LCT (HVH) - PEF / LCD compliance document

for wood products

Methodological document for life cycle assessments according to the guidelines and rules of the European PEF Initiative and the ILCD International Life Cycle Data System for the HVH / LCT climate footprint, the HVH / LCT environmental footprint and ECO Footprint .

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introduction

For years, the European Union has pursued the concept of environmental product declarations (eg Environmental Product Declarations EPD, Product Environmental Footprint PEF) with the aim of "standardizing" the environmental impact of all types of products and making them more easily comparable. Information on the environmental impact of products is becoming increasingly important in planning processes. Many building classification systems in their environmental impact assessment are also based on environmental labels and environmental product declarations. As a result, HVH / LCT has not only developed a proof of origin with environmental certification, but also provides quantitative documentation of the environmental impact.

TYPE III labels are mainly environmental product declarations (EPD) or environmental product footprints (PEF) for groups of products or for products of individual manufacturers. EPD and PEF are not environmental (evaluative) labels but provide quantitative information that is not evaluated. There is a wide variety of EPD concepts and holders, under which corresponding declarations can be created. HVH / LCT is also the program owner for an HVH / LCT Environmental Footprint. This complies with the European PEF requirements as shown in the following document.

In Europe, the specifications of the PEF initiative are preferred, in Germany EPDs are preferred by the responsible authorities. HVH / LCT can only resolve this discrepancy by showing that the HVH / LCT environmental footprint corresponds in all respects to the specifications of classical EPD and PEF data. UBA (Report 2018) writes: "The PEF is not an EPD program, but also develops product specific rules (PEFCR). Contrary to existing EPD programs, it has not yet been specified how the results of a PEF should be used for communication or who will be the program operator. Existing program operators are partly involved in the ongoing pilot phase. "

HVH / LCT notes here that this is also the case for most EPD program holders (eg IBU, IFT etc.). HVH / LCT also refers here to the white paper "Pros and contras of classic EPDs from a Practical perspective", which HVH / LCT created after an analysis of 70 EPDs of construction products from the common life cycle assessment databases and which shows some systemic problems on the applicability of classic EPDs. This document has been verified by the European project partners in the LIFE project.

It is also considered problematic that classic EPDs can usually only be calculated with one or two programs (GaBi Software by PE International and Umberto Software) if they are to be accepted in public databases (eg Ökobaudat). The problem here is that companies can also use software to create their own lifecycle assessment and, in principle, mainly use standard datasets for many lifecycle stages. Anyone familiar with this can calculate huge differences in environmental balance using certain data sets during the calculation phase.

UBA (2018) is of the opinion: "The opinion of the majority of program operators towards the PEF initiative can be assessed as skeptical"

HVH /LCT considers, not only for the purposes of the LIFE project, that this is not the case and that the PEFs even allow, in practice, to introduce provisions that are partly more realistic. HVH/LCT believes that the possibility to introduce also qualitative environmental aspects that can be expressed in terms of potential risks represents a great advantage and that the perceived environmental impact cannot be represented with the classic EPD.

According to UBA, the main difference between EPD and PEF is the scope and target group. According to UBA (2018), PEF is communication oriented, business-to-business (B2B) or business-to-consumer (B2C), while this is not explicitly addressed in ISO 14040/44. However, from the available PEF

documents, the authors of the white paper are not aware of any specifics or limitations to specific target groups.

Considerations on the issue of chains upstream of building materials should focus more on the material, origin, and transport aspects. Our economy depends on energy and raw materials. Addressing it sustainably is becoming more and more important. At the same time, the climate, water, soil and biodiversity must be protected. Sustainable construction must pay more and more attention to how the construction products used are made respectful of the climate, resources and the environment. Transport plays a very important but hitherto underrated role. Origin and material are also important. **The importance of upstream chains is increasing.** The contribution of materials to the environmental impact of the building is becoming increasingly important. The more buildings are energetically optimized for the use phase ("red energy"), the more important the chains upstream of building materials ("grey energy") become.

1 / PEF requirements

1.1 / Basics

1.1.1 / Basic principles

The five most important principles of a PEF study are: **Relevance, Completeness, Consistency, Accuracy, Transparency** .

Relevance. All methods used for quantification and the data collected should be as relevant as possible to the study. **Completeness.** The quantification must represent and record all environmentally relevant material and energy flows and other interventions in the environment that are relevant to meeting defined system boundaries, data requirements and applied impact assessment methods. **Consistency.** The specifications of the guidelines for the EU Commission's PEF study require that comparability with similar analyzes be ensured. **Precision.** The PEF Principles require that all reasonable efforts be made to minimize uncertainties in modeling and reporting of results or to ensure the accuracy of statements. **Transparency.** The information must be disclosed in a way that guarantees users the best possible transparency of the data. Users should also be able to assess the resilience and reliability of a PEF's data and claims.

1.1.2 / Involvement of interested parties

The process of developing the PEF or PEFR and the underlying PCR must be open and transparent and include consultation with relevant interest groups. Reasonable efforts should be made to reach consensus throughout the system boundary process (adapted from ISO 14020: 2000, 4.9.1, principle 8).

1.1.3 / Search for comparability

The results of PEF studies conducted in accordance with this PEF Guide and the related PEFCR document, where applicable, can be used to compare the environmental performance of products of the same product category on a life cycle basis and to formulate comparative claims.

Therefore, the comparability of the results is of paramount importance. The information provided for this comparison must be transparent to allow the user to understand the limits of comparability inherent in the calculated result (adapted from ISO 14025).

1.1.4 / Creation of PEFCR, PCR

Each life cycle assessment or PEF is based on PEFCR or PRC. Product Environmental Footprint Category Rules (PEFCR) and Product Category Rules (PCR) contain product group specific rules for creating life cycle assessments for these product groups. PCR and PEFCR are based on ISO 14025.

(1) PEFCR

Product Environmental Footprint Category (PEFCR) rules mean creating specific product group rules to create lifecycle assessments for these product groups. PEFCRs should, as far as possible, comply with existing international standards on product categories (PCR). PEFCRs typically provide additional specifications and guidance, e.g. B: Provide more specifications to solve multifunctional problems. A PEFCR can further specify the requirements set out in this PEF Guide and add new requirements where the PEF Guide provides multiple choices. In the absence of PEFCR, the key areas that would be covered in the PEFCR must be specified, justified and explicitly stated in the PEF study.

A key aspect of PEFCR for practice is that they should aim to focus PEF studies on those aspects and parameters that are most relevant for determining the environmental performance of a particular type of product . This should also **reduce time, effort and costs.** The PEFCR document describes the type of information that can be provided about a product from a life cycle perspective and also how this information should be generated.

(2) PCR

Product Category Rules (PCR) , with their specific rules, guidelines and requirements, aim to develop "type III environmental declarations" for any product category. "Type III environmental declarations" are ***quantitative*** life cycle based (LCA) declarations about the environmental aspects of a particular good or service. For the development and verification of product category rules (PCR), ISO 14025 describes the procedure and specifies the requirements for the comparability of different "Type III environmental declarations". PCR is more limited than PEFCR.

PCR based on ISO 14025 is based on the following basic aspects:

- **Identification of the product category** for which a PCR is to be developed, including a description, for example, of the functions, technical performance and uses of the product.
- **Definition of the objective and scope of the life cycle assessment** (LCA) of the product, according to the requirements of the ISO 14040 series, e.g. B. in relation to the functional unit, the system boundary, the requirements for data quality.
- **Description of the life cycle inventory analysis** with a focus on the data collection phase, the calculation process phase, the calculation process and the allocation rules.
- **Selection of indicators** for EF impact categories to be included in the LCA.
- **Description of any predefined parameters** for reporting LCA data, eg. B, some predefined inventory data categories and / or EF impact category indicators.
- **Justification of life stages considered or life stages not considered.** If not all life cycle stages are included in the LCA, the information / justification on which stages are not covered.
- **validity** of the PEFCR to be developed. If other PCRs are available from other systems, they can be used as a basis for developing a PEFCR, in accordance with the requirements of this PEF guide.

(3) CPA

The PEFCR structure based on the classification of products by activity (CPA). The product classification scheme based on their activity (CPA) is used to code and define the information modules used to represent the product life cycle. The CPA product categories refer to activities defined using the NACE codes (i.e. the Statistical Classification of Economic Activities in the European Community). of the economic sectors of the European Community). Each CPA product is mapped to a single NACE activity, so the CPA structure parallels that of NACE at all levels. NACE is made up of a hierarchical structure as follows (NACE Rev. 2 200837). The International Standard Industrial Classification (ISIC) and NACE share the same code at the highest level.

If PEFCR are required, they must be based on a division of the CPA code of at least two digits (default option). However, PEFCRs may allow (justified) deviations (e.g. three digits). For example, more than two digits are needed when it comes to the complexity of the industry. If multiple manufacturing routes are defined for similar products using alternative CPAs, the PEFCR must take into account all of these CPAs.

CPA 2008 describes the statistical classification of products in relation to economic activities in the EU.

The functional unit (according to ISO 14040/44): is called "Unit of analysis" in the PEF (however, the terminology was changed during the pilot phase, so that the PEF now also uses the term "Functional unit"). The main difference in the case of the functional unit is that the PEF provides more specific information on the definition. Furthermore, the functional unit must be linked to the codes of the product classification by activity (CPA) / NACE (Nomenclature statistique des activités économiques dans la Communauté européenne). CPA is the European classification of goods in connection with economic activities. Product categories of the CPA refer to the statistical classification of economic sectors, i.e. each CPA product is assigned to an activity of NACE, which means that the structure of the CPA is parallel to the structure of NACE (Eurostat 2013). The NACE codes are constructed according to the following hierarchical structure (Eurostat 2008): section: alphabetical code; Departments: 2-digit numeric code; Groups: 3-digit numeric code; Classes: 4-digit numeric code. PCRs should be based on codes of at least 2 digits, possibly 3 digits (European Union 2013).

1.1.5 / Verification

There are the following differences between ISO 14040/44 (EPD) and PEF regarding the requirements for reporting and critical examination. Writes UBA (2018) "In life cycle assessments according to ISO 14040/44, the expert must always be external and independent. Instead of an expert, a review committee (with at least 3 members) can also be used "And also" The PEF is required to have at least 1 independent and qualified expert (or review committee) for both external and internal communication. In the case of comparative studies, an independent review committee (at least 3 qualified members) must carry out the critical review ".

PCR and PEFCR underpinning a PEF "should be peer-controlled".

1.2 / Review of the environmental footprint

1.2.1 / Objectives of the PEF study

Goal setting is the first step in a PEF study and defines the general context for the study. The purpose of the objectives should be clearly defined to ensure that the analytical objectives, methods, results and intended applications are optimally aligned and that there is a common vision with which study participants can align.

In defining the objectives it is important to indicate the expected applications and the level of depth and analytical rigor of the study. For analyzes involving eg. are geared towards green sourcing, product design, benchmarking, and more cost-effective reporting.

Combined approaches are also possible within a PEF study, when only some parts of the supply chain are subjected to a quantitative analysis and others are subject to a qualitative description of potential environmental hotspots (e.g. a quantitative analysis from the cradle to gate combined with qualitative descriptions of the environmental aspects from cradle to grave or with quantitative analyzes of the phases of use and end of life for selected representative product types).

The scope definition of a PEF study should be consistent with the defined study objectives and include (see the following sections for a more detailed description): units of analysis and reference flow; system boundaries; Ecological footprint impact categories; Assumptions / Limitations.

1.2.2 / Scope and units of analysis (*definition)*

The scope definition of a PEF study should be consistent with the defined objectives of the study and include (see subsequent sections for a more detailed description): **(1) units of analysis and reference flow, (2) system boundaries , (3) footprint of the environmental impact categories, and (4) assumptions or limitations** .

1.2.3 / Resource, use and emission profile (*life cycle inventory)*

Resource, use and emission profile. As a basis for modeling the PEF, it is necessary to create an inventory (profile) of all material / energy resource inputs / outputs and emissions to air, water and soil for the product supply chain. This is referred to as the "Resource Use and Emissions Profile" in PEF. Sometimes this is also called life cycle inventory. Life Cycle Inventory Analysis, according to ISO 14040/44, is referred to as the "Resource Use and Emission Profile" in PEF. Elementary flows must be modeled. Non-elementary flows (complex flows, e.g. electricity, transport) should be converted into elementary flows. The main difference for the “prioritization of impact categories” aspect is that weighting for comparisons and comparative product claims is allowed in the PEF, as long as the corresponding PEFCRs are available. For the assessment of life cycle assessment studies according to ISO 14040/44 and PEF, the main difference is that according to ISO 14040/44 the impact assessment of a life cycle assessment according to ISO14040 / 44 does not have to be the only comparative statement comparative statements, whereas comparative statements are possible in the PEF, provided that the study is based on the PEF Guide and the corresponding PEFCRs.

1.2.4 / Impact assessment (*life cycle assessment)*

One of the main differences in terms of impact categories and impact assessment methods between ISO 14040/44 and PEF is the set of impact categories and impact assessment methods specified by the PEF. In the PEF there is a predetermined set of 14 impact categories and corresponding midpoint methods (and thus also characterization factors), which must be applied. Meanwhile, the EC has expanded the list of impact categories by three additional categories (eutrophication, marine environment; climate change, biogenic; climate change, land use) to a total of 17 categories. A more detailed analysis of these methods can be found in Chapter 3.1.3.1. ISO 14040/44 does not specify categories or methods, it only says that these should be accepted internationally and that the selection of categories must be justified and reflect the environmental impacts related to the system.

The main difference between ISO 14040/44 and PEF relates to the scope: unlike PEF, ISO 14040/44 emphasizes that impact assessment should not be the only basis for comparative claims (intended for publication), in how much more information is needed to overcome some of the inherent limitations (e.g. relative approach, missing temporal / spatial reference). Other relevant information (qualitative / quantitative) may be added (if not already covered); must be checked / verified (e.g. information on the use of hazardous substances, information on local effects).

The PEF method is based on the life cycle approach. This considers all relevant environmental interactions associated with a good, service, activity or facility from a supply chain perspective. This contrasts with focusing solely on site-level impacts or individual environmental impacts to reduce the possibility of inadvertent shifting of environmental pressures from one stage of the supply chain to another, between impacts and resource efficiency and / or between villages. The PEFs are based on recognized

product environmental accounting methods and guidelines, the most important literature and the ILCD document are cited in the bibliography.

The most important aspects of the impact assessment are **(1) Threshold criteria, (2) compensation, (3) representative product, (4) system boundaries, (5) energy modeling, (6) carbon storage, (7)) foreground and background information, (8) screening, (9) Allocation, (10) Robustness, (11) Product categories and benchmarks, (12) Impact assessment, (13) Standard impact categories, (14)) Assumptions, constraints, limitations, (15) Additional requirements for the development of PEFCR, (16) definition of foreground and background processes, (17) possibility and management of deviations, and (18) nomenclature for resource consumption and the emissions profile**

(1) Threshold criteria

In addition to minor terminological deviations in the definition of the life cycle, in the specification of foreground and background processes and in the screening phase (which essentially corresponds to the iterative approach of ISO 14040/44), the main difference between the PEF and the ISO 14040/44 is this that the cutoff criteria are not allowed. It is not clear from the PEF documents that no cut-off criteria are allowed. Any process that is not included must be described transparently and must be explained why it does not play a significant role in material flow and environmental balance.

