net calorific value
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials (PENRE)	MJ, net calorific value
Use of non-renewable primary energy resources used as raw materials (PENRM)	MJ, net calorific value
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	MJ, net calorific value
Use of secondary material (SM)	kg
Use of renewable secondary fuels (RSF)	MJ, net calorific value
Use of non-renewable secondary fuels (NRSF)	MJ, net calorific value
Net use of fresh water (FW) [m3]	m3

2.6.1.3 Waste and output flows and stored energy

The reporting of resource uses related inventory flows in the EPD are listed below.

Table 8 Parameters describing waste categories and output flows.

Waste parameters	Unit
Hazardous waste disposed (HWD)	kg
Non-hazardous waste disposed (NHWD)	kg
Radioactive waste disposed (RWD)	kg
Output flows	**Unit**
Components for re-use (CRU)	kg
Materials for recycling (MFR)	kg
Material for energy recovery (MER)	kg
Exported electrical energy (EEE)	MJ
Exported thermal energy (EET)	MJ

Energy stored as material in packaging materials and in the product is zero over the life cycle, and here referred to as 'balanced out' over the life cycle A to C (and no inherent properties are accounted for in module D). When reporting primary energy used as material the net calorific combustion value is used. The low heating value (LHV) is easier to handle if the dry matter is recognized and used in the background inventory. Moreover, we do not always use the energy figures of LHV given by the source since it varies and is not always correct given in respect to wet and dry mass, this is why other data is used instead (see list below). This approach is acceptable according to EN15804 and is needed since the data does not always report feedstock energy and this word could be defined in different ways. The following combustions values are then used:

	Fossil	**Renewable**
Cardboard	0 MJ/kg	19,2 MJ/kg dry matter
MUF	18,0 MJ/kg	0 MJ/kg
PU/MDI	24.0 MJ/kg	0 MJ/kg
PVAc dispersion (55% dry matter)	13.2 MJ/kg	0 MJ/kg
Nylon	28,8 MJ/kg	0 MJ/kg
Wood	0 MJ/kg	19,2 MJ/kg dry matter
PE	42,7 MJ/kg	
Alkyd, primer, water born (Ökobaudat)	7.5 MJ/kg	0 MJ/kg
EPD: Pinja Protect G, tonad vit. RTS_80	20.5 MJ/kg	0 MJ/kg
Alkyd, intermediate[2] (Ökobaudat)	7.5 MJ/kg	0 MJ/kg
Diesel	36 MJ/liter	
Wolmanit	14.3 MJ PENRM/kg	0 MJ PERM/kg
Tanalith	0.27 MJ PENRM/kg	0 MJ PERM/kg

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 embodied energy in the product from stage C that is substituted as energy in module D is calculated as (PERM) and (PENRM) as given in A1-3, for renewable and non-renewable energy, respectively. A check is made based on the energy figures given above that the reported energy content is correct.

[2] Intermediate means that its include both the primer and the second paint layer and applied with one layer.

If an additional material is added, the preferred source to add as reference for the low heat value (LHV) etc. is the xls matrix from Sustainability Impact Metrix (that is a Delft University of Technology[3] (the list also includes information on biogenic carbon content).

[3] https://www.ecocostsvalue.com/EVR/img/embedded%20oil,%20heat%20of%20combustion,%20CO2%20emissions%20and%20pyrolysis%20plastics&chemicals.xlsx

2.6.2 Additional environmental indicators

2.6.2.1 GWP as calculated by PEF- GWP-IOBC or GWP-GHG

The wood PCR EN 16485 introduced to the EPD community that the content of biogenic carbon in the product shall be accounted for and added up with the common impact category climate change biogenic ($GWP_{biogenic}$) and part of GWP_{total}. To handle this is the summed elementary biogenic carbon stored in the products recalculated as it was stored as CO_2 in the wooden product (but is not in the real world). Moreover, the wood PCR stipulate that 1 kg biogenic CO_2 shall be regarded as equal with 1 kg CO_2e (GWP100). This is then also implemented in the EC-JCR characterization factors EF3.0 and 3.1 and in line with EN 15804-A2.

This kind of GWP indicator is problematic when the full life cycle is not accounted for and when compatible result module-by-module are part of the scope. In legislation on the building level, it is therefore required in Sweden, Finland and Norway that the LCA result shall also be given for GWP without inherent biogenic carbon. This is in fact how GWP is calculated by EF 3.0 and EF 3.1 when adopted for PEF (Product Environmental Footprint). In EPD Norway is this mandatory additional indicator called GWP-IOBC and in EPD International GWP-GHG. An additional GWP indicator will therefore be reported in the EPD as follows:

- GWP-IOBC/GHG (instantaneous oxidation of biogenic carbon) as the term is given in the wood PCR.

2.6.2.2 Information describing the biogenic carbon content at the factory gate

According to the cut-off rule given in EN 15804 (section 6.4.4) concerning packaging material can inherent biogenic carbon and stored energy in packaging material be balanced out directly if the contribution of these is less than 5% of the total mass of the packaging A1-3. This cut-off rule is followed here and stated in the EPD. This 5% cut-off rule is adopted for reporting biogenic carbon in packaging materials and affects the indicator results for GWP biogenic as well as energy stored as material. The environmental impact related to packaging material is however accounted for. The information on biogenic carbon stored in the product or its packing material is mandatory information and reported in the EPD as elementary biogenic carbon (kg C).

2.6.3 Content declaration

For construction product EPDs compliant with EN 15804, 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" (https://echa.europa.eu/sv/substances-restricted-under-reach), in case their content exceeds the limits for registration with the European Chemicals Agency (0.1% of the weight of the product). Wood as raw material is not in this listed as SVHC.

In EPD Norway it is asked for substances listed in the Norwegian priority list[4]. Since this list only covers substances that already are listed by REACH (appendix XIII), a conformity assessment related to REACH is enough.

If the declared product includes any added substance, it is required that the manufacturer confirms with a signed document that none of the substances from the SVHC candidate list are used in a concentration above 0.1%. Such signed confirmation shall be supplied for verification of the EPD. Products only including wood do not need such a confirmatory statement.

The product composition is declared in the EPD in kg and %, including packaging materials. A declaration concerning potential content of hazardous substances is required if reporting limit values, as given above as listed in the REACH Candidate list or the Norwegian priority list. The text below can be used for the signed confirmation about SVHC if needed.

Confirmation for the compliance of REACH order 1907 /2006/EC (SVHC list)

REACH is the abbreviation for Registration, Evaluation, Authorisation and Restriction of Chemicals. REACH is an EU regulation with the number 1907 /2006/EC, which came into force on 01 June 2007 with the purpose of harmonising the national chemicals laws. Our company is aware of its tasks and obligations with regard to the regulation.

The product/-s /please list here/ are "articles" in the sense of REACH. REACH does not provide for registration or pre-registration of articles. There are, however, information obligations regarding SVHC substances. The REACH Regulation provides that Substances of Very High Concern (SVHC) are subject to a special authorisation procedure. These SVHC are subject to an obligation to inform within the supply chain if an article contains a substance from the candidate list in a concentration of more than 0.1 % (w /w).

We hereby confirm that no substance from the candidate list is used in the above-mentioned products in a quantity requiring information.

Shorter alternative:

We,

[4] https://www.miljodirektoratet.no/ansvarsomrader/kjemikalier/prioritetslista/?

/*manufacturer name*/

/company address/

here by declare that the following of our products (articles) or substances are REACH compliant according to EC regulation 1907 /2006/EC. We hereby declare the products /product name/ that none off the substances listed in Annex XIV is present in the product (articles) or substances.

Signature

Name
Title (position in the company))
Company name

See conformity assessments related to products added in the EPD tool in Appendix: SVHC: Conformity assessments.

2.6.4 Additional environmental information in the EPD

The following environmental information is reported in the EPD according to additional requirements in EPD Norway:

- g CO_2e/kWh for electricity used in the core manufacturing site (A3) and double reporting of GWP so figures on market-based approach and location-based is reported.
- indoor air: VOC material emissions.
- carbon footprint.

Concerning the sawn and planed products, no VOC emission measurement is required when used as construction materials. On request emission figures are sometimes asked for painted or treated wood products when exposed directly to indoor air and intended for indoor use. If such measurements are available, it can be reported in the EPD.

Carbon footprint according to ISO 14067 has not been worked out for the product according to the implementation of this tool, but may be reported as additional information in the EPD Norway EPD template and therefore reported, but always left without any information.

2.6.5 Value based choices related to decisions regarding characterization models, factors and methods etc.

No value choices are made regarding impact categories, characterization models, and characterization factors. Normalization, grouping and weighting are not applied.

No input/output flows are identified that do not have a characterization factor applied on the list of characterization factors of the EN15804 and applicable PCR.

Only emissions up to 100 years shall be accounted for according to EN 15804, no long-term emissions (> 100 years) are included in the inventory.

2.6.6 Assumptions and limitations associated with the interpretation of results as declared in the EPD

No interpretation of the LCIA result is carried out, since the goal and scope with the LCA is only to provide necessary data and documentation to perform an EPD according to the requirements of PCR NPCR 015 version 4.0, 07.10.2021, and to gain insight into the environmental impacts related to assessed product.

3 Life cycle inventory (LCI) data developed for the specific generator

3.1 Product specifications

Timber used in the sawmills covered by this report are spruce/whitewood or pine/redwood and oak. The figures presented below are agreed Swedish average figures valid for the roundwood assortment that are used for sawn timber.

Table 9 Material composition per m³. Figures based on average data and consensus dialogue to be used in LCA calculations between IVL, Skogforsk and Swedish wood 2022.

Material properties	Pine 20%	Spruce 20%	Pine 18%	Spruce 18%	Pine 16%	Spruce 16%	Pine 12%	Spruce 12%	Oak 9% 1)
Dry raw density, kg DM/m³	420	384	420	384	420	384	420	384	625
Dry density, kg DM/m³	433	396	437	399	440	403	448	409	700
Density as delivered, kg/m³	519	475	515	471	511	467	502	459	736
Raw moisture content, %	95	100	95	100	95	100	95	100	80
Moisture content before drying, %	70	75	70	75	70	75	70	75	65
Moisture content, %	20	20	18	18	16	16	12	12	9
Cprod, kg C/m³	216	198	218	200	220	201	224	205	337
GWP-BIO, kg CO_2/m³	-793	-725	-800	-732	-807	-738	-821	-751	1237
PERM, MJ/m³	8309	7597	8381	7663	8454	7729	8598	7861	12956

1) Figures on moisture content is from Trä AB KG List, June 2024.

When a mix of species are used at the sawmill the average raw material mix is normally accounted for and reported in the EPD. The sawn and planed timber are produced in different dimensions and length. No adjustments are made for potential different densities in different assortments, and the average value is always used.

In addition, it should then be noticed that the wood volume changes when it is dried beneath a moisture content of 30 %. The calculation of the density therefore has to account for both the volume change as the moisture content in order to calculate that actual density. The density of wood at is current state (i.e. its actual moisture content and volume, $\varrho_{x,x}$) can be calculated as follows (Erlandsson 1996):

Actual density ϱ x,x = ϱ 0,30 /(1-β) * (1- β *u/0.3)*(1+u)

where

u	Moisture content [m/m]
ϱ	Dry raw density
β	Volume shrinkage [$\varrho_{0,0}/ \varrho$]

Based on the volume shrinkage of 12% valid for conifer as an average, the density of product can is then calculated.

3.2 Life cycle inventory (LCI) developed for the specific generator

3.2.1 Forestry (A1)

The inventory data for the forestry is representative for Swedish conditions and based on commonly used references divided in different process steps that take place during a tree rotation period.