(2) Compensation

The term "compensation" is often used in relation to greenhouse gas reduction activities by third parties, for example systems regulated under the Kyoto Protocol (CDM - Clean Development Mechanism, JI - Joint Implementation, ETS - Emissions Trading Schemes) or voluntary systems. Offsets are discrete greenhouse gas (GHG) reductions that are used to offset greenhouse gas emissions elsewhere, for example to meet a voluntary or mandatory greenhouse gas target or cap. Offsets are calculated against a baseline that represents a hypothetical scenario for emissions that would be generated without the emission reduction project generating the offsetting payments. Examples of offsets are carbon offsets under the clean development mechanism, carbon credits and other off-system offsets.

(3) Representative product

Representative product is a newly developed concept under the PEF, which is intended to represent the average product of a product category based on market shares or as a real product capable of representing the entire product group. The environmental impacts of the representative product should reflect the average environmental impacts of the product category, thus serving as a benchmark for the product category under consideration. There is no such concept in ISO 14040/44. The definition of a representative product (i.e. a real product or a virtual product defined on the basis of the market average) is only required for PEFCRs. This is also based on the ultimate goal of ensuring comparability. The benchmarking system must be classified using the representative product.

(4) System boundaries and deviation possibilities and management

PEF provides much more specifications than ISO 14040/44. If relevant to the product, these are, for example, specifications for the use phase, logistics (e.g. transport parameters, standardized comparison units) and waste treatment phase, classifications based on fossil carbon and biogenic, direct and indirect effects on land use and others. It is not clear from the PEF documents that no cut-off criteria are allowed. If a process is not included, however, it must be described transparently and explained why it does not play a significant role in material flow and environmental balance. In each PEF study, the system boundaries must be defined, which parts of the product life cycle and which associated

processes belong to the analyzed system. A system boundary diagram or flowchart is a schematic representation of the analyzed system. Any deviation from the standard cradle-to-grave approach should be explicitly specified and justified, e.g. the exclusion of the unknown use phase or the end of life of intermediate products.

(5) Storage and carbon offsetting

Offsetting emissions (e.g. offsetting CO2 emissions via the clean development mechanism) can be listed separately in the additional environmental information. Regarding carbon storage and delayed emissions, ISO14040 / 44 proposes an exclusion from the scope. The PEF stipulates that credits cannot be taken into account in the specified impact categories (only if requested in the PEFCR). The information is provided in the Additional Environmental Information.

(6) Energy modeling

For the modeling of electricity, ISO 14040/44 stipulates that the composition of electricity, the efficiencies for the combustion of energy carriers, conversion, transmission and distribution losses must be taken into account when electricity is supplied. According to the PEF, modeling is done with vendor-specific data. If these are not available, with country-specific consumption mixes. The use phase must reflect trade between countries / regions. In the absence of data, the average EU consumption is used as the most representative mix. It must also be ensured that there is no double counting of renewable energies.

(7) Featured and background information

In PEF, the processes are divided into foreground and background systems in order to ensure a better understanding of the examined system even for non-LCA experts. Processes included in the system boundaries are divided into **foreground** processes (i.e. core processes in the product lifecycle for which there is direct access to information) and **background processes** (i.e. processes in the product lifecycle for which there is no direct access to information possible).

(8) screening

The screening phase in the PEF is comparable to the iterative approach of ISO 14040/44, with the difference that the former is mandatory, the latter "only" strongly recommended. The real difference between the two methods is the provision of a large number of specifications in the PEF, for example for fossil and biogenic carbon or direct and indirect land use changes. Many of these specifications have already been discussed in connection with the development of ISO 14040/44 or are addressed in the context of other existing methods for life cycle based product assessment (eg in the Greenhouse Gas Protocol).

(9) Assignment

Unlike ISO 14040/44, PEF specifies requirements for allocation in recycling, for example the special “end of life formula (EoL)”. This formula was revised several times during the pilot phase to reduce existing weaknesses. The current EoL formula - the so-called "Circular Footprint Formula (CFF)".

(10) Robustness

The evaluation after the PEF includes an analysis of the robustness of the PEF model, identification of hotspots, estimation of uncertainties, conclusions, identification of hotspots, limits and recommendations. In addition, an analysis of the influence of the methodological assumptions on the results must

be carried out. Optionally, completeness, sensitivity and consistency checks can be applied. The estimate of the error is made through at least a qualitative description of the uncertainties of the PEF results (respect of assumptions and data). It is also envisaged that PEF studies for comparative statements (for the public) should be based on the PEF guidelines and the corresponding PEFCR. The conclusions should include a summary of the "hotspots" and potential improvements resulting from the management interventions.

(11) Resource Use and Emissions Profile Nomenclature

All relevant uses and emissions of resources related to life cycle phases contained within the defined limits of the system must be documented in studies or documents on PEF using the nomenclature and properties of the International Life Cycle Reference Data System (ILCD) as described in Annex IV. If the nomenclature and properties for a particular stream are not available in the ILCD, an appropriate nomenclature should be developed and described. PEFCRs are classified using the NACE code or Central Product Classification (CPC).

(12) Standard impact categories

Additional environmental information must be (1) based on reasonable information and which has been or can be verified or verified in accordance with ISO 14020 and Section 5 of ISO 14021: 1999. They must be (2) specific, accurate and not misleading and (3) relevant to the product category in question. The selection of EF impact categories should be comprehensive in the sense that they cover all relevant environmental aspects related to the supply chain of the product of interest. For a PEF study, all specified EF standard impact categories and associated EF impact assessment templates specified must be applied.

(13) Assumptions, Limitations, Limits

Various limitations may occur in PEF studies, which is why hypotheses can / should be made. For example, generic data may not fully represent the reality of the product under study and may be customized to best represent it. All limitations and assumptions must be disclosed in a transparent manner. Standard EF impact categories can also be excluded in PEFCRs. Exclusions from the standard EF impact categories must be declared and justified, in particular as regards the comparability aspects. Limitations of standard EF impact categories. The impact of each exclusion on the final results, in particular as regards the limits related to comparability with other PEF studies, should be discussed and reported at the interpretation stage. All exceptions must be explicitly documented, justified, stated in the PEF report and supported by suitable examples.

(15) Additional requirements for the development of PEFCR

In addition to standard environmental information, PEF allows for additional environmental information which can be quantitative and / or qualitative. The PEF guide emphasizes that the relevant environmental impacts of a product can go beyond widely accepted life cycle-based environmental assessment models. The PEF guide further stresses the importance of considering these environmental impacts whenever possible. If additional environmental information is used to support the interpretation phase of a PEF study, all data needed to generate that information must meet the same quality requirements. Information and instructions (e.g. product safety data sheets) which do not refer to the environmental performance of the product should not be part of a PEF. Likewise, information relating to legal requirements may not be an integral part.

An example of additional environmental information is the impact on biodiversity due to land use change associated with a particular site or activity. This may require the application of additional EF

impact categories not included in the standard list of this PEF Guide, or even additional qualitative descriptions if the impacts cannot be quantitatively linked to the product supply chain [1].

[1] Other examples of additional environmental information are: list of materials information; Information on decommissioning, recyclability, recoverability, reusability and resource efficiency; information on the use of dangerous substances; information on the disposal of hazardous / non-hazardous waste; information on energy consumption; Local / site impact information and more, e.g. local impacts on acidification, eutrophication and biodiversity; Other relevant environmental information on the activities and / or sites involved and on the product output; other environmental impacts relevant to the product category; other relevant technical parameters which can be used to evaluate the product concerned and which allow comparisons with other products in terms of the overall efficiency of the product. These technical parameters can e.g. on the use of renewable versus non-renewable energies, on the use of renewable versus non-renewable fuels, on the use of secondary materials, on the use of fresh water resources or on the disposal of hazardous or non-hazardous waste ; other relevant approaches to perform the characterization of the streams from the Resource Use and Emissions Profile when the characterization factors (CF) are not available in the standard method for specific streams (e.g. groups of chemicals); environmental indicators or product stewardship indicators (according to the Global Reporting Initiative (GRI)); Energy consumption over the entire life cycle, divided by primary energy source, with the use of "renewable" energy; Direct energy consumption according to primary energy sources, broken down into "renewable" energies; power consumption for the factory gate; For the gate-to-gate phases: number of species present in the IUCN Red List and in the national conservation lists; with habitats in the areas affected by the operation, divided by level of extinction risk; Description of the significant impacts of activities, products and services on biodiversity in protected areas; protected areas and areas with a high biodiversity value outside the protected areas; total weight of waste by type and disposal method; Weight of transported, imported, exported or treated waste which is subject to the provisions of the Basel Convention; of Annexes I, II, III and VIII of the Basel Convention are classified as hazardous and the percentage of waste transported.

1.3 / PEF Data quality, data security, data management plan

ISO 14040/44 specifies that specific (or representative) data should be collected for processes whose contribution to mass and energy flows is significant, as well as for processes with environmentally relevant inputs / outputs. Data quality requirements are more extensive in ISO 14040/44 (qualitative) than in PEF. However, the PEF contains additional "almost- quantitative" requirements, in which it specifies, for example, that data for rivers whose contribution to impact categories is 70% (or more) must be of "good quality" (European Union 2013). Another difference is that PEF is specific to data sources.

Information on the aspects is provided below: **(1) coverage, (2) criteria, (3) operational data, (4) generic data, (5) data for resource and emissions profile, (6) treatment of missing data, (7) elementary and non-elementary streams, (8) additional data and additional data requirements, (9) data management plan (optional) and (10) ILCD compliant data sets**

(1) Detection range

In ISO, as in PEF, the coverage areas are: temporal, geographical and technological coverage areas .

(2) Criteria

According to ISO 14040/44 and PEF, the following criteria (quantitative and qualitative) must be specified: precision, completeness, representativeness, consistency, reproducibility .

(3) Operating data

where possible**, directly collected operational** data or asset specific inventory data.

(4) Generic data

Generic data is usually used for processes where the company does not have direct access to specific data. For generic data (if they meet the quality requirements): data that meet the requirements of the PEFCR; Data compliant with the requirements of the PEF study; Data from the ILCD data network or the European Life Cycle Database (ELCD).

(5) Resource and emission profile data

According to the PEF, all relevant stages of the life cycle must be considered. The following minimum requirements apply to the resource and emissions profile: “good quality” for flows with ≥70% of the contribution to the impact categories; "Medium quality" for flows with a contribution of 20-30%; "Quality below average" for flows <10% of the contribution.

(6) Management of missing data

In the absence of data, the following statements are valid: “value other than zero”, which is made explicit; “Zero value” if justifiable or value calculated based on values recorded by process modules using similar technology. Gaps in the data must be filled with the best generic or extrapolated value available. The contribution of these data must be <10% of the total contribution.

(7) Elementary and non-elementary currents.

According to the PEF, specific data should be used for all foreground processes and, where applicable, for background processes. If generic data is more representative or appropriate for the foreground processes, it must be documented and justified. According to ISO 14040: 2006, the PEF guideline defines **elementary flows** as "materials or energy that enter the system under consideration and has been taken from the environment ...". Elementary flows are, for example, resources taken from nature or emissions into air, water, soil. According to the PEF guide, non-elementary (or complex) flows are all other inputs. According to the PEF guide, this also includes transport processes and waste, by-products. According to the PEFCR guide, the life cycle sections, processes and elementary flows are determined only for elementary flows all phases of the life cycle, processes and elementary flows whose contribution to the overall result is greater than 80 are identified as relevant %, that is: (1) all phases of the life cycle whose contribution to the overall result of the category is 80%, (2) all processes whose contribution to the overall result (e.g. the relevant life cycle sections) is 80% and (3) all elementary flows whose contribution to the overall result (e.g. that of the related processes) is 80%. Note: UBA (2018 Report) considers it insufficient and writes “the determination of the relevance of the life cycle sections, processes and elementary flows is carried out only for the categories identified as relevant. Since the procedure for determining the relevance of the categories is not adequate, any errors are continued here. Furthermore, it seems too little to take into account only 80% of environmental impacts. "UBA therefore recommends" This procedure makes sense for internal use. However, 80% should be replaced by 90%. This means that all phases of the life cycle, processes, and elementary flows whose contribution to the overall result is greater than 90% must be considered relevant and taken into consideration ".

(8) Additional data and requirements for additional data

According to the PEF guide it is possible to include additional data. In this case, only an adequate screening phase is required for inclusion to ensure data quality and calculation methodology.

(9) Data management plan (optional)

PFE recommends a data management plan. The data management plan should contain at least the following information: a description of the data collection procedures; the sources of the data; calculation methods.

(10) ILCD compliant data series

The ISO 14040 and 14044 standards provide an important framework for life cycle assessments. However, this framework leaves the individual expert, practitioner, and data developer with a number of important decisions subject to individual interpretation, which lead to differences in the consistency, reliability and comparability of evaluation results. The methodological assumptions underlying the life cycle data can also be very different. The International Reference Life Cycle Data System (ILCD) is an initiative developed by the JRC and DG Environment since 2005 with the aim of providing guidelines and standards for greater consistency and quality assurance in the use of cycle assessments. life to be realized. ILCD publications have been produced as part of a series of broad public and stakeholder consultations. The ILCD manual is an important contribution to the ILCD and contains a series of publications that comply with international standards for life cycle assessments (ISO 14040/44). International ILCD Life Cycle Data System (https://eplca.jrc.ec.europa.eu/ilcd.html).

1.4 / Limits of the PEF system

1.4.1 / Procurement of raw materials

The phase of extraction and processing of the raw material must be precisely defined. In many PEFs, for example, this includes transportation within and between extraction and pretreatment facilities and to the manufacturing facility.

1.4.2 / Transport

So far, transport has mostly been classified as background processes in PEF. However, the PEF guide provides information on what might be taken into account during transportation, such as mode of transportation, vehicle type and fuel consumption, loading speed, number of empty returns, transportation distance , taking into account the effects of transport.

1.4.3 / capital goods

Capital goods such as machines used in production processes, buildings; Office equipment; transport vehicles; The transport infrastructure must be classified as a process in the PEF.

1.4.4 / Production

The production phase begins when the product components enter the manufacturing plant and ends when the finished product leaves the manufacturing plant. Examples of activities related to production are: chemical processing; production; Transport of semi-finished products between production processes; assembly of material components; - packaging; - waste treatment; transportation of employees (if applicable); Business trips (if applicable).

1.4.5. / Distribution and storage

In a PEF, if this is important, you can specify transport, distribution and storage scenarios.

1.4.6 / Use phase

The use phase begins when the consumer or end user physically takes possession of the product and ends when the used product is disposed of for transport to a recycling or waste treatment facility. In the use phase of the products, the consumption of electricity, heat, refrigeration, the consumption of water and resources is relevant. The formation of waste water can also be relevant. Generic data or product and company specific values can also be used here. The durability of the product and its repairability or other can also be classified.

1.4.7 / End of life

An EoL formula presented at the PEF that addresses the issue of multifunctionality. The formula applies to all product groups and aims to increase the comparability between the different products by allocating credits and loads in the EoL phase. In the formula, the energy use is evaluated as the use of the material. Thus the formula was beneficial for product groups which tend to be incinerated rather than recycled and disadvantageous for products which tend to be recycled. The CFF formula has been revised and developed, but in the same way, it still favors energy use.

In the case of the CCF, a maximum credit of 80% is usually awarded which, as an allocation factor, divides the expenses and savings of secondary materials between the user and the supplier. In ISO 14040, a full credit (100%) is usually given because all the material is reused.

UBA (2018) also considers it a problem that some of the default data provided is somewhat questionable. The UBA writes: “For example, materials such as metal (eg steel, aluminum) and glass have a value of 1, which means that the quality of the secondary material is the same as that of the primary material. It is questionable to make this hypothesis across the board for all metals, as the quality of the secondary material for some metals can certainly be lower than that of the primary material. What is unacceptable, however, is that the assumption of a quality term of 1 is also accepted for some plastics such as PP or HDPE, as the quality of recycled plastic largely cannot reach the quality of the raw material ". According to UBA (2018), it is generally questionable whether a single formula is suitable for evaluating a large number of products. Each group of materials, each product group, each product has characteristic properties that can hardly be differentiated with a single formula

The end-of-life phase begins when the used product is discarded by the user and ends when the product is returned to nature as a waste product or enters the life cycle of another product (i.e. as a recycled input).

Examples of end-of-life processes that can / should be included in the PEF study are: collection and transport of end-of-life products and packaging; - disassembly of components; shredding and sorting; conversion into recycled material; composting or other methods of organic waste treatment; litter box; waste incineration and disposal; Landfill and landfill management and maintenance; Transport necessary for all end-of-life treatment plants. However, because, according to the PEF, it is often not known exactly what happens at the end of a product's life cycle, it is necessary to define end-of-life scenarios.

1.4.8 / Additional aspects

Many and many very significant environmental impacts cannot be expressed using classical quantitative factors such as those used up to now in life cycle assessments. Many of these more qualitative environmental impacts can be clearly expressed through risk factors or indices. This principle is already included in many EU regulations and is already used for risk assessments (see CPI Index). In contrast to the EPD, the PEF allows the use and introduction of new factors, including qualitative factors and indices, if justified in a transparent way and which address a significant environmental aspect.

The issue of biogenic carbon withdrawal and emissions in PEF was dealt with as follows. Carbon withdrawals, for example in the context of wood cultivation, are indicated with a characterization factor of -1 CO2-eq for global warming. Carbon emissions are released from wood combustion with a characterization factor of +1 CO2-Q. for global warming. Withdrawals and emissions from biogenic carbon sources are separated in the resource use and emissions profile of the PEF.

Direct land use changes. The effects of land use change on climate change arise essentially from changes in soil carbon stocks. Direct land use change is the result of a conversion from one land use type to another which occurs in a given land cover and possibly changes in the carbon stock of that specific area, but which do not lead to a change to another system. Greenhouse gas emissions resulting from the direct land use change must be allocated to the following goods / services for 20 years after the land use change, using the IPCC standard value table.

Indirect land use change . The effects of land use change on climate change arise essentially from changes in soil carbon stocks. Indirect land use change occurs when a particular land use change causes changes outside the system boundary, i.e. in other types of land use. Greenhouse gas emissions resulting from indirect land use change are not included.

2 / HVH / LCT certification system and fingerprints

2.1 / Overview of tools

In the following, HOLZ VON HIER is abbreviated to HVH and LOW CARBON TIMBER to LCT. The following schematic drawing provides an overview of the PEF compliant environmental balance data system, which is based on the " **HVH / LCT climate and environmental label** " (ISO type 1), **European benchmarks** and other **innovative factors** .

These are the **"HVH / LCT climate footprint for products"** , **"HVH / LCT environmental footprint for products"** and " **ECO footprint for products** " and, based on this, **"climate footprint for** buildings" and **" ECO for buildings** . ”The following table (Tab. 1) contains brief summary explanations of the respective tools and the following figure (Fig. 1) shows an overview of the effects and monitoring.

Table 1: HVH/LCT tools:

instruments	**Remarks**
HVH / LCT climate footprint for products	• Here the entire upstream supply chain is recorded in real time and in reality for a given product, • It covers the life cycle stages A1, A2, A3 and A4. These are shown separately. This is best practice and PEF compliant. This means that there are no A1-A3 total values as is customary in many classic life cycle assessments (analysis of 70 EPD building products). • By definition, life cycle stages B, C, D are not part of the upstream chains. They are therefore indicated only in the documentation accompanying the imprint. The data reported here represent generic data and standard values used in classic life cycle assessments. For this purpose, the life cycle assessments of 70 construction products were analyzed and generic values were formed for wood-based products (ökobaudat, baubook, IBU, EU publications). • Only the quantitative environmental aspects are shown. • Only the Global Warming Potential (GWP) is shown. As usual in life cycle assessments, the GWP is calculated using factors from the University of Laiden which are also used in the classical life cycle assessment data (e.g. Thünen, Ökobaudat, Probas studies).
HVH / LCT environmental footprint for products	• Here the entire upstream supply chain is recorded in real time and in reality for a given product, • It covers the life cycle stages A1, A2, A3 and A4. These are shown separately. This is best practice and PEF compliant. This means that there are no A1-A3 total values as is customary in many classic life cycle assessments (analysis of 70 EPD building products).

	• By definition, life cycle stages B, C, D are not part of the upstream chains. They are therefore indicated only in the documentation accompanying the imprint. The data reported here represent generic data and standard values used in classic life cycle assessments. For this purpose, the life cycle assessments of 70 construction products were analyzed and generic values were formed for wood-based products (ökobaudat, baubook, IBU, EU publications). • Only the quantitative environmental aspects are shown. • GWP, AP, EP, POCP, ODP, PERE, PENRE, ADP, water and the lumber shop are shown. As usual in life cycle assessments, the factors are calculated using factors from the University of Laiden, which are also used in classical life cycle assessment data (e.g. Thünen, Ökobaudat, Probas studies).
ECO footprint for products	• Here the entire upstream supply chain is recorded in real time in reality and for a specific product. • The quantitative and qualitative environmental aspects are mapped. • The recorded qualitative environmental aspects (I) are: (I-1) GWP, (I-2) water and (I-3) embodied energy (PERE + PENRE) as total A1-A3 values. If desired, AP and EP can also be recorded as a total value, but it plays no role, especially with wood products, the other factors play a more than subordinate role with wood products. • The recorded qualitative environmental aspects (II) are: (II-1) RMA (Availability of raw materials, availability of resources; (II-2) REP (Risk of environmental pollution, risk of high environmental pollution in the extraction of raw materials; (II -3) RBL; Risk of biodiversity loss, risk of biodiversity loss in the upstream chains); (II-4) EoL: end-of-life factor for the reusability of materials in the product; (II-5) country factor (total value from CEPI, FWE, DMCI); (II-6) SFR (social equity in the extraction of raw materials, sum factor from various indices); (II-7) RR risk achievement, risk of substances in the product that are dangerous to health). • Information on the life cycle stages B, C, D can be found in the supporting documents of the footprint. The data reported here represent generic data and standard values used in classic life cycle assessments. For this purpose, the life cycle assessments of 70 construction products were analyzed and generic values were formed for wood-based products (ökobaudat, baubook, IBU, EU publications). • More information on this in the ECO-Footprint manual.
Climate footprint for buildings	• The climate footprint for buildings is only assigned to buildings that contain a significant percentage of products in plant planning (!) That carry an HVH / LCT certificate and can simultaneously present an HVH / LCT climate footprint for these products.

	• The climate footprint for buildings is not actually a construction certificate. However, it can be used to record the actual amount of wood certified or installed in the building and not just later. This has enormous advantages in assessing the climate impact of the building. The problem today is that, especially in the case of larger municipal or commercial buildings, the architect's plan and the work plan, which is usually carried out by the executing client, can in practice differ by up to 20%. The climatic footprint for buildings can therefore also be an essential and important control tool for the certification of buildings downstream in order to be able to effectively record the real environmental impact of buildings, even afterwards. • The imprint on the associated certificate shows exactly what proportion and which types of products with HVH / LCT certificates were used in structural construction and interior design.
ECO footprint for buildings	• The ecological footprint for buildings is assigned only to buildings that contain a significant share of products in the plant planning (!) That have an HVH / LCT certificate. • With the ECO Footprint for buildings, only the environmental impacts of the chains upstream of the installed products are recorded and their reusability assessed. The ecological footprint for buildings does not make statements about the use phase, because this depends very much on the building, the constellation on site and the behavior of the users.

Product Environmental Footprint for the " Climate footprint" for products , the " Environmental footprint " for products and the " ECO footprint for products " and, based on this, the "climate footprint for buildings" and the "Ecological Footprint for Buildings" **Rules (PEFCR**) . There are **product category rules (PCR)** for " climate footprint" for products , " environmental footprint for products" and "climate footprint for buildings".

The following document explains compliance with the PEF specifications for these instruments. There are separate documents for the " **ECO footprint" for products** , the **"climate footprint for buildings"** and the **"ECO footprint for buildings"** . t

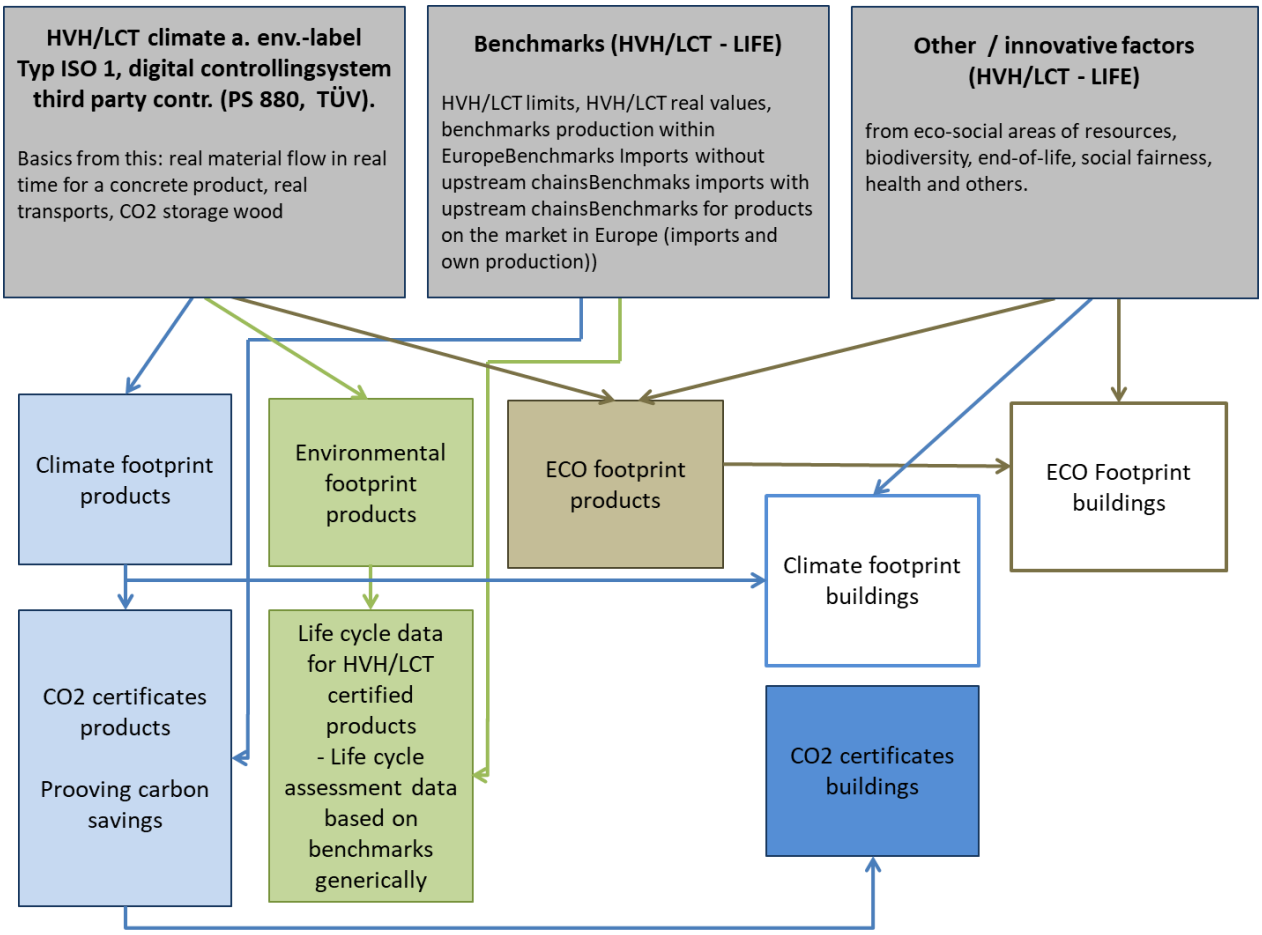

Fig. 1) HVH/LCT footprints

2.2 / HVH / LCT certification system

2.2.1 / Basics

The LCT / HVH climate and environmental label includes all material flows in the entire chain of custody, namely cradle-to-gate (ctg), gate-to-customer (gtc) and cradle-to-customer (ctc). The big advantage here is that material flows along the real material flow are recorded as real-time digital data. This means that no standard value is used, which could distort the real environmental impact many times over. The data is not even checked retrospectively every year, but each delivery that arrives at the customer or at the construction site can exhibit a certificate that traces the entire path in the material flow of production.

The HVH / LCT certification system on which the "HVH / LCT climate footprint for products" and the "HVH / LCT environmental footprint for products" are based, with its digital supply chain control system, is characterized by following aspects:

- It is based on scientific principles.
- central environmental factor .
- It is monitored externally by neutral third parties (PS 880 / TÜV).
- It is the only environmental label (Type I ISO 14024) that specifically records and documents the environmental impact of the processing chain.
- As a quality mark, it meets the requirements of §34 VgV.
- It works with an innovative electronic control system that follows the entire flow of material from node to node under control in real time.
- It works cross-border and cross-border within the European Union (EU).
- It is already recognized in relevant platforms on sustainable consumption and procurement.

2.2.2 / Basic criteria

The basic criteria of the HVH / LCT certification system on which the HVH / LCT environmental footprint is based are:

- 100% of the round wood must come from sustainable forestry (proven by FM certificate according to FSC, PEFC or comparable).
- No wood from primary forests and no wood from internationally threatened tree species is allowed according to IUCN and CITES.
- Particularly climate-friendly (CoC) supply chains must be implemented through short and above-average climate-friendly transport routes in the entire upstream chain from the extraction of raw materials to the place of use.

2.2.3 / Product groups

LCT / HVH covers a wide range of applications with certified products:

- Wood as a building material (building materials, building elements, etc.)
- furniture and interior design
- Outdoor wood (e.g. terraces, urban furniture, playgrounds, etc.)
- energy wood
- paper

2.2.4 / Quantitative balancing

HVH / LCT tracks a quantitative balance in the Chain of Custody (CoC) in real time on the concrete real product. This corresponds to the credit model of ISO 38200. The credit model is also used for forest labels FSC, PEFC, although here a check is carried out subsequently and not in real time but once a year. Many EU directives require the credit model for the control of raw materials, semi-finished products and products. The climate and environmental label LOW CARBON TIMBER® (LCT) resp. HOLZ VON HIER® (HVH) basically implements the credit model. All principles and requirements of the European specifications for credit models are fulfilled by the LOW CARBON TIMBER® (LCT) resp. HOLZ VON HIER® (HVH) and their CoC digital control system are respected.

HVH / LCT does not claim physical identity. But no actor can market more products with LCT / HVH than he has previously purchased suitably certified material. This means that the products always contain 100% wood according to the criteria of LCT / HVH .

So these are 100% climate-friendly supply chains with wood from sustainable forestry. With HVH / LCT, in line with new EU regulations, you have products that have proven to have deforestation-free supply chains behind them .

Basic procedures

Credit model (applied to HVH / LCT). The credit method is applicable when two or more categories of input material are used in a product. Products certified according to HVH / LCT always contain 100% wood according to the HVH / LCT criteria.

For comparison: percentage methods . The single percentage method mixes the material categories in such a way that the proportion of each material category mixed in the output is equal to its proportion in the input. The method is based on the use of a variable proportion of a specific category of material that enters the company in a defined period of time, so that an average percentage can be declared for the product / production during the declaration period.