A1 Forestry	
Aspect	**Notes**
Precision	Swedish average
Completeness	Data accounts for all known sub-possesses
Consistency, allocation method, etc.	Allocation follows physical causality in line with EN 15804. A conservative approach is used where all forestry activities are allocated to round timber and nothing to forestry by products (GROT). Only the final process step that is only related to forestry by products (GROT) is allocated to these by-products. This approach can be regarded as the economic allocation approach as outlined in EN 15804 when low value by product occurs, where the value of the by-products is set to zero.
Geographical coverage	Data is valid for Swedish average forestry
Time related coverage	2012-2020. Original data is valid for 2012 and regarded as relevant for current practice based on the consensus work carried out by BioInnovation concerning Swedish forestry (Högbom et al 2020). The data for the plant nursery school is quite old and newer data is found in (Högbom et al 2020), but

A1 Forestry	
Aspect	**Notes**
	a factor of 10 lower than Aldentun 1999. We assume that there is an error made by BioInnovation and that this figure in future will be corrected. Until then we use the old figure for the plant nursery school.
Main data sources (references)	Forestry processes: Brunberg 2009, 2013. Plant nursery school: Yvonne Aldentun 1999 Forestry roads: Högbom m.fl. 2020 See Table 9 for the full list of references
Validation of data	Main source data contributing to the impact from the forestry is valid for 2012 (Brunberg, 2013) and regarded as relevant for current practice based on the consensus work carried out by BioInnovation concerning Swedish forestry (Högbom et al 2020). The validly of the data is therefore set to 2020.
Representativeness	Data is set to be representative for the current Swedish situation and valid for the forestry suppliers to the Swedish sawmills.
Treatment of missing data	No data is found missing
Data quality assessment	Data quality as required in EN 15804 is met. It is not common that specific data for the actual forestry is available.
Comments	The most up to data for Swedish available average is used. Ecoinvent is used for upstream data from machinery etc. Reduction diesel (see 3.3.4) is used in the forestry. Note that a conservative allocation approach is used when allocation of all forestry activities is attributed to round timber and nothing to forestry waste products, in Swedish GROT (GROT is equal to branches and (tree) tops that is low value product that when harvested is used as fuel). This conservative approach is in line with the economic allocation approach given in EN 15804 for low value by products when the studied product is the main product, i.e. round timber.

Table 10 Forestry's diesel use divided into sub-processes and converted to round hours harvested per m³f with regard to an entire rotation period has if it happens instantly (fub is equal to solid measure under bark).

Process operation	Amount	l/ha	ha/m³fub	Use l/m³fub	MJ/m³fub	Source
Forest roads				0.13	4.7	Timmermann & Dibdiakova. 2013
Plant nursery school					0.3	See note 1) below
Plant transport 2)					0.02	Högbom m.fl. 2020
Planting 3)				0	0	Ågren m.fl 2021
Soil preparation		26.0	0.0027	0.07	2.5	Brunberg, 2009
Fertilizing		11.0	0.0005	0.01	0.2	Brunberg, 2009
Cleaning (Röjning)		9.9	0.0050	0.05	1.8	Brunberg, 2009
Thinning, harvester 4)	0.33			1.60	19.2	Brunberg, 2013
Thinning, forwarder 4)	0.33			0.98	11.8	Brunberg, 2013
Final cut, harvester 4)	0.67			0.83	19.9	Brunberg, 2013
Final cut, forwarder 4)	0.67			0.72	17.3	Brunberg, 2013
Sum					77.7	

1) Besides 0.3 MJ diesel (Aldertun 1991) consumption at the plant nursery school plus use of 1.0 MJ of electricity (Aldertun 1991) and 0.77 MJ biofuel for heating (Svenska Skogsplantor) per m³ fub[5] *that* is accounted for separately.
2) The energy use is based on 1 MJ/ton·km
3) Planting is made manually
4) Based on statistics are 1/3 of the yearly harvested round timber from thinning and the rest from final cut (Skogsstyrelsen 2019).

[5] Solid measure under bark. This unit is commonly used in Sweden.

3.2.2 Transport from forestry to sawmill (A2)

The specific transport distance from the different harvesting sites is used as input for the transport calculation related to A2 from the forestry roadside to the sawmill. The load factor for the trailer used (34-40t) is 90% in one direction and then an empty return, resulting in an overall load factor of 45%. Based on these specifications and the NTM database (NTM 2016) the energy use is 0.98 MJ/ton·km. This figure is about almost the same figure suggested by Brunberg (2018) and referred to in a project from the research program BioInvation (Högbom et al) that developed a PCR for forestry products in EPD International.

The round timber weight used in the EPD generator is equal to the final density of the board etc. as delivered. This means that a correction factor has to be introduced taking the raw density into account and a resulting increased energy use for transportation. This correction factor is equal to raw density/density as delivered, and results in a factor around 2.

Besides this correction is the transport from forestry to sawmill based on an economical allocation where the part of the round timber that is used for sawn timber will be attributed to a larger amount of this transportation work based on an economical allocation for A2 as suggested by EN 16485. This factor is around 1.8. This kind of allocation of transport is seldom or never made for other material or referred to in other cPCR. This is justified by EN 16485 by the purpose of transport is the forthcoming sawn timber and not the co-products in the sawmill sawing and reducing milling that generates a by-product mainly used by the paper and pulp industry. Please note that the PCR B for wooden products in EPD Norway overrule this odd allocation approach in EN16485 and state “Forwarding and road transport shall not be allocated by revenue as they are not regarded as joint co- production”. Nevertheless. Based on a market dialogue in Sweden and neighboring countries, it is decided that here a conservative approach shall be used for the settings of transport in A2 that follows EN 16485. This approach almost doubles the impact from this transport (in an LCA context it is always accepted to make conservative choices and this is also reported in the EPD). Both these correction factors are then added to an overall A2 correction factor of about 3.5, and referred to as “Allocation factor (according to cPCR EN 16485)” in the supplementary LCA report.

3.2.3 Additional transport for non-integrated sawmills (A2)

In the case of a processed sawn timber is assessed and when further manufacturing takes place at a separate site than the sawmill itself, extra transport will occur. This extra transport will be reported and elaborated in the supplementary LCA report (when relevant). Note that there will not be a need for any correction factor due to moisture content, since the sawn timber moisture content will be the same as the processed timber transported to the manufacturing site for further processing like planning etc.

3.2.4 Manufacturing at the sawmill (A3)

Sawmill A3	
Aspect	**Notes**
Precision	Site specific
Completeness	Data accounts for all known sub-possesses
Consistency, allocation method etc.	Allocation follows EN 15804 and an economical allocation approach is valid for all sawmill processes except the drying process that follows a physical allocation. See text and comments below on how corrections of different moisture content in the outputs can be made when recalculations from an average moisture content have to be done to a more precise moisture class.
Geographical coverage	Data is valid for the specific company that besides the national market normally also export their products.
Time related coverage	Data validity is specified in the supplementary report and in the EPD
Main data sources (references)	The data is besides generic allocation factors based on site measurements. See inventory in the supplementary reported in the section/sheet "A3 Manufacturing" for details.
Validation of data	Data are validated with EPD from Swedish Wood and their average EPD for sawn timber[6] and planned timber[7] (published in EPD International). These EPD indicate a large span from 22.4 to 36.9 for sawmills and an average of 31 kg CO_2e/m^3. The EPD for planed timber do not include as many sawmills as for sawn timber and report a figure of 30 kg CO_{2e}/m^3 for a mill with an integrated sawing and planing, respectively 49 kg CO_{2e}/m^3 for at pure planing mill. This latter figure is quite high and based on very few planing mills and where import of sawn timber affects the result significantly (and cannot be regarded as representative. The fact that the EPD for planed timber is lower than the one for sawn timber reflects that these sawmills are more modern. A modern sawmill typically always includes a planing process.
Representativeness	Measured data is mainly used and therefore representative for the processes applied.
Treatment of missing data	No data is found missing, and if so, shall it be reported in the supplementary report
Data quality assessment	Data quality as required in EN15804 is met.

[6] S-P-02537 - Swedish sawn dried timber of spruce or pine (environdec.com)
[7] S-P-02657 - Swedish sawn and planed wood product (environdec.com)

Sawmill A3	
Aspect	**Notes**
Comments	See below.

3.2.4.1 Generic calculation factors applied for sawn timber

The sawmills in Sweden do not normally have measured energy use for the individual process steps (see Figure 1). For this reason, generic energy use figures are defined here to make it possible to perform the economical allocation per process step as outlined in ISO 14044 and EN 15804 per process step. The approach is then that these generic allocation factors are applied on the total energy reported for each sawmill.

We are aware that most LCA consultants, due to lack of information from individual process steps at the sawmill, regard the whole sawmill just as one black box and allocate including all sawmill process as a proxy (typically using 85% as allocation factor for sawn timber compared to all co products). This is acceptable according to EN 15804 if the LCIA is limited to the main product sawn timber. Since this EPD generator is designed to handle also all co-product sawmill processes, there is a need to also generate energy use figures for individual co-products allocated according to EN15084, a more complete subdivided process description is needed. The sawmill is therefore here subdivided into several individual subprocesses (see Table 10). Based on a literature review, the amount of energy used for biofuel/heat, electricity and diesel consumed at the site, is divided into different sawmill subprocesses. This basic work is made within the project Mistra Digital Forest and used here as the main reference for these figures. These figures are used in Mistra Digital Forest as data for a generic sawmill including its by-products (Erlandsson 2022) and described below.

To start with a generic mass or volume balance is needed to set up these energy-related generic allocation factors. Yearly statistics are published from the monitoring of round timber bought by different end users like board industry, sawmills, and pulp producers. These statistics also include manufactured products in all sawmills in Sweden and is illustrated in Figure 2.

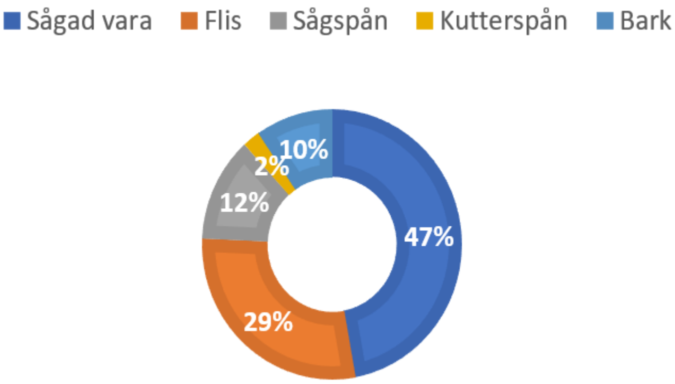

Figure 2 *The sawmills' production distributed by quantities sold in weight-% (Biometria 2019). (sågad vara/sawn timber, flis/chips, sågspån/sawdust, kutterspån/shavings)*

It should be noticed that the so-called 'sawmill yield' is about 50% for producing sawn timber (see Figure 2)[8], meaning that slightly more than 2 m^3 round timber is needed to get 1 m^3 sawn timber. At the same time, it can be stated that of these about 2 m^3 per m^3 sawn timber intake to the sawmill, there will in principle be no waste, since all co-products of about 1 m^3 is usable flow used in other processes as raw material and subject for co-product allocation. Based on fundamental LCI methodology all co-product are subject for co-product allocation in A1-3, meaning that the upstream impact from the forestry will never be less than 1 m^3 round timber per m^3 sawmill product out[9]. This implies that, e.g., 1 m^3 generated bark from the sawmill will be attributed to the environmental impact of 1 m^3 round timber and the related forestry processes. The same figure for sawn timber is that about 1.15 m^3 round timber and the upstream forestry impact is attributed to sawn timber, where 0.15 m^3 is equal to the energy that is used in the drying process.

The mass balance approach (reference flow) that defines how much upstream raw material is attributed to a co-product is generically valid for all kinds of co-product allocation. In parallel to this fundamental co-product allocation EN 15804 is clear (compared to ISO 14044) and does not leave room for interpretation and states; "*Irrespective of the allocation approach chosen for a co-production process or for secondary flows crossing the system boundary between product systems, specific inherent properties of such coproducts or flows, for example calorific content,*

[8] Note that if you incorrectly use this information as a basis for raw material output for sawmill product, the environmental impact from the forest will be twice as high as it should be and double-booked, since the sawmill's co-products are also charged with this environmental impact from forestry.
[9] This is also why so-called pre-consumer waste has an environmental upstream impact from its raw material production, compared to a discard product that becomes a post-consumer waste where the 100/0 allocation approach, imply that the environmental upstream impact for raw material production is attributed to the first product.

composition (biogenic carbon content, $CaO/Ca(OH)_2$ content, etc.), shall not be allocated but always reflect the physical flows.". This allocation principle is applied for all usable flows and co-product allocation from the sawmill, meaning that independent of the environmental impact allocated from the sawmill the inherent energy content and biogenic carbon stored is exactly the same for all these flows per m^3 dry matter.

Table 11 General market value per m^3f (f, normalised to a fixed and solid volume), for sawmill products (Erlandsson 2022)

Assortment	Market price kr/m^3f	Relative price vs. sawn timber kr/kr
Round timber	550	31%
Bark	300	17%
Cellulose chips (raw)	450	25%
Shavings and dry by-products	300	17%
Sawn timber	1 800	100%

The co-product allocation stepwise procedure in EN 15804 requires that an economical allocation shall be performed if a significant difference exists between the main product and co-products. This is the case for the products out from the sawmill process (see Table 10 that list in which process step the co-product appears and Figure 2 gives information about the amount of co-product that is generated). This economical allocation is based on the market price for all usable flows sold from the sawmill and the applied figures are listed in Table 10.