For comparison: physical separation processes . Physical separation is not practiced today in practice, even in the first phase of processing in the sawmill, because this would mean separate storage, which today is an important cost factor. In retail, physical segregation is often pursued. However, this is of little use in terms of electricity flow, because extensive mixing has usually occurred in the chain and in today's material flows. An example: a company that certifies proportionate quantities of wood according to FSC, PEFC and purchases only DD compliant should keep 3 separate warehouses in stock, which in practice (except trade) today hardly carries out the operation in practice. HVH / LCT does not claim physical identity and does not suggest it. But no actor can market more products with LCT / HVH than he has previously purchased suitably certified material.

2.2.5 / Control system

HVH / LCT control system.

In general, the HVH / LCT control system works regardless of geographic or other boundaries. It is adapted to the practical distances for each range. For a specific product, the entire supply chain is recorded in real time, not just the last stage of production.

HVH / LCT CO2 certificates for HVH / LCT climate building certificates.

For LCT CO2 certificates included in LCT certificates for climate buildings based on " HVH / LCT climate footprints for buildings" , LCT type I project / process approach 1 is used as standard, but LCT type I project / process approach 2 can be used or the LCT type I project / process approach 3 can be used, whereby this is then noted separately on the certificate. Detailed explanations can be found in the associated documents (see list of documents).

2.2.6 / Reporting period

HVH / LCT certified.

The HVH / LCT certificate records the real material flow of a product or delivery batch in real time.

HVH / LCT climate footprint for products and HVH / LCT environmental footprint for products.

The "HVH / LCT climate footprint for products" and the "HVH / LCT environmental footprint for products" record quantitative data of classical life cycle assessment, but for the actual material ***flow*** of a product or batch delivery ***in real time*** .

The HVH / LCT climate footprint for products and the HVH / LCT environmental footprint for products have a serious advantage over traditional life cycle assessments (eg EPD). For example, EPDs are only created for one product every> 5 - 10 years. In practice, such data cannot capture the real environmental impact of a product today, simply because the conditions and material flows in the upstream chains in general and especially in the case of wood products can significantly change in practice in a short period of time. . This makes the current situation of the wood market in Europe (wars between Russia and Ukraine) more than clearly understandable for everyone. But this is also true in "normal" times. It is very unlikely that a life cycle assessment made five or more years ago and (sadly) still in use today will in any way reflect the true environmental impact of supply chains. All users should be aware of this.

Expiring dates

The durability dates of construction materials and components are determined according to the BBSR durability tables.

The durability of the building is assumed to be 100 years. This is compatible with other systems and databases [1] .

[1] The Baubook also calculates a useful life of 100 years for the buildings.

2.2.7 / Environmental data collected

The quantitative output data of the HVH / LCT environmental footprint are the classic parameters of all PEF or EPD:

GWP	= global warming potential in [kg CO_2 equivalent]
AP	= potential for acidification of soil and water in [kg SO_2 eqv.]
EP	= eutrophication potential in [kg PO_4 eqv.]
ODP	= depletion potential of the stratospheric ozone layer in [kg CFC11 eqv]
POCP	= tropospheric ozone formation potential in [kg ethene eqv.]
ADPE	= Potential for abiotic exhaustion of non-fossil resources in [kg SbEqv.]
ADPF	= abiotic potential depletion of fossil fuels in [MJ]
PEARS	= renewable primary energy as an energy source in [MJ]
PENRE	= non-renewable primary energy as an energy source [MJ]
Water	= water consumption in [kg of water]

2.2.8 / Fulfilment of the fundamental principles

(1) HVH / LCT meets all principles of PEF requirements

The principles of the GHG protocol and the PCAF standard come into play in the identification and assessment of emission sources along the value chain. LCT / HVH fulfills this as an example of best practice, as shown in the following table (Tab. *5)*. The "climate footprint for products" and the "environmental footprint for products" HVH / LCT fully correspond to the principles required by the PFF (see list of documents in the appendix): these are the same principles required by the GHG protocol in scope 3.

Relevance. The PEF requires greenhouse gas emissions to be adequately reflected. The HVH / LCT control system ensures that all (!) Greenhouse gas emissions are calculated for real material flows for specific real products.

Completeness. The PEF requires the collection and reporting of all relevant and significant GHG emission sources / activities within the inventory limits. Disclosure and justification of any specific exceptions. In the HVH / LCT system, the data is complete throughout the entire life cycle, as the actual material flow is tracked in real time.

consistency. The PEF requires the use of consistent methodologies to enable monitoring of issuance performance and documentation of any data changes, as well as transparent disclosure of inventory limits, methodologies and other relevant factors. With HVH / LCT, the calculation methods and steps are absolutely consistent thanks to the digital, neutral, "incorruptible" and externally monitored mass balance system and the data can therefore be extensively compared.

Accuracy / Accuracy. PEF wants to ensure that the quantification of GHG emissions is systematically neither above nor below the actual emissions and that uncertainties are reduced as much as possible. Data accuracy for HVH / LCT can only be defined as optimal, as actual material flow conditions are demonstrated here for specific products. HVH / LCT uses only the highest quality and most up-to-date

data and factors available for the calculations and only basic data from officially recognized databases and sources.

Transparency. The PEF requires all relevant issues to be addressed factually and consistently, based on clear verification capabilities and the disclosure of relevant assumptions, references and data sources. Transparency and disclosure are standard practices for HVH / LCT as a climate and environmental label in accordance with ISO 14024. All processes on which the data and controlled material flows are based, as well as the same certification as the ISO TYPE 1 environmental label, are monitored externally by recognized organizations (DWI, TÜV). In HVH / LCT, the transparency of data, methods, data source and billing steps is ISO compliant and defined in detailed documents.

Recognition. HVH / LCT is already recognized in Europe as a climate and environmental label and the HVH / LCT environmental footprint complies with PEF principles.

Measurement. The environmental values presented via HVH / LCT for specific products, objects and buildings correspond to the respective real material flows.

attribution. Environmental HVH / LCT values are given in standard units (e.g. kg $CO_{2\text{-eq}}$ / t) and can therefore be calculated, converted and compared in subsequent systems.

Tab. 2) Presentation of how LCT / HVH meets the principles of the GHG protocol and the PCAF standard.

	GHG	PEF	PCAF	LCT HVH	LCT / HVH
completeness	☑	☑	☑	☑	LCT / HVH deals with all the life cycle stages necessary for upstream chains, goes beyond European specifications and is monitored externally by state institutions (DWI, TÜV). Assumptions, conversion factors, etc. they are transparently stored in documents. All accounting, calculation methods and data sources used are transparently stored in documents created specifically for this purpose and accessible to auditors.
consistency	☑	☑	☑	☑	LCT / HVH allows for consistent and meaningful monitoring of emissions over time. With LCT / HVH, subsequent organizations (e.g. building appraisals, financial institutions) can document all changes transparently. With LCT / HVH, the system limits, methods, factors and calculation steps are precisely described.
relevance	☑	☑	☑	☑	With LCT / HVH, real emissions are available for real material flows across the entire supply chain.
Accuracy / Accuracy	☑	☑	☑	☑	With LCT / HVH, real emissions are available in real supply chains. LCT / HVH appoints benchmarks for generic values of comparable supply chains. LCT / HVH data correspond to real environmental impacts and not to standard data. The basic LCT / HVH data and factors are based on internationally recognized databases and are rated 1 in the data quality at PCAF. Data quality and security are of great importance when it comes to international standards and HVH / LCT takes this into consideration.
transparency, disclosure	☑	☑	☑	☑	In LCT / HVH, all data sources, calculations, computation paths and methods are transparently presented in publicly accessible documents depending on the security level, up to documents visible only to accredited certifiers.

recognition	☑		☑	☑	The LCT / HVH data correspond to but exceed the emissions of Scope 3 according to the GHG Corporate Value Chain protocol.
Measurement	☑		☑	☑	Financial institutions report their financed issues using PCAF methods. Absolute emissions must be measured as a minimum. However, emissions avoided and removed can also be measured when data is available. HVH / LCT provides data on this
attribution	☑		☑	☑	HVH / LCT data can be financially assessed clearly on the carbon market (prices per ton of CO_2).

2.2.8 / Objectives and recipients

HVH / LCT is relevant for all target groups. In practice, companies, municipalities and planners have so far been particularly interested in the HVH / LCT climate footprint for products and the HVH / LCT environmental footprint for products. The document for each environmental footprint contains the following information:

- Purpose and reasons for conducting the study.
- Decision-making context and the European context.
- Target group, users, stakeholders.
- type of publication.
- Client, editor and representative of the firm as well as executor of the will (if not immediately with the representative).
- verification process.
- Information on important EU regulations related to the product group and / or description of HVH / LCT's compliance with relevant EU regulations and strategies.
- Source and methodological notes.
- System boundaries and environmental parameters and explanations for this.
- input-output flows
- environmental data
- Notes on data and interpretations

2.2.9 / Involvement of interested groups

HOLZ VON HIER ® (HVH) resp. LOW CARBON TIMBER® (LCT) fully meet this requirement. The non-profit initiative Holz von Hier has several committees that ensure stakeholder participation not only in the beginning but also on a permanent basis. HVH / LCT is already continuously involved in a multi-stakeholder process through committees. No decisions of ecological, economic, social or political importance are made without these bodies, in particular the Stakeholder Board and the Advisory Boards.

These bodies are:

- A stakeholder board with representatives from all relevant stakeholder groups from the environment, society, municipalities and businesses.

- Advisory committees.

- An expert panel with well-known scientists from various fields such as climate and environment, European law, municipal affairs, economics, planning, design and architecture, forestry and wood industry, health and consumer protection.

All stakeholder groups have been involved in the development of the HVH / LCT TYPE ISO 1 environmental label and certification system of the same name from the very beginning. As required by ISO 14024, the development was based on scientific specifications and an accompanying environmental discourse. This development was funded by the Deutsche Bundesstiftung Umwelt, the largest environmental foundation in Europe. The HVH / LCT system itself is monitored externally according to the PS 880 standard of the German Institute of Public Accountants and also by the TÜV.

Current

The same is true for the development of the HVH / LCT climate footprint, the HVH / LCT environmental footprint and the ECO footprint. These are currently (as of August 2022) coordinated with partners from various European countries in a European LIFE project and implemented within the EU in accordance with PEF. The tools are tested in the project in model regions and, if necessary, adapted in an iterative manner so that at the end of the LIFE project there is a coordinated and consistent set of tools to the European PEF with regard to the environmental footprint.

2.2.8 / Search for comparability

The HVH / LCT climate footprint, the HVH / LCT environmental footprint and the ECO footprint fully respect this passage from the PEF guidance documents.

All data in HVH / LCT are created using the same methodology and are therefore completely comparable. All data and basic factors used come from recognized databases (Probas, Baubook, Ökobaudat, FAO, Eurostat, etc.).

All methods and procedural steps, as well as databases, are made transparent in the associated documents.

2.2.10 / Creation of PEFCR, PCR

The most important objectives of PEFCR, PCR such as comparability, reproducibility, consistency, relevance, focus and efficiency are HOLZ VON HIER® (HVH) resp. LOW CARBON TIMBER® (LCT) fully satisfied and described in more detail in the attached documents. HVH / LCT bases its entire environmental communication and developed benchmarks on NACE Rev.2 Codes in the European Union. All the reference data used in the environmental communication are based on recognized databases such as Eurostat FAO, among others.

2.2.11 / Verification

The HVH / LCT system itself is fundamentally subject to an independent double external review by the certifying authorities of the DWI (status PS 880) and the TÜV.

All the data used by HVH / LCT in the environmental communication and in the determination of the benchmarks come from recognized databases (e.g. Eurostat, Ökobaudat, Baubook, Probas, IUCN, etc.) which are subject to its own screening processes.

In the HVH / LCT database, the data is organized according to the schema specified by ILCD.

The PEF and benchmark documents created in the LIFE project are verified by colleagues and partners from different European countries. The documents are therefore based on an international consensus process in the European Union.

2.2.12 / Scope and unit of analysis

HVH / LCT is a best practice example for a resource, use and emission profile that a PEF is intended for, as all material and energy flows in the chain of custody are recorded here, e.g. along the entire chain processing and not (how often) only in the last processing phase.

HVH / LCT control system, also subject to HVH / LCT climate footprint and HVH / LCT environmental footprint and ECO footprint data and quantitative factors, records the exact material flows of specific products in real time, from the cradle to the gate and gate to the customer. The qualitative factors of the ECO-Footprint are "risk parameters" which serve to describe the possible risk potentials in the chains upstream of a product and work with the factors. It is an internationally recognized procedure (e.g. WIR, UNEP, IUCN) and also by national environmental authorities and serves to record and describe the environmental impacts and make them comparable which cannot be expressed in CO2 kg (e.g. risk of loss of biodiversity). in some processes of extraction of raw materials, etc.).

The use phase and end-of-life material flow are mapped into associated documents using generic data and benchmarks.

For each HVH / LCT environmental footprint, the relevant documents can be called up which, for example, describe the product groups in more detail: "Product group profiles". Other documents define other properties of the product groups, such as shelf life, etc. (see attached documents HVH / LCT).

2.2.13 / Profile of resources, use and emissions

HVH / LCT climate footprint, HVH / LCT environmental footprint for products applies to a specific product or a specific actual delivery lot. This is precisely defined in real time by the type of wood, the amount of wood, etc. (see below).

The ecological footprint applies (1) to generic product groups and (2) to the products of individual producers and represents the averages of the supply chains of individual producers. Similarly to a classic life cycle assessment, the ecological footprint is valid for three years (see ECO-Footprint documents). The associated documents point out that the average material flows of the respective manufacturer are shown here and not the real-time material flows. However, unlike the HVH / LVCT climate footprint or the HVH / LCT environmental footprint and unlike the classic life cycle assessments based on the EPD scheme, the ECO footprint integrates not only quantitative environmental data but also

qualitative environmental parameters, which they can only be recorded as risk factors because they cannot be expressed as quantitative data. This is not allowed in the classic Environmental Footprint (EPD) scheme, which is mainly used in Germany and Austria. However, in the European Union Product Environmental Footprint Scheme (PEF), used within the EU, this is allowed if the factors used are described transparently and if the factors and data used come from recognized databases. This is the case with HVH / LCT.

According to HVH / LCT, PEF therefore represent in a more realistic way the real environmental impacts, since many environmental impacts that have an enormous influence on the material flow of products and on their environmental footprint are not represented with the classic quantitative parameters (e.g. pollution environmental impact from mud, felling in primary forests and much more).

2.2.14 / impact assessment

Aspects of a PEF impact assessment are met by the HVH / LCT climate footprint, the HVH / LCT environmental footprint and the ECO footprint for products and accompanying documents for real-time data.

These include information on: (1) threshold values, (2) offsetting, (3) representative product, (4) system boundaries, (5) energy modeling, (6) carbon storage, (7) preliminary and Basic, (8) Screening, (9) Allocation, (10) Robustness, (11) Product Categories and Benchmarks, (12) Impact Assessment, (13) Impact Categories Standard, (14) Assumptions, Constraints, Limits , (15) Additional requirements for the development of PEFCR, (16) Definition of foreground and background processes, (17) possibility and management of deviations, and (18) nomenclature for resource consumption and emissions profile.

(1) threshold values

With PEF, any process that is not included must be described transparently and must be explained why it does not play a significant role in material flow and environmental balance. The HVH / LCT climate footprint and the HVH / LCT environmental footprint are all based on the life cycle approach. They consider the environmental interactions relevant for wood-based products in the life cycle of the goods under consideration. It goes beyond consideration of the site level and consideration of individual isolated environmental impacts. The entire flow of material is recorded "from the cradle to the gate, from the gate to the customer, from the cradle to the customer."

(2) Compensation

Offsets are calculated against a baseline which represents a hypothetical scenario for emissions that would occur without the emission reduction project generating the offsetting payments. The European benchmarks were developed by HVH / LCT (see appendix benchmark documents). Therefore HVH / LCT products can be compared with benchmarks. From the difference it is possible to calculate a real saving for a particular product or group of products.

(3) Representative product

The concept of "representative product" is a concept recently developed under the PEF, which aims to represent the average product of a product category both based on market shares and as a real product that can represent the entire group of products.The environmental impacts of the representative product should reflect the average environmental impacts of the product category, thus serving as a benchmark for the product category under consideration.

The benchmarks for product groups used by HVH / LCT are based on the data and codes of the European Eurostat database and thus correspond to the specifications of the PEF for a "representative product". There are wood benchmarks for all relevant wood product groups

HVH / LCT certificates represent membership of this product group and define exactly and in real time the product for which the certificate is issued.

The HVH / LCT climate footprint and the HVH / LCT environmental footprint for products are based on HVH / LCT certificates and therefore also comply with these PEF requirements. Shown here are all wood product groups that are frequently used in construction and interior design, such as construction lumber, floors, walls, ceilings, furniture, outdoor wood, pulp, paper and bioenergy products.

The ecological footprint applies (1) to generic product groups and (2) to the products of individual producers and represents the averages of the supply chains of individual producers (see chapter 2.2.13).

(4) System boundaries and deviation possibilities and management

In each PEF study, the system boundaries must be defined, which parts of the product life cycle and which associated processes belong to the analyzed system. A system boundary diagram is recommended or a flowchart, that is a schematic representation of the analyzed system. Any deviation from the standard cradle-to-grave approach must be explicitly specified and justified.

With the HVH / LCT certificate and thus also with the assigned HVH / LCT climate footprint and HVH / LCT environmental footprint, the system boundaries range from round timber lying on the forest road along the entire real processing chain (from cradle at the gate) to the customer or the place of use (gate-to-customer), are the phases of the life cycle A1, A2, A3, A4.

The reason why the use phase (B) and subsequent use (C, D) of wood products are not among the featured processes is described in detail below and explained in detail in the accompanying documents and described with examples.

(5) Featured and background information

In PEF, the processes are generally divided into a foreground and a background system to ensure a better understanding of the examined system even for non-LCA experts.

This is regulated and explained extensively and transparently at HVH / LCT. Here it is an essential objective of public relations and the transfer of information to stakeholder groups to explain why and to what extent upstream chains and their environmental impact predominate over the entire life cycle of wood products (see attached documents and brochures).

Upstream chains are the decisive life cycle stage for wood products and are therefore the dominant system in the foreground or the main system according to the PEF guidelines. Processes included in the system boundaries are divided into **foreground** processes (i.e., core processes in the product lifecycle for which there is direct access to information) and **background processes** (i.e. processes in the product lifecycle for which direct access to information is not possible). Any deviation from the standard cradle-to-grave approach must be explicitly specified and justified, e.g., the exclusion of the unknown use phase or the end of life of intermediate products.

The key processes in the product life cycle in HVH / LCT are the upstream chains with the extraction of raw materials, transport from the cradle to the gate, production and transport from the gate to the customer. They represent the **foreground** processes in the system boundaries involved and are key processes in the product life cycle, especially for wood products. The HVH / LCT control process provides direct and real access to information. As **background processes,** i.e. processes in the product life cycle for which direct access to information is not possible, the consumption of energy, water and resources in the use phase is defined and subsequent use is described. However, generic standard data is available in the accompanying documents. The following is an explicit explanation of why HVH / LCT deviates from the "cradle to grave" approach.

(6) Carbon offsetting and carbon storage

Emissions offsets can be listed separately for PEF in the "Additional environmental information" section; however, carbon storage and late emissions cannot be considered as credits in the specified impact categories or only if required in the PEFCR. An "automatic credit" for wood products, as is customary with EPD, regardless of where the wood comes from, is therefore not normal with PEF or should be justified.

The HVH / LCT footprints record the carbon stocks in the wood of the described products (model 1) and less reference values (model 2), as well as a comparison of the HVH / LCT products versus generic products based on reference values (model 3). All models are described in separate documents and exemplary results are shown (see list of attached documents).

HVH / LCT have separate methodological documents on carbon storage (see annexes). HVH / LCT claims that only (!) wood products with a HVH certificate / LCT or, based on it, a HVH / LCT climate footprint, HVH / LCT environmental footprint, can be credited carbon credit in wood, because only here the credit is retained and is not reused in whole or in part due to unclear origins of raw materials (e.g. extraction of unsustainable raw materials, deforestation of primary forests) long distances in the chain of custody and unclear production conditions. This is explained in more detail in the relevant documents and documented with examples (see list of attached documents).

(7) Energy modeling

The HVH / LCT system records the entire "gray energy" of the upstream cradle-to-gate and gate-to-customer chains. In the HVH / LCT system, any form of double counting is excluded. The topic of energy modeling in PEF usually concerns the use phase. For the use phase, the associated documents on the HVH / LCT climate footprint, the HVH / LCT environmental footprint and the ECO footprint provide generic data for the consumption and electricity mix of the respective country in which the respective product under consideration has been manufactured and where the location of the product is in the building under consideration.

This is only possible for products whose entire material flow is known and traceable, such as for HVH / LCT certified products.

In the case of products whose origin is unknown and the upstream supply chains (products without HVH / LCT certificate, in practice an EPD is not enough here) only reference values can be used, for example for European production, although it is not known whether the entire flow of material actually took place within the EU. These data are therefore not always subject to great uncertainties regarding the real environmental impact of the product. Even the European Union (EU) itself is increasingly relying on proof of origin and supply chains because it has recognized this implementation problem. HVH / LCT is an example of best practice within the EU in the area of wood-based and NaWaRo products. Current: This needs to be demonstrated in a European project in the LIFE program using examples.

(8) screening

Many of the specifications addressed in the PEF have already been addressed in other existing methods, such as the Greenhouse Gas Protocol.

All HVH / LCT data and calculations are based on basic data from recognized databases as well as surveys and studies. The most important data of the screening processes are summarized in the documents (see list of system documents). HVH / LCT complies with the GHG protocol, ISO 38200, European Due Diligence and the international standard PCAF. This is set out in separate documents (see list of attached documents). The HVH / LCT climate footprint and HVH / LCT environmental footprint data for products do not require an impact assessment because these data describe the actual material flow of the products in real time. In the ECO-Footprint, process impact assessments and comparative data and generic ECO-Footprints are presented as risk factors. More information can be found in the ECO-Footprint manual. (see list of system documents).

(9) Assignment

According to the PEF specifications, the allocation aspect mainly concerns the use phase of end-of-life products. Unlike ISO 14040/44, PEF specifies specific requirements for allocation in recycling; this is a special "end of life (EoL) formula" for PEF. The current EoL formula is the so-called "Circular Footprint Formula (CFF)".

All allocation steps along the processing chain are stored in the supply chain system at HVH / LCT. The allocation data in the Chain of Custody and its factors correspond to the data and factors commonly used in practice today. In the case of HVH / LCT, an EoL factor is introduced in the post-use phase to be able to specify generic data for post-use as close as possible to practice in the related HVH / LCT accompanying documents. This is based on the PEF allocation principles, but also includes current post-use data in the EU, e.g. real generic recycling data from EU documents. This is necessary because recycling rates in classic life cycle assessments are often indicated incorrectly, which is due to the fact

that standard datasets are used here which either indicate purely theoretical potential or are based on data that already have several years, sometimes decades (e.g. aluminum recycling: information in EPD: often 100% Real values in the EU: 52%, globally 40%, e.g. DE: 56%, EU reports).

(10) Robustness

The PEF should include an analysis of the strength of the PEF model, identification of pain points, assessment of uncertainties and risks, conclusions and recommendations.

The robustness of the data and the system in HVH / LCT is ensured by the control system and certification. The HVH / LCT climate footprint, HVH / LCT environmental footprint and ECO footprint data as well as the HVH / LCT benchmarks correspond to the (highest) quality score 1 according to the PCAF standard. All basic data is based exclusively on recognized databases and the calculations and indicators are explained transparently in the respective associated documents. HVH / LCT is also compliant with ISO 38200, the GHG Protocol and the European Due Diligence, all of which require a risk assessment.

(11) Product categories and nomenclature

In practice, the product categories of HVH / LCT correspond to common product categories for construction and interior design, furniture construction, outdoor wood, paper and packaging, as well as the bioenergy sector. The nomenclature of the HVH / LCT climate footprint, the HVH / LCT environmental footprint and the ECO footprint is based on the nomenclature and properties of the International Reference Life Cycle Data System (ILCD). All relevant uses and emissions of resources relating to the life cycle phases contained within the defined system boundaries are documented. As a European system, HVH / LCT is based on the nomenclatures used by the EUROSTAT database, which are also based on NACE codes. The statistical classification of economic activities in the European Community (NACE Rev. 2) is in turn based on the United Nations International Classification of Economic Activities (ISIC Rev. 4). The use of data from recognized databases such as Eurostadt, for example for benchmark calculations, ensures compliance with this requirement in HVH / LCT, which is inherent in the system.

(12) Reference indices

With the help of the representative product (see above) at the PEF, it is necessary to create a benchmarking system to be ranked. The benchmarks provided by HVH / LCT are developed based on the product categories for wood products stored in the "Eurostat" database in EU foreign trade. This has been expanded to include other categories of real products produced in the EU and used in construction (e.g. KVH, BSH instead of just "timber"), which are not available in the Eurostat database, but which represent essential product categories and important in construction. The information in this regard is stored in separate documents (see list of attached documents, e.g. reference documents, product group profiles, documents on the ingredients of the product categories used, etc.). Consequently, the products are clearly and unambiguously described according to the PEF and are presented in a more differentiated sub-category than the categories used in Eurostat. They are listed in the HVH / LCT database under Eurostat categories ("super category"), eg "KVH solid timber" as a subcategory under "sawn timber" as a super category.

(13) Assumptions, Limitations, Limits

Several restrictions can be imposed on PEF studies, but these must then be declared and justified in a transparent way. HVH / LCT has set limit values for product groups, which are set transparently in

separate documents for each product group. The HVH / LCT climate footprint for products and the HVH / LCT environmental footprint for products show real values for the entire upstream chain. Accompanying documents provide generic dates for non-certified life cycle stages. All assumptions, in which assumptions are made and there are no real material flow values or measured values, are reported transparently in separate documents (see attachments). The assumptions in the ECO-Footprint are specifically filed in the ECO- manual. Footprint (see list of attached documents).

(14) Standard impact categories

With the PEF, it is not only allowed to use standard indicators of classic life cycle assessments (e.g. GWP, AP, EP, etc.), but also to define additional categories and indicators. The standard impact categories are included in the HVH / LCT footprints as classic life cycle assessment factors. The HVH / LCT climate footprint, the HVH / LCT environmental footprint and the ECO footprint are based on clear, transparent and understandable indicators. They are therefore specific, accurate, not misleading and relevant to the respective product categories (see table 3).

Table 3) HVH/LCT-tools and impact categories.

instruments	**Pre-defined impact categories**
climatic HVH / LCT	The recorded environmental qualitative aspects are: GWP (Global Warming Potential).
environmental HVH / LCT	The registered environmental qualitative aspects are: GWP, AP, EP, POCP, ODP, PERE, PENRE, ADP, water and wood storage.
ECO footprint for products	The recorded environmental qualitative aspects (I) are: GWP, water and "gray energy" (PERE + PENRE) The recorded qualitative environmental aspects (II) are: RMA (Raw Material Availability, Resource Availability; REP (Risk of Environmental Pollution, risk of high Environmental Pollution in the extraction of raw materials; RBL; Risk of Biodiversity Loss, risk of loss of biodiversity in upstream chains); EoL: End-of-life factor for the reusability of materials in the product; country factor (total value from CEPI, FWE, DMCI); SFR (social equity in the extraction of raw materials, total factor from various indices); RR (reach risk, risk of substances hazardous to health in the Product).

2.3 / HVH / LCT data quality, data security

2.3.1 / Operational and generic data.

The HVH / LCT system records real material flows in real product supply chains. HVH / LCT includes all material flows in the chain of custody i.e. cradle-to-gate (ctg), gate-to-customer (gtc). The actual material flow in each case is recorded as real-time digital data. This means that no standard value is used, which could distort the real environmental impact many times over. The data is not even checked retrospectively every year, but each delivery that arrives at the customer or at the construction site can exhibit a certificate that traces the entire path of energy, resource and water consumption of the material flow of the supply chains.

HVH / LCT defines transport as elementary flows for wood, paper and bioenergy products. The LIFE project demonstrates that transport in material flows plays an elementary role in the overall product footprint. It is clarified that here are the classic standard transport data sets commonly used to describe this elementary flow. To this end, relevant realistic benchmarks were collected for the first time in the LIFE project.

2.3.2 / Data quality and security

Data quality in HVH / LCT can be classified with the data quality score 1 (e.g. PCAF standard score 1 = high, 5 = low). The reason is that LCT / HVH only uses data from recognized databases such as FAO, Eurostat, USGS, IUCN, WIR, WCMC, UNEP, Worldbank, Ökobaudat, Baubook, Probas, UBA, etc. for its calculations. Factors, benchmarks, comparative data, environmental communication data, etc. they are stored in the SAVE database at HVH / LCT.

Data sources, calculation methods and paths are transparently stored in the corresponding accompanying documents, including databases, assumptions, emission factors and publication dates used to calculate emissions. The reference data set by LCT / HVH are all stored with origin and date and always represent the latest data available. The reference data is recalculated every 5 years.

All HVH / LCT certificate and HVH / LCT environmental footprint data are stored and archived in the control system. Each certificate and environmental footprint document is assigned a unique ID and QR code so that its use can be clearly identified and each certificate can be reliably used only once. This is also part of the external monitoring (TÜV).

2.3.3 / Monitoring of evidence

The HVH / LCT control system is monitored according to the PS 880 standard of the DWI (German Institute of Public Accountants). The same standard is used, for example, to monitor the state biogas register in Germany (plants registered in the biogas register therefore receive state subsidies). The system is also monitored by the TÜV. TÜV monitoring is carried out annually and also includes spot checks and risk analyzes.

The HVH / LCT control system also has industry standards in terms of data security. Certifications such as EMAS collaborate with the HVH / LCT control system in the relevant sectors (e.g. paper). The system is located on a highly secure server in a data center in Germany.

2.3.4 / Data management plan and SAVE database

HVH / LCT control system.

The procedures for data transmission, data archiving and backup, as well as for quality control and verification procedures for data acquisition, input and processing are monitored at HVH / LCT by the digital system and the calculation routines defined therein. The correctness and safety of these calculation routines is monitored by the IT standard PS 880 of the German Institute of Public Auditors. The HVH / LCT certification system is located in a German high security data center. Data security corresponds to industry standards.

HVH / LCT impressions.

All calculations are presented transparently in methodological documents with appendices and all basic data for this come from recognized databases (see above).

database records

All datasets used for the calculations are stored in a corresponding database (database "SAVE"). The basic requirements of the ILCD nomenclature are stored for each data set and, in addition to the environmental data, the date of creation, the creator, the source of the basic data is stored here (see documents and document HVH / LCT method: set of LCT / HVH database data).