Table 11 describes process steps at the sawmill that are needed for the co-product allocation. All processes are allocated based on an economical procedure, except the drying process that is allocated 00% to the dried sawmill products. The sawmill produces dried sawn timber in different moisture classes, where a lower moisture content demands more energy. The simplest way to handle this in an LCI/EPD is to define the declared unit based on the average moisture content. However, according to this EPD generator it is also possible to make a correction of the energy used for a specific moisture content class. This calculation and settings are described further in section 3.3.4.2.

Table 12 Energy used in different processes in the sawmill divided in different energy sources (Erlandsson 2022).

Assortment	Co-products	Fuel for heat	Elecricity	Diesel	Allocation basis
General process like; heating. lightning, transportation etc	—	7.1%	7.0%	45%	Economical
Timber reception and log sorting	—		2.8%	55%	Economical
Debarking and saw intake	Bark		7.0%		Economical
First and second breakdown and sawing	Cellulose chips (raw)		31.0%		Economical.
Drying	—	92.9%	45.1%		Physical*
Final trimming and packaging	Dry by-products		7.0%		Economical

** If other moisture classes than the average moisture content of the sawn timber is to be assessed the drying has to consider the current energy use for that specific moisture class.*

Based on measured energy use at different sawmills generic figures as in Table 10 can be used to distribute the overall energy use into different processes. In the case when a sawmill also has further processing like planning, painting etc. and the energy use for those additional treatments is not measured and typically only covers part of the overall production, we introduce sector average key figures that can be used to fill those gaps.

The initial and most common problem is that the production includes a combined saw and planing mill. In the inventory this is then solved by dividing the combined plant in two major process steps, where a calculation is made so that the first step results in representative figure for a sawmill that virtually produces 100% sawn timber, followed by a second step that produces 100% planed timber. To do so the following key figures can be used per m^3 planned timber (Erlandsson 2022):

- 10 kWh wood fuel
- 5 kWh diesel and
- 24 kWh electricity

Note that the biofuel is used to produce heating of premises and the diesel is used for internal transportation at the site. Moreover, all waste flows in such combined saw and planing mill are always allocated to the sawn timber and the only exception is additional waste that occurs in processes where the waste typically is handled separately, such as waste from painting or wood preservatives.

Table 13 Over all allocation factors (energy use for sawn timber/total energy use) for different energy carriers used at the sawmill (Erlandsson 2022).

Assortment	Fuel for heat	Electricity	Fuel	Allocation basis
Sawn timber	99%	91%	79%	Economical

In order to decide the generic allocation factor for the energy used for sawn timber based on an economical allocation, the average Swedish sawmill production in Figure 2 is combined with the market value in Table 10 for the different product assortments and the energy use per process as given in Table 11. This calculation defines the allocation factor for sawn timber as reported in Table 12. The allocation factor in this table is used to calculate the part of the total energy at the individual specific sawmill that is attributed to the sawn timber assortment. This allocation is thereby based on site specific energy use and the actual production, while the distribution to different sawmill products is used on a generic allocation factor.

If there is a painting process in the manufacturing step, the raw material is typically planed boards that are cut in two to generate a rough sawn surface which is the surface that is painted and exposed to the outdoor environment. Such key figures that can be used are listed below:

- 1.3 kWh extra electricity per m^3 for the band saw.
- 30 kWh/m^3 extra electricity per m^3 painted layer, where the typical board thickness is 22 mm.

Note that it can be assumed to be the same energy use independent of the amount of paint added that typically varies from 150 g/m^2 for a ground and 120+120 g/m^2 for an intermediate painting respectively, and 120+120+180 to 420 g/m^2 for a final painted board. It can be assumed that about ¾ of the painted production is 22 mm thick boards.

When finger-jointing process are to be accounted for, the following key figures can be used.

- 9 kWh extra electricity per m^3 for the finger-jointing (without planing that takes place after the jointing).

- 20 kWh extra electricity per m^3 for an additional (second) planing of the board

It can be assumed that the average finger-jointed element is 45 mm thick, and the average total resin uses 0,9 kg/m^3.

Note that it is assumed that the processing for both painting and finger jointing is taking place in connection with the planing and internal transport and heating of the facility is already accounted for as part of the planing process (see above). If this is not the case, additional energy for the planed/or finger-jointing shall be added for internal transport and heating as given above namely, 5 kWh diesel, respectively 10 kWh wood fuel per m^3.

3.2.4.2 Correction of drying energy to a specific moisture class

A sawmill may produce sawn timber with different final moisture contents, while the yearly based reported figures used for the EPD are valid for an average. If on-site measurements are not applicable for such recalculations from an average moisture content to a precise moisture content, valid for a defined moisture class, a simplified calculation can be made to handle this. If this is done the calculations shall be documented in the supplementary report.

The input and output moisture content are crucial input data for calculation of the energy use for drying of wood. If site-specific measuring does not take place and a simplified calculation is done to estimate the actual energy used for different moisture classes at the sawmill kiln, general statistical data for the mean input moisture content value can be used (see Table 6). A simplified equation to calculate the energy needed per kg water evaporated is given in Erlandsson (1996) and includes a constant that must be determined, see equation below:

$$\bar{e}_{in,out} = 2{,}5 + c * \ln(u_{in}/u_{out}) \qquad \text{[MJ/kg]}$$

A default value of the constant, c, was calculated based on references Hedlund (1994), Esping et al (1982) and Esping (1995) and gave the value of 1.4 MJ/kg, valid for conventional drying sheds. Erlandsson (1996) gives a sample calculation made where the heat requirement based on the equation above is calculated as follows:

- class 8 - 5,5 MJ/kg evaporated water
- class 12 - 5,0 MJ/kg
- class 18 - 4,4 MJ /kg

Based on these examples can it be calculated that energy needed for drying spruce from 18% to 12% will require an extra amount of energy to dry the wood equal to 24.5 kg (=409*(0.18-0.12)). This will cause additional drying energy about 123 MJ/m^3 (=24.2*5) or 34 kWh/m^3 to achieve a final moisture content of 12%, which is about 10% extra heat/fuel need per m^3. The electricity used can be set by dividing the same figure by 5, equal to an additional 25 MJ electricity per m³ to reach a final moisture content of 12%.

3.2.4.3 Check of correction of drying energy needed based on tree species mix

When a sawmill is using different tree species the drying energy will vary because the round timber contains different amounts of bound water in the wood cells. In practice it will be the amount of water needed to evaporate from the dried wood that may cause a difference. This difference is, however, reduced by the fact that the spruce has a lower density compared to pine, but the green moisture content is higher, see Table 8.

Table 14 Variation in energy use at the sawmill drying process based on different tree species per m³.

Material properties	Pine 16%	Spruce 16%	Pine 12%	Spruce 12%
Water before drying kiln, kg	399	384	399	384
Water after drying, kg	70	64	54	49
Water evaporated, kg	329	320	345	335
Additional energy need pine versus spruce, %	2.7	0	3.0	0

In Table 13 the extra energy is needed (heat and electricity) to dry 1 m³ of pine compared to 1 m³ of spruce is reported. Because the energy variation in the drying is equal to or less than 3%, this impact is assumed to be neglectable. This maximum variation of 3% measured for bioenergy use, and its contribution to any impact category shall be compared to the declared product impact from information module A1 to A3, why this aspect described here fulfills the PCR requirement that this variation A1-3 for any impact category is less than 10%. It is therefore assumed that the declared value in the EPD is thereby assumed to be representative for a mix of pine as well as spruce, without calculating a separate figure for the two species and reporting this in two EPD. If one producer would like to calculate and report per species this is possible, and the same correction as outlined in sections 3.3.4.2 can be used.

3.2.4.4 Calculation of Swedish generic average data for specific assortments.

These average data for sawn and planed boards described here and associated calculations are needed when generic data is used in the EPD Generator instead of specific data for the upstream process. The approach allows us to have full control of the source data used and (if needed) create an average figure valid for any sawmill product. characterization

Source data was collected for Swedish generic sawmills and their products in a report by Erlandsson (2002) commissioned by the project Mistra Digital Forest. The goal with this report was to establish several unit operations that all together described the manufacturing output from sawmills and other products from the sawn round timber-based industry.

These source data are validated for planed boards by using the sector EPD for an integrated sawmill producing planed timber[10]. The GWP-GHG A1-3 for this EPD is 29.5 kg CO_2e/m^3 (Swedish Wood 2021). The same figure when used in the EPD generator is 30.6 kg CO_2e/m^3. The deviation is about 3% and must be regarded as very close result to the EPD. A known difference between the two LCA calculations is that the calculation made within the EPD generator uses an updated figure for Swedish reduction diesel (see 3.3.4), where a 5% higher proportion of biocomponents in the diesel blend is used. A final remark: it can be stated that the generic average figures that use source data from Erlandsson (2022) is slightly conservative based on this observation.

3.2.5 Module A4 transport to construction site

The transport distance A4 is given in the cPCR EN 16485, as 300 km and with the assumption that there is an empty return. The load factor for the trailer used (34-40t) is 90% in one direction and then an empty return, resulting in an overall load factor of 45%. Based on these specifications and the NTM database (NTM 2016) the energy use is 0.98 MJ/ton·km. Based on market requirements an additional transport scenario can be reported in the EPD and shall then be documented in the supplementary LCA report and the EPD.

3.2.6 Module A5 assembly at the construction site

No Swedish statistics exist on wooden based waste factors at the construction site and that is why 5% is used (as a common proxy). A default scenario used for a lot of product groups in the EPD Generator is that a crane is used to lift the product and a front loader to distribute

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[10] S-P-02657. Swedish sawn and planed wood product fromSwedish Wood. 2021-06-15, EPD International AB.

the product on site. The energy need is 0.06 kWh/ton lifted 20 meters (based on: Lundström 2016), respectively 0.6 kWh/ton for 4 minutes transportation work (based on: Erlandsson 2013).

In simple terms the unique figure for the specific EPD is achieved by multiplying the above figure with the declared unit weight. This calculation is transparently reported in the supplementary report and used as source data to the EPD generator.

3.2.7 C End-of-life stage: Process for reuse, recycling and recovery

The EPDs from the EPD tool apply the so-called 100% scenario approach in the end-of-life (modules C and D). This approach is suggested by CEN TC 350 and the CPR Acquis process in order to increase transparency and modularity for end of life (EoW) scenarios. The typical implementation is then to report on the most common/likely end-of-life alternative as the 'base scenario'. We then present a realistic worst-case scenario as a 'complementary scenario'.

There exists no national statistic in Sweden on waste materials generated on the construction or demolition sites and the sorting efficiency. However, for most construction products is it likely that a high material sorting and recovery is achieved (more than 90%), if the material is not very small, locked up in a component or fixed in the construction like part of concrete. Based on this knowledge gap the most likely end of life scenario is instead selected for discarded wood products as energy recovery. Moreover, in the EPD is the so called 100% scenario approached used, this likely is the approach that will the mandatory way of reporting according to the new Construction product regulation in EU, Energy recovery is the most likely EoW scenario used for reporting as the base scenario result in the EPD. The supplementary scenario is defined as 100% wastage of the wooden product at the construction site. It assumed that the wood is lost in site in the topsoil or on the surface, where it will be broken down without producing methane. Based on this 100% scenario an EPD user may easily recalculate the result to reflect different national or local conditions. This assumption is also explained in the EPD.

For organic material landfilling of combustible and organic waste is prohibited according to EC regulation (99/31/EG) that is implemented in national law (2001:512). The number of exemptions to this regulation is reduced in Sweden[11] and not applicable to construction waste. In stage C therefore wooden products to be demolished, collected and used as fuel and

[11] https://www.naturvardsverket.se/vagledning-och-stod/avfall/deponering-av-avfall/

minor parts will be transformed into waste and stay at the site on the surface or the topsoil. This 'lost at site' is therefore the alternative 100% scenario to energy recovery as landfill is not a legal alternative.

C1 Demolition

The energy used for demolition of a building can be reported per m2 and additional energy used for preparing the waste for recovery and thereby figures on energy use for demolition and handling of different material, as defined in Erlandsson and Peterson (2015) can be obtained. According to this reference the energy needed for treatment of the wood at the demolition is 1.1 kWh/ton, see Table 15 below (screen shot from the IVL report in supplementary LCA report). This figure is used as a general applicable figure if no more precise information exists and is therefore referred to as 'IVL generic branch figures' and the table us used by several different EPDs and materials.