Data sets for various environmental aspects in all life cycle stages and the origin of goods from 170 countries around the world, for 216 transport routes and 83 construction product groups are stored in the SAVE database. There are 212 assessment factors and 47,820 individual data sets (as of July 2022). In **the sector of origin,** data for 170 countries has been calculated, which makes it possible to make statements on the aspects of energy, climate, biodiversity, water, resources and social equity and characterizes the extraction of raw materials and industrial production in these countries. In **the transport sector**, the transport per ton of goods traded was calculated by truck and ship on the common trade routes from 170 countries to Europe for the following parameters: CO_2, GWP, AP, EP, ODP, POCP, ADPE, ADPF, PERE, PENRE, HTTP Air and water, indirect water consumption, RBL factor. In **the materials and products sector** , data from life cycle assessments of existing products in the energy, climate, environment, water and resources sectors were assessed to assess the assessment. In the area of durability / eco-design of a product, end-of-life and health parameters and assessments were used that are not found in the classic life cycle assessments, described transparently in the associated documents. Data records in the product data area are created for preliminary products and construction products. The data comes from the Probas, Baubook, Thünen Institute, Ökobaudat, IBU databases. The parameters are available as: GWP, AP, EP, ODP, POCP, PERE, PENRE, PERT, PENRT and the data are available as environmental data for 1 m^3, 1 m^2, 1 t of product. As it has been shown that most of the classical life cycle assessment data are not directly comparable, the values have been converted into "building functional units" and are also available as data in 1 bauFE. More information about the selected EPD with EPD ID number, publisher and other information can be found in the SAVE database, the data and calculation methods are also stored transparently in the documents.

2.4 / HVH / LCT system boundary

2.4.1 / Overview: Phases of the life cycle

Operating system boundaries for **HVH / LCT** are the upstream chains of building materials along the entire real processing chain (chain of custody) in real time, i.e. cradle-to-gate (ctg), gate-to-customer (gtc). The big advantage here is that material flows along the real material flow are recorded as real-time digital data. This means that no standard value is used, which could distort the real environmental impact many times over. The data is not even checked retrospectively every year, but each delivery that arrives at the customer or at the construction site can exhibit a certificate that traces the entire path in the material flow of production.

The HVH / LCT records all phases of the life cycle of the **upstream chains,** i.e. A1, A2, A3 and A4, and shows all environmental parameters (GWP, etc.) separately for A1, A2, A3, A4.

A1 = extraction of the raw material
A2 = transport from the cradle to the gate (ctg)
A3 = production
A4 = gate-to-customer transport (gtc)

As a rule, only the following phases of the life cycle of a product are analyzed in life cycle assessments: **A1, A2, A3.** The following table (Tab. *4)* shows that the HVH / LCT environmental footprint data go beyond the environmental requirements and data of the classic life cycle assessments and represent the real environmental impact.

Tab. 4) Comparison of HVH / LCT and classic EPD according to the single phases of the life cycle.

LC phase comparison	**Environmental footprint HvH**	**classic EPD** (e.g., created by Gabi Software)
A1 / extraction / supply of raw materials	No overexploitation, as there is evidence of national origin, FM-FSC or FM-PEFC or similar certificates for 100% of the round wood included in the chain of custody check at HVH / LCT	No proof of origin, therefore no knowledge of the origin of the wood and not even if it also comes from sustainable forest management or primary forests or from species in danger of extinction.
A2 / "Transport"	REAL transports recorded in real time in the entire material flow of a specific product as “cradle-to-gate” transports.	Using standard data sets instead of actual material flow conditions (usually information from 50 to 350 km). Most EPDs only record transport to the subcontractor.
A3 / Production	Average values of the product group or company specific values where available.	Average values of the product group or company-specific values for the last stage of production.
A4 transport to the construction site / customer	recorded for the first time, product-specific, in real time, as "gate- (to-market) -to-customer" transport	Not registered.

The data in **the use phase** (B) is not recorded, as the construction products are in the use phase, i.e. they do not consume energy, water or raw materials, unlike stoves, lamps or electrical appliances (see German BMUB - Ministry Federal Environment, Nature Conservation, Nuclear Safety). The data of the post- **use phase** is also not recorded. First, because today no one can realistically say how a component will be recycled or disposed of in fifty years or more. Secondly, this is also ISO compliant because according to ISO 14025, submission of data for this life cycle stage is not necessary. Since the classic PEF or EPD always make the same assumptions and use standard data sets here, these standard data are listed with comments in the accompanying documents for the HVH / LÖCT environmental footprint and can therefore be viewed by users. More information and standard data can be found in the supporting documents for the HVH / LCT Environmental Footprint.

2.4.2/ Procurement of raw materials: upstream supply chain, main process, generic data

In life cycle assessments, A1 indicates the supply of raw materials. In the case of wood, the collection of wood with a diesel engine and the supply of logs on the forest road for harvesting. For the collection of logs, the classic EPDs generally used the same standard values. These are based on silvicultural conditions in Germany, Austria and Switzerland and are therefore applicable to the HVH / LCT environmental footprint. However, the dataset should not actually be used for timber harvesting anywhere in the world. However, this is usually done automatically in life cycle assessments of wood products created by computer programs and is also common for wood imported into Europe. HVH / LCT points out in its accompanying documents that this is incorrect and provides datasets for various regions of the world as a comparison.

In the case of wood products, a "carbon credit" for A1 is always included in the classic assessment of the life cycle of wood products, i.e. it is taken into account that wood removes CO_2 from the atmosphere because it binds CO_2 during its growth. This is done as standard with every EPD or PEF for wood products, regardless of whether you have a more detailed knowledge of the raw material, for example if you know whether the raw material comes from sustainable forestry or not. However, a credit should only be granted if the wood comes from a sustainably managed forest. In the case of wood of uncertain origin or overexploitation, no "credit" should be applied, as the wood does not grow back. HVH / LCT also refers to these aspects in its accompanying documents.

HVH / LCT takes this into account with its generic values for raw wood for life cycle stage A1, which are presented in a European LIFE project (see appendix HVH / LCT documents). These values are also adapted to other NaWaRos and materials.

The extraction and processing phase of the raw material in HVH / LCT begins with the extraction of resources from nature and ends with the first transport phase. In the case of wood, this includes growing and harvesting trees. Transport for the HVH / LCT chain of custody begins with the raw wood stacked along the forest trail. All types of pre and post processing are part of the chain of custody control at HVH / LCT. Transportation within and between extraction and pretreatment facilities and to the manufacturing facility is not included in A2 at HVH / LCT.

2.4.3 / Cradle-to-gate transport: upstream chain, main process, real data.

In ISO 14021, the life cycle stage "A2" designates "transport in upstream chains". In HVH / LCT, all transports in the entire material flow of the upstream chains are summarized in A2 according to ISO. The digital system of HVH / LCT records in real time the transports in the entire material flow from the extraction of raw materials. This is unique and usually not the case with classic life cycle assessments (see accompanying document "Weaknesses in classic life cycle assessments"). Emissions are calculated based on the emission factors of recognized databases such as Probas, Baubook, etc. The emission factors used are stored in the accompanying document "emission factors used".

In classic life cycle assessments, models are used in which standard data sets are used, which greatly underestimate the actual transport. The HVH / LCT therefore emphasizes in its accompanying documents that it can generally be assumed that "all transport has been taken into account" only if the transport distances (km) and transport load (t * km) included are named. The assignment phases calculated in a transparent and understandable way . Only in this way can environmental values based on kilometers be traced. Unfortunately, this is only the case with some classic life cycle assessments available. The standard comment "all transports are taken into account" or the indication of sources such as "HBEFA 2.1 and TREMOD 2009" are not very useful (only classic emission factors are given here). If A2 is not shown separately, the user of a classic life cycle assessment does not know if it is 50 km or 10,000 km that these factors are related to.

Transport is classified as an essential process in HVH / LCT. Consequently, the transports are accurately recorded under A2 in the upstream chains.

2.4.4 / Gate-to-customer transport: upstream chain, main process, real data.

The stages of the A4 life cycle describe the transport from the last producer to the customer or to the construction site. As a rule, these paths are not recorded in classic life cycle assessments, although they can play a crucial role in environmental impact. HVH / LCT also records these transports accurately and reports them separately. Because it obviously plays a significant role in the actual environmental impact of a product that a designer installs in a central European building, whether the product comes from a short distance from Central Europe or a long way from Asia.

Transport from the manufacturer to the customer or to the construction site (at HvH "gate to customer"). These paths cannot be recorded in the lifecycle assessments inherent to the system but can at most be simulated using scenarios. Of course, the fact that it comes from Germany, Russia or China plays an important role in the environmental footprint of the building material you install in a building. Conversely, HVH Wood Environmental Footprint provides this information for specific products as well.

Transport is classified as an essential process in HVH / LCT. Consequently, the transports are accurately recorded under A4 in the upstream chains.

2.4.5 / Production: upstream chain, main process, real data or generic data

In life cycle assessments, A3 indicates production. The industry average values for the process steps are stored in the HVH / LCT environmental footprint (data from recognized scientific studies and databases such as Thünen Institute, Ökobaudat, Baubook, etc.). This corresponds to the structure of classic life cycle assessments for upstream chains. However, a special feature of HVH / LCT is that company specific data can be stored even if documented.

In life cycle assessments, A3 indicates production. Industry life cycle assessments indicate average energy and environmental data for manufacturing a product group . Business life cycle assessments indicate (average) values of energy and environmental data for the production of a specific product. These life cycle assessment data are generally based essentially on the energy consumption of the production. Corresponding data is recorded in all classic generic life cycle assessment data for this life cycle stage. This is captured when using generic data for A3. When using company data for A3, company profiles are created using standard documents.

2.4.6 / Capital goods as well as sale and storage: sub-aspect "produc- tion", secondary process, not registered.

capital goods

Capital goods are valued at HVH / LCT with an ancillary process. This is not data that would be important for the material flow of the supply chain, but exclusively company data. Therefore, no value is applied to HVH / LCT. First of all, because in HVH / LCT a "pure" value must be created only for the material flow of the respective material and because the environmental data for capital goods that must be written down annually are negligible compared to the material and energy flow recorded at HVH / LCT. Investment flows are also often recorded in the A3 life cycle stage in the generic life cycle assessment data (see here).

distribution and storage

The aspect of storage, delivery, etc. it strongly depends on the type of product and is not evaluated by HVH / LCT. Products that require a cold chain with huge electricity / diesel requirements for cooling, such as food, need to be valued completely differently than wood products, for example, when it comes to food, the cold chain is a crucial aspect of distribution and storage.

Many building materials, on the other hand, are now produced just-in-time, precisely to largely avoid warehousing, which represents an important cost item. In industry, small and medium-sized enterprises as well as crafts, wooden products are now often made to order by individual customers and deliveries "on site" have now become almost normal. Plant planning is therefore a crucial aspect today, where collaboration between product manufacturers and construction companies has become essential. Long storage times have become absolutely unusual here, especially for building materials. The storage of primary products, e.g. in silos, often affects other product groups such as plastics and their primary products (e.g. storage of plastic granules in silos) or primary metal products.

This aspect in the distribution of products is also increasing in the case of bioenergy (e.g. pellet silos). However, the consumption of energy, water or resources in such interim storage facilities is highly dependent on the product. In the case of bioenergy, neither energy nor water nor raw materials are used in the form of storage. Conversely, the distribution is more climate friendly due to the shorter

distances with smaller vehicles from the customer. Nowadays wood shops are not available for the product group of wood building materials or are used as briefly as possible. The storage of wood products usually does not involve any consumption of energy, water or raw materials. In the case of HVH / LCT, this phase of the life cycle of timber construction materials is classified as irrelevant in terms of environmental impact. Any storage at the forest level only occurred during storm events when the quantity of logs was too high for the downstream supply chain. This is certainly not the case today with the huge wood requirement of the wood industry, but here in Europe it doesn't play a role either because the wood is removed from the forest as quickly as possible. Any "intermediate storage" in storage areas is highly undesirable here only for cost and logistical reasons. Each log transfer is very expensive and is not financially rewarded in the subsequent supply chain. In general, this aspect should also be included in A1.

2.4.7 / Use phase: generic data, supporting documents

In HVH / LCT, the data in **the use phase** (B) is not recorded via the digital control system. **Energy, water, resource consumption building materials: for HVH / LCT environmental footprint as building materials BI ("0")**

Building materials are inert during the use phase and do not consume energy, water or raw materials, unlike appliances, lamps or heating. Therefore, upstream chains play an essential role, especially with building materials. The use phase is then rendered inert for the building materials themselves to HVH / LCT, i.e. with an environmental impact equal to "0". This is explained in more detail in the accompanying documents and the classic consumption data and their CO_2 emissions for building types are also provided (see annex HVH / LCT documents).

2.4.8 / End of life: generic data, accompanying documents

data from the post- **use phase** is not recorded. First, because today no one can realistically say how a component will be recycled or disposed of in fifty years or more. Secondly, this is also ISO compliant because according to ISO 14025, submission of data for this life cycle stage is not necessary. As a rule, the classic ones always use the same scenarios, assumptions and standard data sets. These are listed with comments in the accompanying documents.

An EoL formula presented at the PEF that addresses the issue of multifunctionality. The formula applies to all product groups and aims to increase the comparability between the different products by allocating credits and loads in the EoL phase. In the formula, the energy use is evaluated as the use of the material. Thus the formula was beneficial for product groups which tend to be incinerated rather than recycled and disadvantageous for products which tend to be recycled. The CFF formula has been revised and developed, but in the same way, it still favors energy use.

In the case of the CCF, a maximum credit of 80% is usually awarded which, as an allocation factor, divides the expenses and savings of secondary materials between the user and the supplier. In ISO 14040, a full credit (100%) is usually given because all the material is reused.

UBA (20198) also sees a problem and the HVH / LCT agrees from a practical point of view that some of the default data provided is somewhat questionable. The UBA writes: “For example, materials such as metal (e.g. steel, aluminum) and glass have a value of 1, which means that the quality of the secondary material is the same as that of the primary material. It is questionable to make this hypothesis across the board for all metals, as the quality of the secondary material for some metals can certainly be lower than that of the primary material. What is unacceptable, however, is that the assumption of a quality

term of 1 is also accepted for some plastics such as PP or HDPE, as the quality of recycled plastic largely cannot reach the quality of the raw material ". According to UBA (2018), it is generally questionable whether a single formula is suitable for evaluating a large number of products. Each group of materials, each product group, each product has characteristic properties that can hardly be differentiated with a single formula

The reusability and therefore the probable real subsequent use of the building products is decided at the time of installation in the building and not only when the wrecking ball is in front of the building. This is determined on the one hand by the material (e.g. wood compared to PVC), but also by the type of product (wood fiber insulating panels vs. ETICS) or by the type of installation (floating or glued parquet) of resources from the beginning "is therefore a constructive aspect that starts very early, that is with your design. The conservation of resources from the beginning is a theme that Holz von Hier promotes to create awareness on the importance of renewable raw materials in this phase of the life cycle, see the factsheet "Resources" in the training documents.

Transport to the recycler / disposer (at HVH / LCT: C1)

If this life cycle stage is mentioned in the life cycle assessments, standard datasets are usually used here (usually 50 - 75km provided). They considerably underestimate actual conditions, for example waste wood is a globally traded commodity. However, according to ISO 14044, balancing this life cycle stage is not absolutely necessary. Assessments of the recycling and waste market in Europe make it clear that some residual and waste materials are now being transported across Europe and even the world.

waste management

In the subsequent use of building materials, the following aspects are important Aspects of waste management. Again, only standard data sets are generally available. Therefore, only scenario assumptions can be made. The actual processing and recycling options in practice are very important here. The topic is usually the subject of the highest degree of speculation. However, according to ISO 14044, balancing this life cycle stage is not necessary. Information sheet and (few) details from the life cycle assessments in the accompanying documents.