Table 15 Generic energy figures for end-of-life processes used for construction demolition developed for Boverket (Erlandsson and Peterson 2015).

Module and process	Unit	kWh/m^2 BTA [5)]	kWh/ton
C1: Preparatory demolition work	Electricity	0.1	
	Diesel	1	
C1: Decomposition (crushing) of the construction, regardless of the type of frame [1)]	Electricity	8	
	Diesel	10	
C1: Additional for frame consisted of,			
concrete	Diesel		10
masonry	Diesel		5
steel	Diesel		1.1
wood and other materials	Diesel		1.1
C1: Additional crane for floors over six meters above ground [2)]			
concrete	Diesel		4.1
masonry	Diesel		4.1
steel	Diesel		2
wood and other materials	Diesel		2
C3: Reprocessing to be able to sell recovered materials made of [3)],			
concrete (crushing)	Diesel		2.0
masonry (crushing)	Diesel		1.5
steel (fragmentation)	Diesel		7.4

Module and process	Unit	kWh/m² BTA [5)]	kWh/ton
wood (chipping)	Diesel		6
other materials	Diesel		0.8
Disposal and backfilling of demolition materials [4)]	Diesel		1.6

1) This is a general item regardless of the building's material and is then supplemented with various additions such as additional energy use in addition to the general item.
2) In cases where there are basements, it is assumed that no crane is needed.
3) In the basic case, it is assumed that this reprocessing is done at the demolition site to minimize the transport work.
4) The item includes laying out and compaction at landfill/backfilling.
5) BTA, *brottoyta* in Swedish is equal to the gross area includes the area of all stories that can be measured, including exterior walls, holes for stairs, glazed conservatory, etc.

C2 Transport to waste handling

The distance from the demolition site and waste reception plant is set to 35 km and a load factor of 90% and then an empty return that results in an overall load factor of 45%. A diesel driven lorry TT/AT 14-20+20-28t is used and consume 1.33 MJ which is the type of truck and load factor according to NTM (2016).

C3 Waste processing

In module C3 it is assumed that the discarded wood product is chipped before it is sold. This process is assumed to use 6.0 kWh diesel/ton wood chipped and sorted at waste reception plant (Erlandsson, Peterson 2015), see Table 1.

For further details and the resulting energy used figures calculated for the specific EPD see the supplementary LCA report and the sheet "C1, C3, C4 End of life". In simple terms the unique figures for the specific EPD are achieved by multiplying the above figure with the declared units' weight. These calculations are transparently reported in the supplementary report and used as source data for the EPD generator.

3.2.8 Module D

Based on the fact that the discarded wooden product is chipped and handled as fuel in stage C and EoW criteria is fulfilled and if the wooden waste is not classified as hazardous waste, the next process step will be as fuel in a district heating plant in module C3. In module D the generated fuel is substituted with the average fuel mix commonly used for district heating. Since the LCA data covers the same Swedish average district heating, the efficiency is assumed to be the same, independent of the fuel used. Note that the result will be the same if exported energy given in MJ was accounted for from C4 (i.e. EEE/EET) instead of kg fuel and its LHV. So, in module D the chipped discarded wooden-based product is used as a fuel in district heating and thereby replaces the average fuel mix supplied to the Swedish national district heating plants (and the related impact from a life cycle perspective).

As already mentioned, this is the only legal end-of-life scenario for wood in Sweden and landfill is banned by law (see above). This scenario is therefore representative of the most likely scenario alternative in module D.

EN 15804 states that the avoided material or fuel shall be "*based on current average technology or practice*.". The substituted fuel in module D is therefore equal to the fuel mix used in Swedish district heating for the year 2019. The source data for district heating is published by Swedish Energy as an xls-file and valid for year 2019 (Svensk Energi 2020). The LCA data used for individual primary fuels, and its upstream impact is based on ecoinvent and combustion of waste (where EoW criteria is not fulfilled) Naturvårdsverket (2020). However, data on the amount of fossil carbon in the household waste used in district heating is based on a figure from Swedish EPA that is used for national climate reporting and is equal to 40.5% w/w fossil coal (Naturvårdsverket 2020). The same reference gives a heating value of 10 MJ/kg household waste on average. Emission figures from combustion are based on figures from Swedish EPA (Naturvårdsverket 2021). Emissions from the combustion that contributes to $GWP_{biogenic}$ from biogenic energywares in district heating from waste fuels are according to this reference; 0.005 kg methane/GJ and 0,04 kg laughing gas (also called nitrous oxide) /GJ and for wooden fuels; 0.011 kg methane/GJ and 0.03 kg laughing gas/GJ.

3.3 Generic data for energy and transport

3.3.1 Location based Swedish electricity

The data for the electricity generation applied in the core manufacturing process (A3) make use of Swedish average production mix if location- based approach is used: Since EPD Norway require double reporting of electricity this market based mix shall be reported with the amount of electricity used in A3 core process (bought electricity to the site) and alternative GWP data per kWh shall be reported for the residual mix. Both electrical data is from ecoinvent (see appendix 1).

3.3.2 Market based electricity

The electricity power mix in any EPD from EPD Norway shall include double reporting of electricity bought in the core process (A3) that is referred to as a location-based perspective market-based approach. When location-based is the main alternative in an EPD, the main indicator results need to be complemented by the residual mix valid for the country where the manufacturing process is placed and that is equal to the Swedish residual mix. This additional reporting is placed in the section 'Additional information' and is in line with the additional requirement published only on EPD Norway webpage. Since the guarantee of origin, GoO, is seldom reported with LCA-based results according to EN 15804, generic representative data are needed to calculate the LCA data for the market based GoO electricity and the GWP figures used in the calculation, as given in Table 15.

Table 16: GWP-GHG/GWP$_{fossil}$ used for GoO if EPD data from actual supplier is not available (see Appendix 1 for ecoinvent data used).

Energy source	kg/kWh
Hydro power	0,043
Nuclear power	0.007
Wind power	0.028
Biomass	0.047
Photovoltaics	0.082

The source data for the market-based residual mix is based on data published by AIB that in praxis is handled by Grexel. When a GoO exists, the data specified in this contract is used instead of the residual mix. The data for different electricity types are based on the generic data found in Gabi representative for Sweden, independent of residual or data for a specific GoO is used.

CEN TR 16970 + CEN TR 15941 sets requirements for GoO that requires a registry and reporting on the residual mix within the system. Concerning source of origin of electricity delivered in EC countries this is regulated by law (and by default answers issue No 6.1.1, 6.1.2). The issuance, trade and retirement of EECS certificates is regulated by the EECS Rules, developed by the Association of Issuing Bodies (AIB), available at https ://www.aib-net.org/eecs/eecsr-rules

The EECS certificates are based on and developed upon the requirements of the Renewable Energy Directive 2009/28/EC (RED) and the recast Renewable Energy Directive (EU) 2018/2001 (RED-2). The aim of the AIB and the EECS Rules is to standardise and harmonise the national guarantee of origin (GO) systems across its member countries. This is designed to facilitate and promote cross-border transfer of renewable energy between the AIB member countries.

Market-based electricity Case 1

In the case when electricity provided by manufacturers that produces energy on site that is physically linked to plants nearby, general requirements are listed in the verification protocol issue 6.1.4.

It is noticed that Case 1 can actually be sub-divided into two cases, referred to as Case 2 and 3 in the verification protocol. For all countries that follow European legislation Case 2 is valid. The difference between Case 1 and Case 3 is that a manufacturer will have to generate a list of issued certificates and the cancellations for this as proof of the GoO. This list acts as proof and will always describe historical data, and this is why the follow-up routine given below shall be applied. Note that the maximum variation when source data for the LCA calculations are changed is 10% and limited to the LCIA environmental indicator result and shall be checked if energy settings are changed in future.

Market based electricity Case 3

In the case when electricity is provided from national statistics with registry (called Case 3 verification issue 6.1.4):

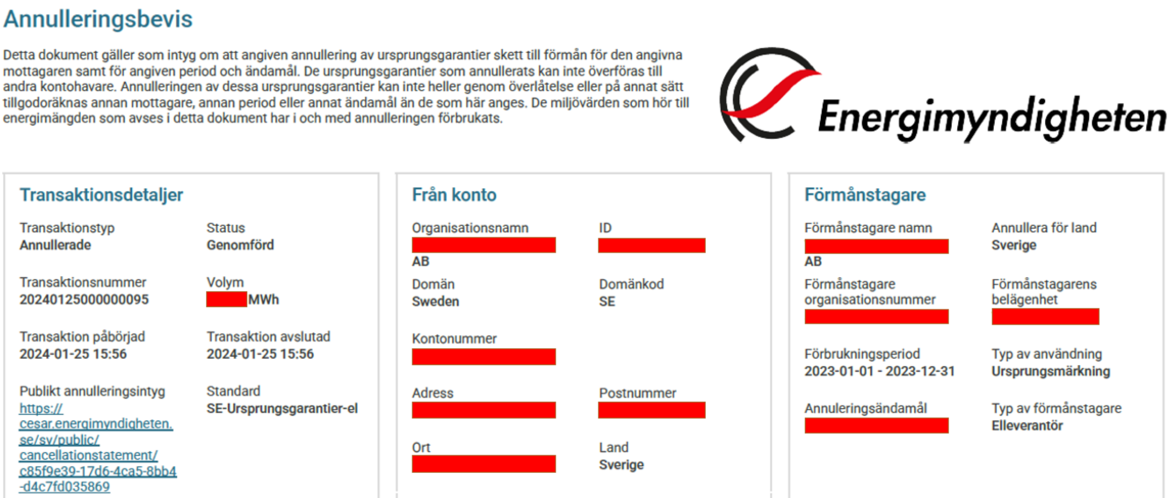
Case 3 is valid for the GoO in all EC countries. The reporting asked for valid for Case 3 is found in the EPD and aspects to be listed in the LCA report given below.

In the LCA report the following information related to a specific GoO shall be found in a proof that can be either: the contract, or a second party statement to the EPD Owner designed as a diploma from the electricity provider (see issue 6.1, 6.1.4. The list below is expanded compared to the mandatory list):

- Energy provider, the name of the company that sells electricity
- Client, the name of the buyer of the electricity
- A list of all manufacturing sites, if the contract is valid for more than one site (this is typically given as a separate list or as part of the contract or GoO Diploma),
- Electricity mix type, if more than one type of electricity source is contracted (this is typically given as a separate list or as part of the contract or GoO Diploma or on the web based on historical data)
- If outside European Union: A statement that there is no additional electricity delivered/bought for those manufacturing sites listed above (note that this replaces the EPD Norway requirement reporting of the energy amount, since this cannot be given for the future)
- Time of issue of the contract or GoO diploma
- Validity of the GoOs contract or GoO Diploma if longer than one year, where the contract shall at minimum be valid for the year the EPD is published.

The EPD owner needs a follow-up routine as required in the complementary rules published at EPD Norway webpage. To handle this, the follow up requirement from EPD Norway the routine listed below shall be implemented by the EPD Owner:

- When new data is published valid for the year before, this latest electricity mix must be checked if changed that this causes a change in the value A1-3 on GWP_IOBC/GHG less than +10% rule. If less than 10% (that is the most likely for a sawmill) no action is taken. If greater than 10%, the verifier must be notified and the EPD updated accordingly.
- The EPD owner must inform the verifier if the certificate used in the initial verification is not renewed or changed in any matter. The EPD owner will then also answer if the new contracted electricity causes a change of less than +10% or not and if so, no further action is needed. If more than 10%, an update is required.



Annulleringsbevis

Detta dokument gäller som intyg om att angiven annullering av ursprungsgarantier skett till förmån för den angivna mottagaren samt för angiven period och ändamål. De ursprungsgarantier som annullerats kan inte överföras till andra kontohavare. Annulleringen av dessa ursprungsgarantier kan inte heller genom överlåtelse eller på annat sätt tillgodoräknas annan mottagare, annan period eller annat ändamål än de som här anges. De miljövärden som hör till energimängden som avses i detta dokument har i och med annulleringen förbrukats.

Energimyndigheten

Transaktionsdetaljer

Transaktionstyp
Annullerade

Status
Genomförd

Transaktionsnummer
20240125000000095

Volym
[redacted] **MWh**

Transaktion påbörjad
2024-01-25 15:56

Transaktion avslutad
2024-01-25 15:56

Publikt annulleringsintyg
https://cesar.energimyndigheten.se/sv/public/cancellationstatement/c85f9e39-17d6-4ca5-8bb4-d4c7fd035869

Standard
SE-Ursprungsgarantier-el

Från konto

Organisationsnamn
[redacted] **AB**

ID
[redacted]

Domän
Sweden

Domänkod
SE

Kontonummer
[redacted]

Adress
[redacted]

Postnummer
[redacted]

Ort
[redacted]

Land
Sverige

Förmånstagare

Förmånstagare namn
[redacted] **AB**

Annullera för land
Sverige

Förmånstagare organisationsnummer
[redacted]

Förmånstagarens belägenhet
[redacted]

Förbrukningsperiod
2023-01-01 - 2023-12-31

Typ av användning
Ursprungsmärkning

Annuleringsändamål
[redacted]

Typ av förmånstagare
Elleverantör

Figure 3 Example of the first part of the cancellation proof authorised by Energimyndigheten that can be used as a third-party proof in the follow up routine to list all GoO certificates and if a mix is bought to verity the amount of different type of electricity and the amount of energy delivered.

The cancellation proof, as given in Figure 2, can be supplied by the EPD electricity provider and consists of several pages. The pages not given in the figure above list all individual GoO certificates that all together can be summed up to the amount of electricity delivered. Note that the figures given above can also be used to verify that 100% of delivered electricity to the specified recipient for the electricity delivered is the same as stated in the contract or GoO diploma.

3.3.3 Transport data

A simplified approach is used in the EPD generator for the transportation settings in A2 where average energy use for different transport alternatives is used, see Table 16.

Table 17: Default average energy consumption used for different transportation types.

Transport type	Energy consumption	References
Fuel consumption for different transport types • Truck o Local distribution o Regional transport o Road transport • Railway o Nordic electricity mix o Diesel • Boat o Coastal shipping o Offshore shipping o Tanker	Default value parameters (not to be changed by the user): 2.5 MJ/ton km 1.5 MJ/ton km 1 MJ/ton km 0.3 MJ/ton km 0.86 MJ/ton km 0,47 MJ/tonkm 0,18 MJ/tonkm 0,11 MJ/tonkm	These figures are used in the IVL tool for construction works "The construction sectors climate tool" (BM) (Erlandsson, 2018) and include load factor and amount of empty returns. The original figures on boat transport is Tillman (1994) and the assumptions based on different statistics. The same figures are also used by Trafikverket in "Klimatkalkyl" (Miliutenko et el 2018) and in Boverkets database and is there mandatory as default for generic resources. The diesel consumption is calculated by using the same conversion factor (0.35) that is given in Table 2 in VTI meddelande 718 (Lenner 1993).

The diesel used in Sweden is subject to a law that regulates the amount of bio-based components and is referred to as reduction diesel (see 3.3.4). Besides this "standard reduction quality" it is possible as a consumer to purchase HVO100 (referring to 100% Hydrotreated Vegetable Oil [12]). If so and used for an EPD it requires a certificate that this quality is actually bought and is planned to be bought throughout the validity of the EPD (if this is changed, the EPD needs to be verified if it affects the GWP A1-3 result more than 10%). This quality HVO100 is "outside the reduction system" and can therefore be used to reduce the impact from transport work (i.e. an alternative to the reduction diesel).

A standardised default approach is also used in the EPD Generator where several example transportation types for a lorry can be selected from a ready-made list. This list available in the LCA Generator is equal to the alternatives in Table 16. More precise transport alternatives can be used if needed.

[12] HVO, Hydrotreated Vegetable Oil), is also nowadays called HDRD, Hydrogenation Derived Renewable Diesel, since in addition to vegetable oil is animal fats and other raw materials are now also used to produce the fuel.

Table 18: Different ready-made lorry transport alternatives, where the three first is the default alternatives (see Table 1) and the remaining is examples based in the NTM database (NTM 2016).

Transport	Energy use, MJ/ton km
Lorry, city distribution	2
Lorry, rural or with 50% load factor and empty return	1.5
Lorry, country road/long distance	1
Lorry, 40t, 90% loaf factor (LF) + empty return	0.93
Lorry, 40t, 70% LF + empty return	1.12
Lorry, 33t, 90% LF + empty return	0.92
Lorry, 33t, 70% LF + empty return	1.1
Lorry, 26t, 90% LF+ empty return	0.98
Lorry, 26t, 70% LF + empty return	1.19
Lorry, 16t, 90% LF + empty return	1.34
Lorry, 16t, 70% LF + empty return	1.65
Lorry, 40t, Isolering 15 kg/m3 x % LF	12.18
Lorry, 40t, Isolering 35 kg/m3 x % LF + empty return	5.23
Lorry, 40t, Isolering 100 kg/m3 x % LF + empty return	1.97
Concrete lorry (Betongbil), 6 m^3, 80% LF+ tom return	1.65
Round timber lorry (timmerbil), 40t, 90% LF + empty return	0.97
Other, specify	

When transportation is significant, it is recommended to give as precise an alternative as possible, based on the commonly used ARTEMIS database (NTM 2016). This approach allows the user to give an exact load factor and settings of the return trip or if it is based on a route. Different type of vehicles can be selected and then documented in the supporting LCA-report that complements this Generator generic LCA report, when such specifications are made.

LCA data for combustion of fuels are in general based on data from ecoinvent. LCA data for combustion of biocomponents included in the diesel mix is handled by using the same emission factors as for fossil diesel (‘GLO, diesel, burned in building machine’), but where the biogenic emission of CO, CO_2 and methane are changed to biogenic carbon. This approach allows us to generate data for transport including manufacturing of the fuel and combustion in an engine with any mix of fossil and biogenic diesel. See section below for LCA data on different fuels used in Sweden.

For A5 transport to the customer the default transport distance of 300 km shall be used, as defined in the cPCR EN 16485, and a diesel use of 0.98 MJ/ton·km. As a general rule, specific transport distances are used in the LCA calculations, but for auxiliary materials with very low contribution to the overall impact it is accepted to use 500 km lorry and 0.98 MJ/ton·km for all resources except wooden product that are set to 250 km and 0.98 MJ/ton·km.

3.3.4 Biobased reduction diesel used in Sweden

Swedish diesel and petrol mix for road transport purpose is regulated in a law by introducing reduction goals that yearly will increase the amount of biobased diesel compounds in the average diesel mix. The original goal with this biofuel law was that the amount of fossil fuels (petrol and diesel) in total shall be replaced by 66% to biobased alternatives to the year 2030. This will result in an approximately 50% reduction in the contribution to GWP. This law is now under pause and the current amount of biocomponents in diesel is 10% (2025), but we use 6% in the LCA calculations (equal to the European average).

The environmental impact for the different diesel fuel types that are used on the Swedish market, besides the fossil version can be handled with FAME (fatty acid methyl ester) and HVO, where the latter two are replacement for fossil diesel. It is worth noticing that the climate impact per MJ of HVO has decreased in recent years. The forestry and agriculture sector are outside the reduction law and followed up separately but has in a historical perspective always met the reduction goals, while the road figures are valid also for diesel used in the agriculture sector. Standard diesel (referred to as in Sweden as MK1, SS155435) is defined according to EN590 and the maximum content of FAME is 7% and is used as low content bio-based additive, which normally in Europe (and in Sweden) consist of rape methyl ester, RME (FAME is a broader name for all kind of fatty acid-based methyl esters).

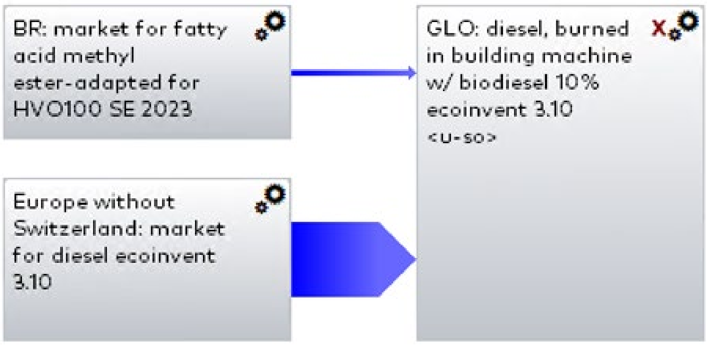


Figure 4 LCA calculations performed to receive data for representative diesel used on the Swedish market.

GWP results for the fuel-mix are sensitive to the amount of bio components. The LCI data used from ecoinvent (EC: market for diesel) is valid for 100% fossil diesel. However, standard diesel in Europe is assumed to have 6.4wt-% biocomponents added, and the sulfur content is set to 10 ppm. The Swedish reduction diesel is mainly mixed with HVO100. Diesel can in Sweden be bought with the reduction mix or as HVO100 (equal to 100% biobased diesel). Such HVO100 is outside the reduction diesel and can therefore be used to improve the climate impact when diesel is used.

The LCA data used for the biocomponents in diesel are based on ecoinvent data for FAME (BR, market for fatty acid methyl ester). The GWP fossil climate impact is, however, adjusted to be in line with the actual representative value for FAME used on the Swedish market namely, namely 33.2 g CO_2e/MJ [13].

LCI data for HVO is based on ecoinvent data 'BR, market for fatty acid methyl ester', where the GWP has been revised to be in line with the actual CO_2e reported for HVO100 used in the reduction mix, namely 16.4 g CO_2e/MJ[14]. Moreover, concerning other impact categories than GWP the production of RME/FAME can be assumed to be a conservative choice for HVO, since emissions from rape production is larger than from forestry waste (GROT[15]) and waste oils that in fact is the most commonly used raw materials in Swedish for HVO production[14].

[13] https://app.powerbi.com/view?r=eyJrIjoiODhlN2IyNmUtMmQ4OC00MzFmLTlkZTEtMWNhZGNhZmFjNzkwIiwidCI6IjVjMTk0OGIzLWE5ODYtNDg1MC04M2YyLTQ2NTk2NWMzNmNhMSIsImMiOjh9

[14] https://app.powerbi.com/view?r=eyJrIjoiODhlN2IyNmUtMmQ4OC00MzFmLTlkZTEtMWNhZGNhZmFjNzkwIiwidCI6IjVjMTk0OGIzLWE5ODYtNDg1MC04M2YyLTQ2NTk2NWMzNmNhMSIsImMiOjh9

[15] GROT= grenar och (träd)toppar meaning branches and (tree) tops, or more generally wood residues from harvesting.

4 EPD Generator interface parameters and link to used LCA and EPD data

The LCA result is calculated in the EPD generator based on input from the user. A supplementary LCA report is developed for each EPD developed based on this EPD generator. This supplementary LCA report is made in xls and allows the user to also document calculations used as input to the generator and thereby increase the transparency. This section includes a copy of the LCA data used divided into different modules. The resource name used in the EPD generator refers to the LCA or EPD data used. The documentation of LCA data and potentially the EPD used in the generator is part of the supplementary report. It is only possible for IVL to add new data in the generator after approval by the EPD verifier. This section describes in brief the parameters that can be used by the end user.

Besides the number of resources used or input/output of inventory flows to be reported in the EPD, is transportation possible to add for each resource used (see figure below). A simplified approach using average figures is used for respective transport type. Specific data is used for all significant resources. For auxiliary material with a weight less than 5% compared to the final product is the transport distance set to 500 km as default. Transport for A2, A4 and in C2 are possible to calculate more accurately and based on precise calculations reported in the supplementary LCA report (xls-file).

Transport faktor	Not	Lastbil distribution, < 20 [km]	Lastbil Regionstransport, < 100 km [km]	Lastbil Landsvägstransport [km]	Tåg El [km]	Tåg Diesel [km]	Båt Kustsjöfart [km]	Båt Högsjöfart [km]	Båt Tanker [km]

A1-2 Raw materials

Resurs	Enhet
Diesel, P&C, reduktionspliksdiesel 2018/2020 (SE) (Generic)	MJ
Electricity production (SE) (Generic)	MJ
Roundtimber, pine, u12 % (tall 420 kg/m3 torr-rådensitet, 502 kg/m3 aktuell densitet)	kg
Roundtimber, pine, u16 % (tall 420 kg/m3 torr-rådensitet, 511 kg/m3 aktuell densitet)	kg
Roundtimber, spruce, u12 % (gran 384 kg/m3 torr-rådensitet, 459 kg/m3 aktuell densitet)	kg
Roundtimber, spruce, u16 % (gran 384 kg/m3 torr-rådensitet, 467 kg/m3 aktuell densitet)	kg

Raw materials for the sawmill are coming from the forest. The data is calculated by IVL based on the final product moisture content and species mix. This means that the biogenic carbon stored resulting in energy stored in the material and uptake of biogenic carbon dioxide will be correctly reported. A check is made that the total mass used as input is the same as the product's final density. Note that if there is additional transport from the sawmill to a new site that could be relevant for a product like planed timber etc. this extra transport shall be added here in A1-2 Raw materials. Parameter settings used for the specific EPD are defined in the supplementary LCA report in the sheet "A1+A2 Product spec and factors" and transport distance from forestry to sawmill in sheet "A3 Manufacturing".