Material and energy recycling

In the subsequent use of building materials, the following aspects are important: how is the material used in the product (material, energy). According to ISO 14044, balancing this life cycle stage is not necessary. This aspect is also largely speculative, no one knows what will actually happen next.

EoL index

HVH / LCT therefore developed a post-use EoL practice index.

However, if a company does an internal analysis for its end-of-life products, it is interested in a real assessment of their EoL phase. HVH / LCT would like to approach this by mapping more practical default values (eg EoL Practice Index) through literature reviews and interviews with professionals (e.g. waste disposal companies and recycling companies). This is the only way to make the significant differences between end-of-life materials more evident. For many materials, there are still misconceptions about recycling in the data sets used in classic life cycle assessments. For example, aluminum is considered 100% recycled in some life cycle assessments. In practice, however, the recycling rate for

aluminum is 52% in Europe and 40% worldwide, which should be considered in the generic data. However, individual manufacturers could use 100% recycled aluminum for their products. In this case, the standard datasets used here in classic life cycle assessments often embellish the environmental impact and do not offer producers any incentive to improve their environmental impact compared to the average, for which a good value is still set. in life cycle assessments, which often has nothing to do with actual market conditions.

2.4.9 / Further aspects of raw material extraction

It is often not possible to express very significant environmental impacts using classical quantitative factors such as those used up to now in life cycle assessments. Many of these more qualitative environmental impacts can be clearly expressed through risk factors or indices. This principle is already contained in many EU regulations and is already used for risk assessments (see CPI Index). In contrast to the EPD, the PEF allows the use and introduction of new factors, including qualitative factors and indices, if justified in a transparent way and which address a significant environmental aspect.

In this "Additional Aspects" area, HVH / LCT has developed several new indices for general environmental communication and for the ECO-Footprint, which are presented for the first time in Europe in the LIFE "EU Low Carbon Value Chains" project. The indices need to be further developed by the new LIFE project and, more importantly, adapted to other NaWaRo and other material groups. A more detailed description of all indices can be found in full methodological documents (see attached HVH / LCT documents list)

Responsible extraction of raw materials

"Carbon credit" for A1 is usually considered in life cycle assessments, which means that wood is calculated to remove CO_2 from the atmosphere because it binds CO_2 as it grows. However, this only applies if the wood comes from a sustainably managed forest. In the case of wood of uncertain origin or overexploitation, in reality no "carbon credit" should be applied, as the wood does not grow back. On the contrary, the overexploitation of wood releases enormous quantities of CO_2 from biomass and soil. The criteria that HVH / LCT applies here are described in the following chapter.

Resource Index - RMA

RMA - Availability of raw material - availability of resources. Wood products have the advantage of using raw materials that are in principle renewable rather than limited. Mineral or petroleum-based products do not have this advantage. For example, the spruce wood species is common (rather than rare) and ubiquitous (rather than geographically concentrated). However, wood can only be classified as "renewable" if it comes from sustainable forest management and not primary logging. Some types of wood are also quite rare and limited to a few regions or come from endangered tree species. This doesn't include spruce, for example.

What are the most environmentally friendly materials and products that can be used for the same purpose? One of the central aspects of sustainability is the question of whether the basic raw materials in products are "renewable or limited", "common or rare", "ubiquitous or isolated". This essential aspect has not yet been adequately taken into account in any environmental assessment tool.Example of wooden building materials. In principle, wood is a renewable raw material. So far, however, this has not been expressed in any environmental assessment tool. Life cycle assessments don't capture this. Example of mineral-based building materials. Availability here is highly dependent on the building material. Example: gypsum-based building materials: about 20% of gypsum consumption in Germany is used for gypsum boards, most of which is natural gypsum, which is a limited and high-quality resource.

Example of synthetic building materials. The base material for synthetic building materials (e.g. EPS) is petroleum, a finished raw material. The availability of accessible oil fields which are not found in crisis regions and which can be extracted with reasonable economic effort and without excessive ecological damage is estimated at today's production rates between 40 and 60 years.

Environmental index - CZECH REP

The "REP" index (Risk of Environmental Pollution - risk of high environmental pollution during the extraction of the raw material) reflects the risk of high environmental pollution during the extraction of the raw material and is very different in every country in the world and also depending on the type of raw material. With wood, it is imperative that it does not come from deforestation or primary forests, and it is not wood from endangered tree species around the world.

Biodiversity Index - RBL

RBL - Risk of Biodiversity Loss - risk of biodiversity loss in the upstream chain. The risks of biodiversity loss are associated with the extraction of raw materials and their transport. This risk depends a lot on where the raw materials come from and on which routes and routes they were transported. you

Country Index by Country Origin - "Origin"

The importance of the country of origin of the product is expressed by a "country factor" (climate, water, resource efficiency of the country of origin). Three factors are evaluated here in a total assessment: the climate efficiency of production (CEPI), the efficiency of fresh water (FWE) and the consumption of household material (DMCI) of a country's industrial production, based on the power of the country's GDP (gross domestic production). Environmentally friendly and sustainable extraction of raw materials is not considered in life cycle assessments. Here, environmental labels such as HVH / LCT also ensure the sustainable and environmentally friendly extraction of raw materials and proof of origin is also extremely important. If there are no environmental labels, as is usually the case with raw materials such as minerals, metals, stones, oil-based products, but also wood imported into Europe, it is essential to pay attention to the origin of the raw materials, semi-finished products and products. This essential aspect has not yet been adequately considered in any environmental assessment tool.

Social equity index - SFR

The risk factor "SFR" (Social Fairness in raw material extract) summarizes various individual factors such as Corruption Perceptions Index-CPI, Rule of Law Index-RLI, Fragile State Index-FSI, Freedom in the World Index-FWI databases recognized together (rating: 1 = best, 0 = worst)

2.4.10 / Further aspects of the product use phase

Sanitary building materials: a HVH / LCT environmental footprint as B-III building materials as a RR (Reach Risk) factor

RR - REACH risk - Risk of harmful substances in the product. The health and safety of a construction product is decided (1) in daily use and (2) in the event of a fire. In daily use, emissions from contact with indoor air play an important role. (See e.g. wood versus plastic or solid wood versus wood-based panels). It should be borne in mind that in fires more people die from the toxic gases of the fire than from combustion. (e.g. wood fiber insulation vs polystyrene). Regarding the health of building materials, the REACH regulation applies in Europe. REACH regulates the handling of highly dangerous and environmentally harmful substances in the EU. These are mostly carcinogenic, harmful to the baby in the womb, harmful to the genetic material, highly toxic and deadly substances. So far, 62 substances are in the REACH regulation and 146 substances in the REACH candidate list (see HVH / LCT documents annex). HVH / LCT has developed a hedging risk factor by evaluating the REACH regulation and its lists, as well as the ingredients of common wood product groups (for methodology, see appendix to HVH / LCT documents).

Durability of building materials: in the HVH / LCT environmental footprint as building materials B-II according to BBSR

What is important at this stage is the shelf life of the products and how healthy and safe the product is. A durable, repairable, modular product is more environmentally friendly than a short-lived product that cannot be repaired or where parts cannot be replaced in a modular way. The durability of the components is determined according to HVH / LCT using the BBSR table of the Federal Ministry of Construction (see attached documents HVH / LCT). However, suppliers often have their own reports and product sheets, which are considered.

2.4.11 / Accurate supply chains down to the building level

The sum of the HVH / LCT product certificates on the construction site or in the factory design of a building results in an **HVH / LCT construction certificate.** The building certificates HVH / LCT are based on the above tests. They are not "building evaluation systems" in the well known and complete sense. The HVH / LCT construction certificate goes beyond scope 3a of the GHG protocol because the supply chains and their climate balance are recorded from the quantitative balance up to the standing building.

This is important because in building practice the quantities of wood used often differ considerably between the design, the planning of the works and the execution. According to the practical experience of experienced planning bureaus, it can sometimes be as high as 20%. The designers plan "walls" and not "tons or m^3 of wood". Therefore, the following evidence also constitutes an important document for the precise recording of the quantities actually installed for the verification of subsequent building evaluations. Without such proof, it is possible that even the quantitative balance of materials used in buildings is not actually recorded. This can lead to significant misjudgments in the climatic balance of buildings.

2.4.11 / HVH / LCT products / buildings with environmental impact and their purposes in the GHG protocol

In accordance with ISO 14204 and the GHG protocol, some aspects of the supply chain up to the standing building are not covered. This is possible because not all emission sources have to be economically and environmentally relevant, can be influenced or can be recorded with existing detection tools. A brief classification of the areas of the GHG protocol in relation to the life cycle phases of the classic life cycle assessments and the reporting tools are shown in the following table (table 5*)*.

The consumption of electricity (cooling, lighting, electrical system) and heat is relevant for the calculation of the climatic balance of the building in the use phase (similar to scope 1 of the GHG protocol). In the case of buildings, the location is also relevant for consumption in use, since, for example, different countries have very different CO_2 emission factors for electricity consumption, depending on the electricity mix available here (similar to Scope 1 of the GHG protocol).

Information and documents on life cycle stages marked "irrelevant" are available in the document index. These include use stage environmental parameters, emission factors and country factors, as well as end-of-life parameters, climate and environmental impact factors and data. However, the data mentioned here are not included in the evidence used for Scope 3a (see tables from x to x), as they deal with supply chains and gray energy or "gray CO_2".

Tab. 5) Analogy with the aims of the GHG protocol and relevant for HVH / LCT certificates.

GHG protocol	similar to purpose 1	similar to Scope2	similar to Scope3 (a)	similar to Scope3 (b)
"activities"	directly	direct"	upstream	downstream
Reference / plan	construction	construction	construction	construction
phase	use phase	to the use phase	pre-chains	reuse
designation	"Red energy"	national indices points of references	"Gray energy"	end of use
stages of the life cycle	B.	to be	A1: raw materials, A2: transport, A3: production, A4 transport	CD
Relevance for HVH / LCT	Not relevant	Not relevant	Relevant	Not relevant
HVH / LCT tests	no proof	no proof	(1) certificate, (2) climate footprint, (3) building certificate. (4) Gray CO2	no proof

The aspects that have not been registered for the **HVH / LCT construction certificate** are shown in the following table (t*able 6*).

*Table 6) Aspects registered and not registered for the **building certificate HVH / LCT** similar to the purposes of the GHG protocol. Note: "relevant" (☑throughout the supply chain) or "not relevant" (nr). Data: Energy consumption as PERE and PENRE in MJ and GWP in kg CO $_{2\text{-eq}}$.*

GHG protocol	scope 1	scope 2	Scope 3 (a)	scope 3 (b)
"activities"	directly	direct"	upstream	downstream
Reference / plan	construction	construction	construction	construction
phase	use phase	to the use phase	pre-chains	reuse
GHG Protocol Criteria for HVH / LCT Purpose 3a				
Position	No	No	☑	No
vehicles	No	No	No	No
Purchase / sale of goods	No	No	☑	No
capital goods	No	No	No	No
fuels, energy	No	No	☑	No
transport	No	No	☑	No
waste generated	No	No	No	No
business trips	No	No	No	No
BUT commuters	No	No	(No	No
leased assets	No	No	No	No
Data				
energy consumption	No	No	☑	No
Climate: GWP CO $_{2\text{-eq}}$	No	No	☑	No

2.4.12 / Additional aspects Use phase: building level

Health building: at HVH / LCT: building B-III

This corresponds to the sum of the classified building materials in the building and their "Reach Risk" indices or specific product ingredients specified.

Energy, water, building resource consumption: for HVV / LCT as generic building BI data

The accompanying documents also provide classic consumption data and related CO2 emissions for building types.

Durability of buildings: at HVH / LCT as B-II buildings

The application of information on the durability of building materials directly to durability in the building complex is generally speculative. The durability of building complex components is generally highly dependent on the type and quality of the installation and is therefore primarily an aspect of design and execution. In the case of HVH / LCT, a service life of 100 years is set here, comparable to Baubook Austria (see attached documents HVH / LCT).

2.5 / Greenhouse gas accounting

2.5.1 / Basic information on GHG accounting

GHG accounting is the annual disclosure of the GHG emissions of a company or project financed by loans and investments of a financial institution at a predetermined time. Funded emissions can be measured as the amount of GHG emissions generated, avoided or removed. The amount of greenhouse gas emissions emitted by an institution, company, project or object and financed by a financial institution is called "emissions generated". To limit climate change and achieve the goals of the Paris Agreement, donors must actively seek measures to reduce "emissions generated".

Measuring financed emissions in "absolute emissions" provides financial institutions with the basis for climate action. However, the corresponding "normalized" data are often also useful for banks and investors to manage the risk of climate change, set goals or develop new products and projects. Normalizing the data means converting the financed emissions into an "emission intensity ratio" (emissions for a given unit).

In the GHG protocol as in the PCAF standard, the term "absolute emissions" is used. "Absolute emissions" means "emissions generated" and not "emissions avoided" or "emissions removed".

The volume of investments by financial institutions is "absolute emissions" divided by a production value and is usually correlated to values in t CO_2eq / € company turnover. Absolute emissions are expressed, for example, as values in t CO_2eq / MWh or t CO_2eq / ton of product produced.

2.5.2 / Gas in the calculation of GHG emissions

(1) Global warming potentials under HVH / LCT

Global warming potentials under HVH / LCT correspond to GHG protocol and ILCD specifications. Greenhouse gas emissions according to the GHG protocol and other standards: CO_2, CH_4, N_2O, HFCx, PFCx, SFx, NFx. If some gases cannot be included or if they are not relevant, this must be justified. At least, however, the greenhouse gas emissions must be calculated as “CO_2equivalent” from CO_2, CH_4 and N_{20}.

For HVH / LCT the values of GWP = Global Warming Potential in kg CO_2equivalent are used, which include the gases specified by the GHG Protocol. The calculation factors of the gases between them come from the commonly used specifications of the University of Laiden. If not all of the above mentioned gases can be included, this is justified and usually related to the lack of internationally recognized data. (Note: other classical environmental aspects such as AP, EP, ODP, POCP, water are also calculated in the life cycle assessments).

2.5.3 / Aspects of climate impact

GHG accounting typically addresses three types of climate impact aspects: **(A) emissions produced, (B) emissions removed, and (C) emissions avoided.**

The emissions generated in the real estate sector are, for example

- Emissions from chains upstream of construction materials and products used
- Significantly reduced emissions in upstream chains through HVH / LCT certified construction materials and products.
- Emissions during construction (regardless of building materials and HVH / LCT certified products).
- Emissions during use of the building (regardless of construction materials and products with HVH / LCT certificate).
- End-of-life emissions (relatively independent of building materials and HVH / LCT certified products).

There are, for example, **emission reductions in the real estate sector**

- Renovations and redesigns, such as the installation of insulation (facades, roof) and new components (e.g. windows) with HVH / LCT certificate
- or even, for example, the installation of new heating systems, energy saving technologies or solar systems.

The emissions avoided in the real estate area mainly occur if it is possible to make credible the amount of CO_2 installed and used or if building materials that are particularly climate-friendly compared to other building materials, for example

- Wood building materials with values above average climate-friendly for short distances with HVH certificate /LCT compared to wood building materials or
- Wood building materials with values above average climate-friendly with HVH certificate /LCT compared to wood building materials

Literature and document list

Creation of important HVH / LCT documents from and for environmental communication in the LIFE project. Some of these documents have already been completed, others are still in the works. However, all documents will be available at the end of the LIFE project.