A1-2 Packaging materials

Resurs	Enhet
Förpackningsmaterial	
Cardboard (Generic)	kg
Corrugated board (Generic)	kg
Kraft paper (Generic)	kg
LDPE film (PlasticsEurope 2014 & sphera, EU) (Generic)	kg
Polyamide 6.6 granulate (PA 6) (DE) (Generic)	kg
Sawn Timber, Swedish Wood (2021 rev1), kg	kg
Steel cold rolled coil (Worldsteel 2018, EU): Used when unspecified low alloyed BF-route	kg

The list of packaging materials includes all known packaging materials used by a sawmill. Parameter settings used for the specific EPD are defied in the supplementary LCA report in the sheet "A3 Manufacturing".

A3 Manufacturing process

Resurs	Enhet
Energy wares	
Biomass, P&C (EU28) (Generic)	MJ
Diesel, P&C (EU28) (Generic)	MJ
Diesel, P&C, reduktionspliksdiesel 2018/2020 (SE) (Generic)	MJ
District heat (EU28) (Generic)	MJ
Electricity production (SE) (Generic)	MJ
Electricity production, Hydro power (SE) (Generic)	MJ
Electricity production, Nuclear power (SE) (Generic)	MJ
Electricity production, Wind power (SE) (Generic)	MJ
Hard coal, P&C (EU28) (Generic)	MJ
Light fuel oil, P&C (EU28) (Generic)	MJ
Natural gas, P&C (EU28) (Generic)	MJ
Peat, P&C (EU28) (Generic)	MJ
Components for re-use (CR) (inventory flow)	kg
Grease, hydraulic oil etc	kg
Hazardous waste disposed (HWD) (inventory flow)	kg
Material for energy recovery (MER) (inventory flow)	kg
Material for recycling, steel (inventory flow)	kg
Material for recycling, unspecified (inventory flow)	kg
Non-hazardous waste disposed (NHWD) (inventory flow)	kg
Water	
Tap water from groundwater (Generic)	kg
Well water (inventory flow)	kg

Non-hazardous waste disposed (NHWD) (inventory flow)	kg
Water	
Tap water from groundwater (Generic)	kg
Well water (inventory flow)	kg

The manufacturing process uses several energywares. The LCA data for these energywares include the inventory scope from cradle to combustion. This implies that generic data for combustion of wood is used instead of specific data. Besides LCA data, all required inventory flow that must be reported in the EPD is also available in this interface. Water use is either bought and then attributed to the LCA resource Tap water, or from own source where energy use for this flow is included in the overall energy figures for the sawmill. In the latter case the impact is related to the resource is zero. In the first case an environmental burden is added via the resource 'Tap water'. Parameter settings used for the specific EPD are defined in the supplementary LCA report in the sheet "A3 Manufacturing".

A4 Transport

Resurs	Enhet
Diesel, P&C (EU28) (Generic)	MJ
Diesel, WtW, reduktionspliksdiesel 2018/2020 (SE)	MJ

The calculation of the impact for A4 can be calculated on the default figures per transport type, but alternative is to make a more specific calculation and report the use of fuel for this transport scenario. The latter is the recommended alternative in this EPD Generator. Parameter settings used for the specific EPD are defied in the supplementary LCA report in the sheet "A4 Transport, construction site".

C5 Construction and installation process

Resurs
Diesel, P&C, reduktionspliksdiesel 2018/2020 (SE)

EPD Generator

EPD Generator: IVL EPD Generator: Swedish Wood

Name

EPD, Sandåsa, hyvlat

A5.1 Wastage fraction

0.050000

Declared unit

m3

The source data for the waste generated at the construction site (module C5) is based on figures already reported for A1-3 and A4, which can be calculated automatically by adding a wastage figure. 5% is used as a default if no known statistic exists. Parameter settings used for the specific EPD are defined in the supplementary LCA report in the sheet "A5 Constr., inst. process".

C1 Deconstruction, demolition

Resurs	Enhet
Diesel, P&C (EU28) (Generic)	MJ
Diesel, WtW, reduktionspliksdiesel 2019/2020 (SE)	MJ
Electricity production (SE) (Generic)	MJ

Deconstruction and demolition require use of diesel and electricity for the different machinery used. Parameter settings used for the specific EPD are defined in the supplementary LCA report in the sheet "C1, C3, C4 End of life".

C2 Transport

Resurs
Diesel, WtW, reduktionspliksdiesel 2018/2020 (SE)

The transport scenario used for C1 is always a vehicle that uses diesel. Parameter settings used for the specific EPD are defined in the supplementary LCA report in the sheet "C2 Transport, waste handeling".

C3 Waste processing

Resurs	Enhet
Diesel, P&C (EU28) (Generic)	MJ
Diesel, WtW, reduktionspliksdiesel 2019/2020 (SE)	MJ
Electricity production (SE) (Generic)	MJ
Material for energy recovery (MER) (inventory flow)	kg
Material for recycling, steel (inventory flow)	kg
Material for recycling, unspecified (inventory flow)	kg

Waste handling includes input on resource use as well as inventory data for outputs generated in C3. Parameter settings used for the specific EPD are defined in the supplementary LCA report in the sheet "C1, C3, C4 End of life".

Module D

Resurs	Enhet
Combustion of oil or fossil in district heating	MJ
Combustion of wood in district heating	MJ
Diesel, WtW, reduktionspliksdiesel 2019/202	MJ
Electricity production (SE) (Generic)	MJ
Module D substitute: District heat, P&C (SE a	MJ
Module D substitute: Light fuel oil, P&C (EU2	MJ

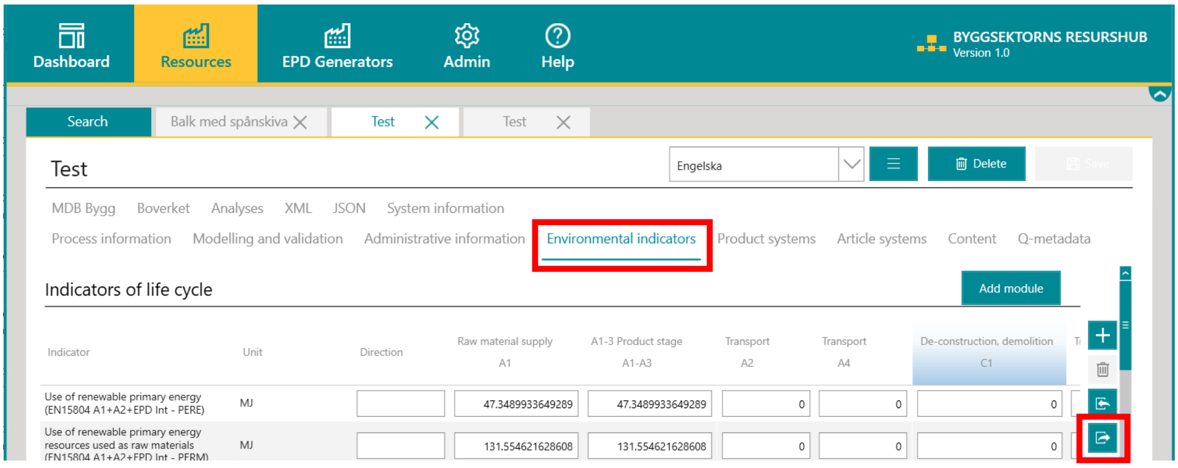
For timber-based products combustion in module D is based on wood fuel origin from C3 (MER) and exported energy (EEE/EET) originating from C4. The alternative fuel in this scenario is Swedish district heating. In the case of a processed wood product declared in the EPD including material like resin, paint etc., data for combustion of such fossil polymers is handled as the combustion of fossil oil. The energy content of the fossil material added to the declared unit is then set to be equal to the fossil material added to the product. In this case the product is divided into two parts where its fossil part generates more emissions of (for instance) greenhouse gases and is thereby accounted for.

Parameter settings used for the specific EPD are defined in the supplementary LCA report in the sheet "Module D".

4.1 Environmental indicator results

The parameters given in the section above per resource constitute the input to the EPD Generator and the resulting LCA/LCI result (reported under "Environmental indicators", see figure below). This LCA result for the individual EPD is exported digitally as an ILCD+EPD+ file or as an xls-file. The xls is currently used as export to create the LCA result in the published EPD, since the EPD template is based on xls.

In future, it is more likely that the EPD report will be part of the tool itself. However, the approach allows the EPD-generator to import the data needed in ILCD+EPD and based on the ILCD structure and nomenclature then export the EPD in ILCD+EPD+. Note that the additional "+" include an extension to cover data quality, Q metadata (Erlandsson 2018), and other aspects chosen by the end user. It is currently optional to publish the EPD as an ILCD+EPD file.



The exported file from the EPD generator is documented in the supplementary LCA report, including the transfer to the draft EPD.

Carbon neutrality over the whole life cycle and a zero balance for energy stored in the material has to be checked and if not balanced out automatically, corrections have to be done and documented in the individual supplementary LCA report.

5 Interpretation

No interpretation of the LCA result in a comparative purpose is carried out, since the goal and scope with the LCA is only to provide necessary data and documentation to perform an EPD according to the requirements of EN 15804.

5.1 Conclusions

At a life cycle level stage A to C, the results show that the fossil fuels used in the core manufacturing process, transportation to the sawmill and within the forestry is the most significant individual environmental aspect. The relative environmental impact from A3 is about double compared to impact from module A2 or A1.

5.2 Assumptions and limitations

The key assumptions in this study concern the construction stage A4+A5 and end-of life (stage C) and module D. These modules are based on an assumed scenario and shall only be regarded as an example of how it could be according to the scenarios declared in the EPD.

No assumptions and limitations are made concerning cradle-to-gate (module A1-3).

5.3 Data Quality Assessment

Inventory data quality is judged by its precision (measured, calculated, or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied) and representativeness (geographical, temporal, and technological).

To cover these requirements and to ensure reliable results, first-hand primary industry data in combination with consistent background LCA information from the ecoinvent 2024 database were mainly used. The LCI datasets from the ecoinvent database are widely distributed and used also with the GaBi Software. The datasets have been used in LCA models worldwide in industrial and scientific applications in internal as well as in many critically reviewed and published studies. In the process of providing these datasets they are cross-checked with other databases and values from industry and scientific publications.

No specific data from EPD has been used in this LCA.

The mandatory data quality documentation on geographical, technical and time representativeness is performed according to EN 15804 A2 following the UNEP approach (see Appendix: Data quality and documentation). This mandatory data quality documentation is divided into data reported per module included in the EPD under the heading "Primary data", and all use of background generic data is reported under the heading "Generic data". This list in the appendix describes available LCA data for the LCA generator and the actually used generic data in the EPD are marked with an "X".

5.3.1 Foreground data A1-3 accuracy

Concerning the relevance of the data in the study, all data for manufacturing in module A3 are collected by the company responsible for the EPD directly from the production site and thereby regarded as specific. This information is provided in the supplementary LCA report. The structure of the input data in the EPD generator is compiled by IVL and divides A1 to A3 as outlined in Table 7. It is not necessary to assess the quantity of specific LCA data used and is in practice not a precise measure. However, this is a commonly asked question concerning the data quality, meaning that the higher amount of specific data used the better precision and representativeness. This figure is part of quality related metadata called Q metadata (Erlandsson 2018) and potentially to be reported in future EPD.

An overall rule of thumb for sawn and planed timber is therefore made here resulting in that about 2/3 of the data used A1-3 (GWP-fossil) can be regarded as specific and explained in Table 7. An exact figure can be calculated for each product declared. Such specific calculations will then make reuse of the classification of the data used as given in Table 18..

Table 19 Quantitative assessment of amount of specific data used for production A1-3 related to GWP Fossil.

A1-3 as divided in the EPD Generator	Classification on degree of specific	Comment
A1-2 Auxiliary material	A1 Generic and A2 specific	All processes from the forestry are based on average data representative for Swedish forestry and can thereby not be regarded as generic. However, the transportation distance is specific and normally a GWP figure for transport from the forestry to the sawmill is around 8 kg CO_2e/m^3 (GWP-Fossil) and the impact from the forestry processes are in the same magnitude.
A1-2 Packaging materials	Generic	Generic LCI data are used for packing materials. However, the contribution from packaging materials as part of the overall impact A1-3 is not so significant. As an example of the GWP-Fossil is normally less than 1.5 kg

A1-3 as divided in the EPD Generator	Classification on degree of specific	Comment
		CO_2e/m^3 sawn timber, why the amount from this part of the lifecycle is normally less than 5%.
A3 Manufacturing	Specific	Manufacturing data is based on a full inventory of the sawmill. Generic emission figures on combustion in the water heater and in different vehicles are classified as representative and thereby as specific. Auxiliary materials used in the sawmill process are only normally less than 1 kg CO_2e/m^3 sawn timber
Sum A1-3	< 67 %	On an average level it is likely that about 2/3 of the impact can be classified as specific.

The type of upstream data used to model the system may affect the relevance, reliability and accessibility of any LCA study. The different aspects of relevance can for instance be temporal, geographical and technological representativeness, as well as completeness of the data. The LCI data used for transport and energy is reported in this LCA report and the major processes. All environmental data used is documented according to the data quality aspects outlined in EN 15804 A2 following the UNEP approach, see Appendix 1.

5.3.2 Model data quality

Completeness:
All relevant process steps for each product system were considered and modelled to represent each specific situation. The process chain is considered sufficiently complete and detailed with regards to the goal and scope of this study.

Precision:
The majority of the relevant foreground data are measured data or calculated based on primary information sources of the owner of the technology, precision is considered to be high. Seasonal variations were balanced out by using yearly averages. All background data are manly sourced from the ecoinvent Databases with the documented precision.

Consistency:
All assumptions, methods and data are consistent with each other and with the study's goal and scope. Differences in background data quality were minimised by predominantly using LCI data from the ecoinvent databases 2024. System boundaries, allocation rules, and impact assessment methods have been applied consistently throughout the study.

Reproducibility:
Reproducibility expresses the degree to which third parties would be able to reproduce the results of the study based on the information contained in this report. The goal is to provide enough transparency with this report so that third parties are able to approximate the reported results. Based on the information given in the LCA report and supplementary LCA report are source data sufficiently accessible and reproducible since all the data used, assumptions made, and datasets applied can be found in these reports.

5.4 Interpretation of the influence of data quality

Poor data quality does not affect the LCA result A1-3 since the significant data used is specific and generic data is limited to data from Swedish forestry and auxiliary materials used like paint, wood preservatives etc. The overall assessment of data quality for sawmill products like sawn and planed timber is therefore representative for the analysed product including data accuracy. Consequently, an in-depth motivation for use of poor or proxy data is not needed, since no such data is used. If auxiliary materials, as described above. It assessed as poor it will be reported in the EPD and part of the verification of each individual EPD.

6 Critical review

An external critical review has been performed by an independent external reviewer according to the general program instructions (GPI) and the valid PCRs.

The title of the external review is: Review of Generic LCA report for the EPD generator: Sawmill products (As the basis for the publication of EPDs within EPD Norway)

Dated: 2025-05-13

The external review is made by:

Dr Callum Hill FIMMM

callum@jchie.co.uk

JCH Industrial Ecology Limited / UK

Corrective action on comments given from the review is included in this revised version of the LCA report.

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Appendix 1: Data quality and documentation

Primary data below represent the aggregated assessed data quality per module in the EPD, while generic data represents individual LCA data used (or may be used) in one or several modules. Currently used in the EPD is marked with an X in column No three in the table below.

Please note that "Year" indicate the date given for the databased used and the age of the data is covered by the mandatory issue "Time representativeness".

Primary data

Name in EPD-tool	Year	Original data set in Gabi etc	Classification of representativeness			Documentation
			Geogr	Techni	Time	
A1 Forestry	2021	—	Good	Very good	Very good	See section 3.3.1
A2 Transport	2021	—	Good	Very good	Very good	See section 3.3.2 and section 3.3.3 when relevant, and supplementary LCA report for each EPD developed
A3 Sawmill	*)	—	Very good	Very good	Very good	See section 3.3.4 and *)supplementary LCA report for each EPD developed
A4 Transport	2021	—	Good	Good	Very good	See section 3.3.4 and supplementary LCA report for each EPD developed
A5	2021	—	Good	Good	Very good	See section 3.3.6 and supplementary LCA report for each EPD developed
C1-3	2021	—	Good	Good	Very good	See section 3.3.7 and supplementary LCA report for each EPD developed
D	2021	—	Good	Good	Very good	See section 3.3.8 and supplementary LCA report for each EPD developed

Generic data and EPD data

Internal ID	New name in RH	Origional DB name, and potentaoil comment	Reference	Version	Year	Geo	Tech	Time
8803	Adhesive MDI (European average)	GLO: Polyurethane adhesive production	ecoinvent	3.10	2023	Very poor	Poor	Very good
2332	Adhesive-MUF	RER: Melamine urea formaldehyde adhesive production	ecoinvent	3.10	2024	Good	Good	Very good
4254	Cardboard (Generic)	RER: Kraft paper	ecoinvent	3.10	2024	Good	Good	Very good
14222	Chemical, inorganic (proxy data)	GLO: chemical production, inorganic	ecoinvent	3.10	2023	Very poor	Very poor	Very good
8656	Electricity production, Biomass (EU, generic)	Modified based on dataset: RER: heat production, wood chips from post-consumer wood, at furnace 300kW; modified based on that heat production reportes is for 100% fuel and the elecricity production has an efficiency of 35 % and heat 85%. All indicators therefore multiplied by 0.85/0.35 = 2.43, equal to with a precombustion of about 10 kg CO2/m3 for the wooden fuel	ecoinvent	3.10	2023	Good	Good	Very good
8658	Electricity production, Residual (SE, generic)	SE: electricity, high voltage, residual mix ecoinvent 3.10 Data is based on figures from calandar year 2022.	ecoinvent	3.10	2023	Very good	Good	Very good
4028	LDPE (GLO, generic)	GLO: Market for polyethylene, low density, granulate	ecoinvent	3.10	2023	Good	Good	Very good
4029		RER: Market for nylon 6, glass-filled	ecoinvent	3.10	2023	Good	Good	Very good
5195	Grease, hydraulic oil etc	RER: Lubricating oil production	ecoinvent	3.10	2023	Good	Very good	Very good
5197	Polyethylene terephthalate (PET) (EU) (Generic)	RER: Market for polyethylene terephthalate, granulate, amorphous	ecoinvent	3.10	2023	Good	Good	Very good
4031	PP granulate (EU, generic)	RER: polypropylene production, granulate	ecoinvent	3.10	2023	Good	Good	Very good
4549	PVAc (Polyvinyl Acetate) 55% DM	RER: Vinyl acetate production	ecoinvent	3.10	2023	Good	Good	Very good

Internal ID	New name in RH	Origional DB name, and potentaoil comment	Reference	Version	Year	Geo	Tech	Time
	(13.2 MJ/kg stored) - adhesive (EU) (Generic)							
7637	EPD: Sawn Timber, Swedish Wood (2021 rev1) (excl biogenic carbon and energy stored), kg	EPD Sawn timber. Swedish Wood. EPD International EPD NO: EPD-IES-0002657:001 (S-P-02657)	EPD Int.	2021	2021	Good	Good	Good
4021	Steel production, BOF, low-alloyed (generic, EU): Used when unspecified low alloyed BF-route	RER: steel production, converter, low-alloyed	ecoinvent	3.10	2023	Good	Fair	Very good
12078	Tanalith E3475	Tanalith E3475 LCA data is based on the confidential report: Cradle to gate environmental impact wood preservative Tanalith variants. 21.0032-1 revised, SHR, Netherlands, October 18, 2022	SHR	21.0032-1 revised	2022	Very good	Very good	Very good
4064	Tap water from groundwater (Generic)	Europe without Switzerland: tap water production, underground water with chemical treatment	ecoinvent	3.10	2023	Good	Good	Very good
11403	Wolmanit CX-8WB	EPD: WOLMANIT CX-8WB, EPD No: S-P-05468	EPD Int.	2022	2022	Very good	Very good	Very good
4050	Electricity production, Hydropower (SE, generic)	SE: electricity production, hydro, run-of-rive	ecoinvent	3.10	2023	Very good	Good	Very good
4051	Electricity production, Nuclear power (SE, generic)	SE: electricity production, nuclear, pressure water reactor	ecoinvent	3.10	2023	Very good	Good	Very good

Internal ID	New name in RH	Origional DB name, and potentaoil comment	Reference	Version	Year	Geo	Tech	Time
4052	Electricity production, Wind power (SE, generic)	SE: electricity production, wind, >3MW turbine, onshore	ecoinvent	3.10	2023	Very good	Good	Very good
6215	Electricity production, Photovoltaic (SE, generic)	SE: electricity production, photovoltaic, 570kWp open ground installation, multi-Si	ecoinvent	3.10	2023	Very good	Good	Very good
4033	Electricity production (SE, generic)	SE: electricity, high voltage, production mix	ecoinvent	3.10	2023	Very good	Good	Very good
4034	Electricity production (EU, generic)	EU: electricity, high voltage, production mix	ecoinvent	3.10	2023	Good	Good	Very good
4348	District heat, P&C, SE average (excl. inherent prop.)	District heat SE, P&C (SE average) Source data from Swedish EPA, Swedish Energy etc., see LCA report section 3.2.8	IVL	2019	2019	Very good	Good	Good
7669	Combustion of post-consumer wood in district heating or sawmill (excl. inherent prop.)	Combustion of bark in sawmill or district heating. Combustion of wood in district heating. Modified data set from ecoinvent: RER: heat production, wood chips from post-consumer wood, at furnace 300kW. The data includes production and combustion (P&C) of wood fuel based on a processing of wood like bark with a precombustion of about 10 kg CO2/m3 for the wooden fuel (410 kg DM/m3,19.2 MJ/kg DM)	IVL+ecoinvent	2024	2024	Very good	Very good	Very good
4061	Dry biomass, wood, P&C (SE)	Combustion of dry wood in district heating. Modified data set from ecoinvent: RER: heat production, wood chips from post-consumer wood, at furnace 300kW. The data includes production and combustion (P&C) of wood fuel based on a processing of wood like dry sawmill by-product and pellets with a precombustion of about 35 kg CO2/m3 for the wooden fuel(410 kg DM/m3,19.2 MJ/kg DM)	IVL+ecoinvent	2024	2021	Good	Very good	Good

Internal ID	New name in RH	Origional DB name, and potentaoil comment	Reference	Version	Year	Geo	Tech	Time
4058	Hard coal, P&C (EU28) (Generic)	Europe, without Russia and Türkiye: hard coal mine operation and hard coal preparation ecoinvent 3.10 + RoW: heat and power co-generation, hard coal ecoinvent 3.10	ecoinvent	3.10	2023	Good	Good	Very good
4053	Light fuel oil, P&C (EU28) (Generic)	Europe without Switzerland: light fuel oil production, petroleum refinery operation ecoinvent 3.10 + Europe without Switzerland: heat production, light fuel oil, at boiler 100kW condensing, non-modulating ecoinvent 3.10	ecoinvent. Heat production efficiency of 85 % assumed and values recalculated according to this for the secondly-mentioned dataset.	3.10	2023	Good	Good	Very good
4056	Natural gas, P&C (EU28) (Generic)	Europe without Switzerland: market group for natural gas. high pressure ecoinvent 3.10 + Europe without Switzerland: heat and power co-generation, natural gas, 1MW electrical, lean burn ecoinvent 3.10	ecoinvent	3.10	2023	Good	Good	Very good
4060	Peat, P&C (EU28) (Generic)	RER: market for peat ecoinvent 3.10 + RoW: electricity production, peat ecoinvent 3.10	ecoinvent	3.10	2023	Good	Good	Very good
10245	PP granulate (EU, generic)	RER: polypropylene production, granulate ecoinvent 3.10	ecoinvent	3.10	2023	Good	Good	Very good
16316	EPD: Pinja Protect G	EPD - Pinja Protect G EPD owner: Tikkurila Group. Registration No: RTS_80_20. EPD system: RTS. Publication date: 5.10.2020	RTS	2020	2020	Good	Very good	Very good
16315	Waterborne alkyd primer paint for external wood	Application primer water based (windows, white)	Oekobaudat	20.23.050	2023	Good	Very good	Very good
16318	Intermediate coating water based alkyd (windows, white)	Intermediate coating water based alkyd (windows, white)	Oekobaudat	20.23.050	2023	Good	Very good	Very good

Internal ID	New name in RH	Origional DB name, and potentaoil comment	Reference	Version	Year	Geo	Tech	Time
13166	Diesel, P&C (EU28, generic)	Data is based on ecoinvent data for diesel burned in building machine, fossil diesel and fatty acid methyl ester (FAME) adoped to be conservative representative for HVO100 used on the Swedish market as given by Energimyndigheten, and with 6% biocomponents. See LCA report for further information	ecoinvent	3.10	2024	Good	Good	Very good
13170	Diesel, P&C, HVO100 utanför reduktionsplikten 2020 (SE) (Generic	Data is based on ecoinvent data for diesel burned in building machine and fatty acid methyl ester (FAME) adoped to be conservative representative for HVO100 used on the Swedish market as given by Energimyndigheten. See LCA report for further information	ecoinvent	3.10	2024	Good	Good	Very good

* ‘P&C’ is equal to production and combustion type ‘well to wheel’ (WtW) but more generic.