A-1 / HVH / LCT document compliance

Document on the HVH / LCT itself on www.holz-von-hier.eu, www.low-carbon-timber.eu.

"HVH / LCT compliance document: Declaration of compliance with ISO 38200 (2022). Document demonstrating compliance of HVH / LCT with ISO 38200. Published by HVH / LCT Europe. Pages 41.

"HVH / LCT compliance document: Company questionnaire according to ISO 38200" (2022). Company questionnaire to collect data required for ISO 38200. Published by HVH / LCT Europe. pages 41.

"HVH-LCT compliance document: Declaration of compliance with EUTR and DD EUTR - European Trade Regulation DD - European Due Diligence" (2022). Published by HVH / LCT Europe. pages 13.

"HVH-LCT compliance document: Declaration of compliance with the RED regulation including certification conditions and due diligence system - according to EU regulation 2021/2018 and 2018/1999 RED II and RED III (2022). Published by HVH / LCT Europe Pages 87. Apply for approval of HVH / LCT as a certification system compliant with RED from the EC bodies responsible in the LIFE project.

"Document of Compliance HVH-LCT: Annex with data to the Document of Compliance RED: Data Lists for RED-II / RED-III" (2022). data lists. Content: Emission factors during combustion (conventional and renewable energy), reduction of net emissions through solid bioenergy and emission factors from upstream chains. Published by HVH / LCT Europe. Pages 27. Apply for HVH / LCT approval as a RED compliant certification system from the EC bodies responsible in the LIFE project.

"HVH-LCT Compliance Document: HVH / LCT-Green-Finance Low Carbon Timber Projects, Objects and Buildings" (2022). Contents. Accounting of greenhouse gas emissions from buildings and objects compliant with the PCAF standard and simplification of accounting through HOLZ VON HIER and LOW CARBON TIMBER PCAF - Partnership for Cabon Accounting Financials according to PCAF Standard, April 2022. Ed. HVH / LCT. Pages: 38. In coordination with EU banks in the LIFE project.

A-2 / HVH / LCT methodological documents

European climate certificates for low carbon timber (LCT) (2020). VCM LCT standard. methodological document. Content: Procedure and specifications for the introduction of CO2 HVH / LCT certificates for objects and buildings in the VCM market. (Information: European VCM standard for regional projects based on Moor-Futures regional standard "). Published by HVH / LCT Europe.

$_2$ storage in wood" (2022). Content: CO $_2$ storage in wood calculated according to ÖNORM EN 16449 for the most important groups of wood products. Published by HVH / LCT Europe.

"LCT project type I - methodological approach 2: methodological document" Origin "(2022). Content: Reduction of CO $_{2\ storage}$ in wood based on the origin of the product and comparison of products without HVH / LCT certificate with products with HVH certificate / LCT -,

"LCT Project Type I - Approach 3:" Transport in Supply Chains "(2022). Methodology document. Content: Realistic generic benchmarks of the supply chain transport load for the main groups of wood products on the market. Published by HVH / LCT Europe.

"LCT-3 Annex A-1: Description" Use Emission Factors "(2022). Annex for the LCT approach 3. Data and information. Published by HVH / LCT Europe.

"LCT-3 Annex A-2: Description" HVH / LCT upper limits and actual HVH / LCT values "(2022). Annex for LCT approach 3. Data and information. Published by HVH / LCT Europe.

"LCT-3 Appendix A-3:" Product groups: production, import and export, consumption, import quotas and own production in the consumption of target countries in the EU "(2022). Annex for the LCT approach 3. Data and information Published by HVH / LCT Europe.

"LCT-3 Appendix A-4:" Reference values for upstream chainless imports into EU target countries for selected product groups "(2022). Annex" IMP-without-VK "for process approach LCT 3. Data and information Published by HVH / LCT Europe.

"LCT-3 Annex A-5:" Generic values for transport in the chain of custody of own production within the EU for product groups selected as a transport route and CO $_{2\ emissions}$ "(2022). Annex" EP ^{TR} -EU "for the LCT approach 3. Data and information. Published by HVH / LCT Europe.

"LCT-3 Annex A-6:" Countries of origin of generic import values. Generic values for the transport of pre-import goods from the countries of origin to the EU for selected product groups "(2022)." GIQ ^{TR} "attachment for the LCT approach 3. Data and information. Published by HVH / LCT Europe .

"LCT-3 Appendix A-7:" Generic values for the transport of imports with upstream chains to EU target countries for selected product groups "(2022). Annex" IMP-mit-VK "for the approach to the LCT procedure 3. Data and information Published by HVH / LCT Europe.

"LCT-3 Annex A-8:" Reference values of product groups on the target country market in the EU, taking into account own production and imports as transport from cradle to market "(2022). Annex" BPG ^{TR} - ctg / ctm "for the LCT procedural approach 3. Data and information. Published by HVH / LCT Europe.

"LCT-3 Appendix A-9:" Reference values of product groups on the target country market in the EU, taking into account own production and imports as a transport cradle- (to-gate-to-market) a- customer "(2022). Attachment" BPG ^{TR} -ctc "for the approach to the LCT procedure 3. Data and information. Published by HVH / LCT Europe.

A-3 / Attached documents HVH / LCT upstream chains

country lists

- List of CPI (Corruption Perceptions Index) EU countries
- List of CPI (Corruption Perceptions Index) countries around the world
- List of FWI (Freedom in the World Index) EU countries
- FWI (Freedom in the World Index) list of countries around the world
- List of EU countries RLI (Rule of the Law).
- List of countries of the world RLI (Rule of the Law Index).
- List of FSI (Fragile State Index) EU countries
- List of FSI (Fragile State Index) countries around the world
- Forest legality initiative
- EU sanctions lists
- List of CEPI countries (Climate efficiency of production) EU
- CEPI (Climate Efficiency of Production) countries list.
- List of EU Fresch Water Efficiency (FWI) countries
- List of Fresch Water Efficiency (FWI) countries in the world
- List of EU DMCI (Domestic Material Consumption of Industry) countries
- List of DMCI (Domestic Material Consumption of Ind.) Countries around the world
- Social equity SFR by country

Goods lists

- CO2 storage in the forest (various types of wood)
- growth index
- CO2 release from the soil
- Timber harvest data (by country)
- Endangered and protected wood species
- Forest certifications by country
- Net emissions from forests

shipping lists

- Transport data (overview)
- Truncate transport data and criteria in EPD
- Emission factors used
- Upper limits HVH / LCT, actual HVH / LCT values
- PIEK - DE data: Product groups imports, exports, consumption, import share of consumption, own production shares of consumption for selected wood product groups.
- PIEK - AT data: Product groups imports, exports, consumption, import share of consumption, own production shares of consumption for selected wood product groups.

- PIEK - Data IT: Product groups imports, exports, consumption, import share of consumption, own production shares of consumption for selected wood product groups.
- PIEK - Daten SL: Product groups imports, exports, consumption, import share of consumption, share of own production on consumption for selected wood product groups.
- PIEK - LU data: Product groups imports, exports, consumption, import share of consumption, own production shares of consumption for selected wood product groups.
- PIEK - FR data: Product groups imports, exports, consumption, import share of consumption, own production shares of consumption for selected wood product groups.
- PIEK - SWE data: Product groups imports, exports, consumption, import share of consumption, own production shares of consumption for selected wood product groups.
- PIEK - MW EU data: Product groups imports, exports, consumption, import share of consumption, own production shares of consumption for selected wood product groups.
- IMP without data VK DE: Reference values for unchained upstream imports (VK) for selected wood product groups.
- IMP without VK data AT: Reference values for unchained upstream (VK) imports for selected wood product groups.
- IMP without VK IT data: Reference values for unchained upstream imports (VK) for selected wood product groups.
- IMP without data VK SL: Reference values for chainless imports upstream (VK) for selected wood product groups.
- IMP without data VK LU: Reference values for unchained upstream (VK) imports for selected wood product groups.
- IMP without data VK FR: Reference values for unchained upstream imports (VK) for selected wood product groups.
- IMP without VK data SWE: Reference values for unchained upstream (VK) imports for selected wood product groups.
- IMP without data VK MW EU: reference values for unchained upstream imports (VK) for selected wood product groups.
- $^{\text{TR-CoC -EU}}$ EP data / Generic values for transport (TR) in the chain of custody (CoC) of in-house production (EP) within the European Union (EU) for selected wood product groups in wood as a transport route (in km) and $CO_{\text{2 emissions}}$ [in kgCO-eq). - European coordinated in a European working group.
- GIQ $^{\text{TR data}}$ / Generic values for imports from countries of origin (GIQ). Values for transport (TR) of pre-imports of goods from countries of origin into the EU.
- IMP with VK DE data: Reference values for upstream chain (VK) imports for selected wood product groups.
- IMP with VK data AT: Reference values for upstream chain (VK) imports for selected wood product groups.
- IMP with VK IT data: Reference values for upstream chain (VK) imports for selected wood product groups.
- IMP with VK data SL: Reference values for upstream chain (VK) imports for selected wood product groups.
- IMP with LU Sales Data: Reference values for upstream chain (VK) imports for selected wood product groups.
- IMP with VK data FR: Reference values for upstream chain (VK) imports for selected wood product groups.
- IMP with VK SWE data: Reference values for upstream chain (VK) imports for selected wood product groups.
- IMP with MW EU data: Upstream (VK) import reference values for selected wood product groups.

- BPG ^{TR}-ctg-mix - data DE: Reference values of wood product groups (BPG) on the target country market in the European Union, taking into account own production (EP $^{TR-CoC}$) and imports (IMP with VK) as cradle-to-market (ctm) values.
- BPG ^{TR}-ctg-mix - AT data: Reference values of wood product groups (BPG) on the target country market in the European Union, taking into account own production (EP $^{TR-CoC}$) and imports (IMP with VK) as cradle-to-market (ctm) values.
- BPG ^{TR}-ctg-mix - Data IT: Reference values of wood product groups (BPG) on the target country market in the European Union, taking into account own production (EP $^{TR-CoC}$) and imports (IMP with VK) as cradle-to-market (ctm) values.
- BPG ^{TR}-ctg-mix - Data SL: reference values of the wood product groups (BPG) on the market of the target country in the European Union, taking into account own production (EP $^{TR-CoC}$) and imports (IMP with VK) as cradle-to-market (ctm) values.
- BPG ^{TR}-ctg-mix - LU data: Reference values of wood product groups (BPG) on the target country market in the European Union, taking into account own production (EP $^{TR-CoC}$) and imports (IMP with VK) as values from the cradle to the market (ctm).
- BPG ^{TR}-ctg-mix - data FR: Reference values of wood product groups (BPG) on the target country market in the European Union, taking into account own production (EP $^{TR-CoC}$) and imports (IMP with VK) as cradle-to-market (ctm) values.
- BPG ^{TR}-ctg-mix - data SWE: Reference values of wood product groups (BPG) on the target country market in the European Union, taking into account own production (EP $^{TR-CoC}$) and imports (IMP with VK) as cradle-to-market (ctm) values.
- BPG ^{TR}-ctg-mix - MW-EU data: reference values of wood product groups (BPG) on the target country market in the European Union, taking into account own production (EP $^{TR-CoC}$) and imports (IMP with VK) as cradle-to-market (ctm) values.
- BPG ^{TR}-ctc-mix - DE data: Reference values of wood product groups (BPG) for the customer / construction site of the country of destination in the European Union as values from the cradle to the customer (ctc).
- BPG ^{TR}-ctc-mix - AT data: reference values of wood product groups (BPG) to the customer / construction site of the target country in the European Union as values from the cradle to the customer (ctc).
- BPG ^{TR}-ctc-mix - data IT: reference values of wood product groups (BPG) to the customer / construction site of the target country in the European Union as values from the cradle to the customer (ctc).
- BPG ^{TR}-ctc-mix - Data SL: Reference values of wood product groups (BPG) for the customer / construction site of the country of destination in the European Union as values from the cradle to the customer (ctc).
- BPG ^{TR}-ctc-mix - LU data: Timber product group (BPG) reference values for the customer / construction site in the country of destination in the European Union as cradle-to-customer (ctc) values.
- BPG ^{TR}-ctc-mix - FR data: Reference values of the product groups (BPG) in wood to the customer / construction site of the country of destination in the European Union as values from the cradle to the customer (ctc).
- BPG ^{TR}-ctc-mix - SWE data: reference values of wood product groups (BPG) to the customer / construction site of the target country in the European Union as values from the cradle to the customer (ctc).
- BPG ^{TR}-ctc-mix - MW-EU data: reference values of wood product groups (BPG) to the customer / construction site of the target country in the European Union as values from the cradle to the customer (ctc).
- CO2 savings through HVH products compared to generic data for average products (benchmark values).
- conversion factors.
- Prices of LCT certificates
- Overlapping flows of goods Foreign trade DE

production

- Production - wood building materials, wood products, production steps (in preparation)
- CO2 emissions in the production of wood building materials and materials (in preparation)

Country profiles - primarily - for woody hotspot regions

- Country Profile Malaysia
- Indonesia country profile
- China country profile
- Country Profile Vietnam
- India country profile
- Myanmar country profile
- Country profile Russia
- Brazil country profile
- Congo country profile

A-4 / Phase of use of attached documents HVH / LCT

use phase products

- use phase data
- Lambda UR values

use the construction phase

- Red energy building

A-5 / Attached documents HVH / LCT subsequent use

Subsequent use of product groups

- Post-use data and use of end-of-life wood building materials (for comparison)
- Post-use data and use of end-of-life PVC construction materials (for comparison)
- Post-use data and use of end-of-life metal building materials (for comparison)

A-6 / HVH / LCT documents on product groups and buildings

Products

- BIZ numbers in wood and wood products
- Hazardous substances in construction products (REACH risk factor)
- raw materials in construction products
- REACH risk for wood product groups versus metal and plastic product groups (for comparison)

Product group profiles

- Product group in profiled wood
- Product group profile wood panels
- NaWaRo Insulation Product Group Profile
- Product group for wooden facades with profile
- Wood flooring with product group profile

construction data

- construction data

A-7 / HVH / LCT documents on classical life cycle assessments

- Overview of Life Cycle Assessment Data of Wood Building Materials from EPD
- LCA data in general
- Weaknesses of classic EPD

Annex A-8 / HVH / LCT documents bioenergy

List Energy - Bioenergy

- Non-renewable electricity sector (data, factors)
- Non-renewable heat sector (data, factors)
- Non-renewable fuels (data, factors)
- Renewable electricity sector (data, factors)
- Renewable heat sector (data, factors)
- Renewable fuels (data, factors)
- Net reduction of emissions for the electricity sector (RED)
- Net emissions avoided for the heating sector (RED)
- Emission factors of conventional fuel upstream chains (RED)
- Emission factors of upstream biofuel chains (RED)
- Emission factors of upstream solid biomass chains (RED)
- Generic data for energy biomass cultivation (RED "cee")

- Energy biomass for generic data processing (RED "ep")
- Generic Data Transport Guardrails Energy Biomass (RED)

Other lists and information

A-9 / HVH / LCT Various

The latest white papers

- "Raw materials for wood products: climate and environmental considerations on the origin of raw materials" (iB 2022)
- "Raw materials for aluminum products: climatic and environmental considerations on the origin of raw materials" (iB 2022)
- "Raw materials for plastic products: climatic and environmental considerations on the origin of raw materials" (iB 2022)

A-10 / Contact addresses

If you have any questions or comments, interested parties are welcome to contact:

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