Appendix 2: REACH conformity certificates

2.1: Arxada: Tanalith 3475, Tanagard 3755

Based on the information given below is it tis the second option that should be filled in in the EPD Norway EPD template concerning dangerous substances.

arxada

To whom it may concern

Regulatory Assurance EMEA
+41 61 563 80 00
reach@arxada.com

Arxada Ltd
Peter Merian - Strasse 80
4052 Basel
Switzerland

Basel, 21 June 2023

Certificate of Conformity

Arxada Ltd. herewith confirms that, based on our present knowledge of our recipes and our manufacturing processes, the following products you purchased from Arxada Ltd.

Tanalith™ 3475

does not contain any substances affected by the current edition of EU REACH Candidate List (last updated: 17 January 2023) less than 0.1% by weight.

The listed substance(s) have not been deliberately added to the above-mentioned product(s). Concerning this, analytical testing is not performed as part of our standard analytical program and therefore no analytical data of these compound(s) are available.

It is the responsibility of the user of our product(s) to assess his final product to ensure the compliance with the given requirements.

Kind regards,

Regulatory Affairs EMEA-REACH, Arxada Ltd.

Simon Giese

Regulatory Professional EMEA REACH

Disclaimer

This information is based on our present state of knowledge. ARXADA does not warrant the accuracy or completeness of this document or its content. This document and any activities undertaken in compliance with it shall not create or constitute any guarantee or representation of any kind with respect to applicable law or contractual relationship or the attainment of any business goals. ARXADA shall not be responsible for any direct, indirect, special or consequential damages resulting out of the use of this document.

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Arxada Ltd
Peter Merian-Strasse 80
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Switzerland

Basel, 13 September 2024

Registration, Evaluation, Authorisation and Restriction of Chemical Substances REACH Regulation (EC) No 1907/2006

Substances of Very High Concern (SVHC), Annex XIV and Annex XVII

Product name: **Tanagard® 3755**

According to the EU Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Registration of Chemicals (REACH), we herewith confirm that the above mentioned products supplied by Arxada contains no substances at concentrations of 0.1 % w/w or more listed in the current Candidate List (last updated: 27 June 2024) or listed in the Registry of SVHC Proposal Intentions. Further, the products contains no substances listed by CAS or EC # in REACH Annex XIV (Authorisation List) or Annex XVII (Restricted Substances List). Substances with a classification relevant for Annex XVII inclusion are listed in section 3 of the corresponding EU Safety Data Sheet.

Kind regards,

Regulatory Assurance EMEA, Arxada Ltd.

2.1: Wolman: Wolmanit CX-8WB, Wolsit SP

Products from Wolman is part of SIKA Sverige AB in Sweden and explain the situation valid for Wolmanit CX-8WB as follows: Wolman refers to the information in the safety data sheet. The data sheets are updated as soon as there are changes to the substances included in the product in question. Thus, there is always correct information to refer to there. The data sheet for Wolmanit CX-8WB in its entirety is available on request, where section 15 concerns REACH, see screenshot below.

AVSNITT 15: Gällande föreskrifter

15.1 Föreskrifter/lagstiftning om ämnet eller blandningen när det gäller säkerhet, hälsa och miljö

REACH - Begränsningar av tillverkning, utsläppande på marknaden och användning av vissa farliga ämnen, blandningar och varor (Bilaga XVII)	:	Villkor för begränsningar för följande poster bör beaktas: Nummer på lista 3
REACH - Kandidatförteckningen för tillstånd för ämnen som inger mycket stora betänkligheter (artikel 59).	:	Inte tillämpligt
Förordning (EG) nr 1005/2009 om ämnen som bryter ned ozonskiktet	:	Inte tillämpligt
Förordning (EE) 2019/1021 om långlivade organiska föroreningar (omarbetning)	:	Inte tillämpligt
Europaparlamentets och rådets förordning (EG) nr 649/2012 om export och import av farliga kemikalier	:	Inte tillämpligt
REACH - Förteckning över ämnen för vilka det krävs tillstånd (Bilaga XIV)	:	Inte tillämpligt

Seveso III: Europaparlamentets och rådets direktiv 2012/18/EU om åtgärder för att förebygga och begränsa faran för allvarliga olyckshändelser där farliga ämnen.	E1	MILJÖFARLIGHET

Andra föreskrifter:

Om ytterligare laggivning gäller, som inte redan föreskrivs någon annanstans i detta säkerhetsdatablad, så är det beskrivet i detta underavsnitt.

As for Wolsit SP, this is a so-called process chemical that most of our customers use. The purpose is to keep the mixed "Wolmanite solution" sterile or free from growth of e.g. moulds. However, the active substances in Wolsit SP will quickly break down in the basic copper solution. Therefore, it is reasonable to assume that there are none of the active substances in Wolsit SP in the treated impregnated wood. For assessments in various Product Registers, e.g. The Swan, Wolsit SP is not included in the calculations for the above reason.

Preservative wood that use Wolmanit CX-8WB and Wolsit SP thereby does not contain substances that are on the candidate list or the Norwegian priority list. Thus is the first option that should be filled in.

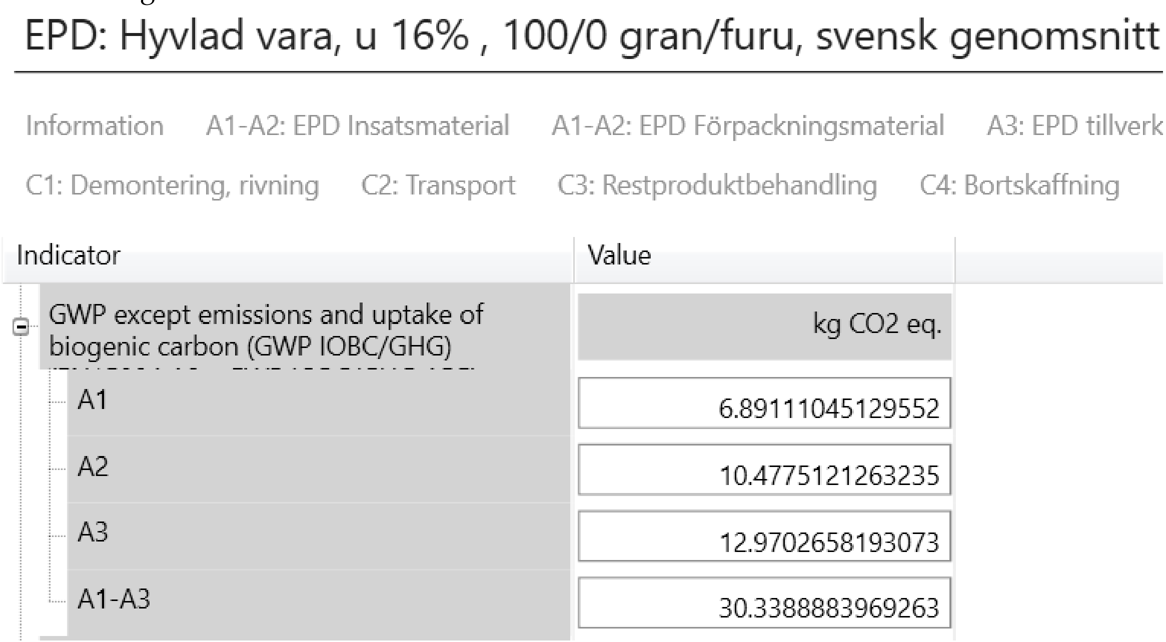
Appendix 3: SE average planed Spruce u16%

The following source data is used for calculating in the EPD Generator the impact A1-3 for SE average planed spruce u16% and data settings reported in Erlandsson (2022).

Summerade indata till generatorn/				
Hyvlat, gran/furu, %	60/40			
Fuktkvot, u	16			
Transportavst lim, km				
Medeltransportavst sågverk (A2), km	100			
Transportfaktor	3.57			
	Sågat		**Hyvlat**	
Energi/Energy	**kWh/m3**	**MJ/m3**	**kWh/m3**	**MJ/m3**
Bränslebehov, till värme	278	1001	288	1037
Elanvändning, SE mix	59	213	83	299
El, vindkraft		0		0
Diesel	13	46	18	64
Bensin		0.0		0.0
Eldningsolja	2.9	10	2.9	10
Insatsvaror/ Auxiliary materials	**kg/m3**			
Mineral/-smörjolja	0.256			
Fetter	0.000			
Kedjesmörjolja	0.000	Sum		
Motorolja	0.000	0.256		
Lim och härdare	0.0000			

Förpackningsmaterial/ Packaging materials	**kg/m3**	
Strön och underslag	1.700	
Plastband, PET	0	
Plastband, nylon	0.040	
Plastfolie, PE	0.420	
Stålband	0.000	
Kartong	0.000	
Vattenanvändning/ Water use	**m3/m3**	**kg/m3**
Användning av kommunalt vatten	0.1	100
Lolal brunn		0
Avfallshantering/ Waste handling	**kg/m3**	
HW, Hazardous waste disposed	0.00001	
NHW, Non hazardous waste disposed	0.002	
CR Components for reuse	0	
MR, Materials for recycling	0.726	
MER Materials for energy recovery	0.105	
Exported electric energy		
ETE, exported thermal energy		

The resulting GWP-GHG is as illustrated below in the screen shot from the tool.



Appendix 4: SE average planed Pine u18%

The following source data is used for calculating in the EPD Generator the impact A1-3 for SE average planed spruce u18% and data settings reported in Erlandsson (2022).

Summerade indata till generatorn/				
Hyvlat, gran/furu, %	60/40			
Fuktkvot, u	16			
Transportavst lim, km				
Medeltransportavst sågverk (A2), km	100			
Transportfaktor	3.57			
	Sågat		**Hyvlat**	
Energi/Energy	**kWh/m3**	**MJ/m3**	**kWh/m3**	**MJ/m3**
Bränslebehov, till värme	241	867	251	903
Elanvändning, SE mix	52	186	76	273
El, vindkraft		0		0
Diesel	13	46	18	64
Bensin		0.0		0.0
Eldningsolja	2.9	10	2.9	10
Insatsvaror/ Auxiliary materials	**kg/m3**			
Mineral/-smörjolja	0.256			
Fetter	0.000			
Kedjesmörjolja	0.000	Sum		
Motorolja	0.000	0.256		
Lim och härdare	0.0000			

Förpackningsmaterial/ Packaging materials	**kg/m3**	
Strön och underslag	1.700	
Plastband, PET	0	
Plastband, nylon	0.040	
Plastfolie, PE	0.420	
Stålband	0.000	
Kartong	0.000	
Vattenanvändning/ Water use	**m3/m3**	**kg/m3**
Användning av kommunalt vatten	0.1	100
Lolal brunn		0
Avfallshantering/ Waste handling	**kg/m3**	
HW, Hazardous waste disposed	0.00001	
NHW, Non hazardous waste disposed	0.002	
CR Components for reuse	0	
MR, Materials for recycling	0.726	
MER Materials for energy recovery	0.105	

The resulting GWP-GHG result calculated is as illustrated below in the screen shot from the tool.

Global Warming Potential, GHG (AR4) (EN15804 A1 - GWP-GHG AR4)	kg CO2 eq.
A1	6.6782074833862
A2	11.2511207432872
A3	11.3793420207922
A1-A3	29.3086702474656

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