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Diploma Thesis

Comparison and analysis of life cycle assessment methods

Submitted in satisfaction of the requirements for the degree of
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von

Margarita Fedorova, BSc.
Matr.Nr.: 11741934

Betreuung: Univ.-Prof. Dipl.-Ing. Dr.techn. **Iva Kovacic**
Dipl.-Ing. **Stefan Schützenhofer**
Institut für Hoch- und Industriebau
Forschungsbereich Intergrale Planung und Industriebau
Technische Universität Wien,
Karlsplatz 13/210-01, 1040 Wien, Österreich

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Abstract

The goal of this study is to evaluate three different life cycle assessments such as OneClick LCA, OI3-Index, and EU-Taxonomy, and to apply them to a case study, a residential 7-storey building in Vienna. The results of the selected LCA methods will be compared, and further analysis will address various causes of discrepancies.

Additionally, the thesis focuses on extensive literature research on three LCA methods and includes an overview of state-of-the-art literature, covering aspects such as temporal system boundaries, life cycle phases, environmental indicators, and databases used for each of the evaluated life cycle assessment methods.

Another essential topic in the frames of this master thesis is the evaluation of certification systems, their characteristics and compatibility with LCA methods.

The results have shown significant discrepancies between the methods throughout the life cycle of a building. The findings provide insights into understanding the dependencies of LCA methods from various factors, and in conclusion, recommendations for sustainable decision-making practices in the building industry have been created.

This study offers improvements in life cycle assessment calculations for future researchers by providing a comprehensive analysis of LCA methodologies.

List of Abbreviations

AP	Acidification Potential
BNB	Bewertungssystem Nachhaltiges Bauen
BRE	Building Research Establishment
BREEAM	Building Research Establishment Environmental Assessment Methodology
DGNB	Deutsche Gesellschaft für Nachhaltiges Bauen
DNA	Disassembly Network Analysis
EP	Eutrophication potential
EPD	European Product Declaration
GWP	Global Warming Potential
IBO	Österreichisches Institut für Baubiologie und - ökologie
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LEED	Leadership in Energy and Environmental Design
ODP	Depletion potential of the stratospheric ozone layer
ÖGNB	Österreichische Gesellschaft für Nachhaltiges Bauen
PENRT	Primary energy non-renewable - total
PERE	Primary energy renewable - energy resources
PERM	Primary energy renewable - material
PERT	Primary energy renewable - total
POCP	Formation potential of tropospheric ozone photochemical oxidants

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1. Introduction

1.1 Problem statement

The environmental impact of human activity has become a mainstream discussion topic in recent years. The architecture and construction industry plays an important role in this due to its enormous contribution to energy consumption, CO_2 emissions, and waste generation rates globally. According to studies, the A&C industry is responsible for more than one-third of all waste (Eurostat. 2021) and 50% of all materials used in Europe (Herczeg et al., 2014). Nowadays, there are certain ecological goals, which aim to address environmental challenges and intergrade sustainability on many levels globally. Among some of the official statements and agreements approved by international organizations are United Nations sustainable Development Goals (SDGs) adopted in 2015. Among other issues, it directly relates to ecological sustainability and includes specific targets to be achieved by 2030. Some of the goals are affordable and clean energy, responsible consumption and production, climate action etc.

Lowering global warming to 2 degrees above pre-industrial levels is reflected in the Paris Agreement. In this agreement countries commit to reducing greenhouse gas emissions, helping to adapt sustainable efforts and support climate finance.

In the recent years the set of policy initiatives and agreements "Green Deal" has gained prominence in the European Union. This initiative commits to achieving climate neutrality in the EU by 2050. It includes significant reduction of greenhouse gas emissions to net-zero levels, promotion of circular economy, transition to clean energy, protection of biodiversity and restoration of ecosystems.

This fact draws a lot of attention from architects and engineers and encourages them to promote sustainable practices and create calculation methods to determine the environmental impacts, using various indicators. Today many assessment methods provide valuable information about building materials and construction processes and take into consideration not only operational phase of buildings, but material extraction, manufacturing, transportation, demolition, and end-of-life.

However, due to inconsistent data availability and quality, particularly for regions and specific building components, there are some challenges, which affect the accuracy and comparability of results conducted by different assessment methods.

This thesis aims to describe the challenges of a very complex approach such as life cycle assessment and factors that can influence accuracy and transparency of the results.

1.2 Motivation

As it was mentioned before, the A&C industry is responsible for a significant share of energy consumption, greenhouse gas emissions, and waste production. As it has been contributing to climate change, it is crucial to adopt sustainable practices for buildings to minimize these negative environmental impacts. This is a necessary step towards a fundamental change to a more sustainable and circular future. We can see that nowadays, many countries implement regulations and standards for sustainability to improve energy efficiency and durability of buildings and to pursue renewable energy sources. To achieve these goals, it is important to integrate LCA into the early stages of building design and make it a part of the decision-making process.

Aa a result, the global market tends to offer its consumers new products with lower environmental footprints to achieve sustainability. Such products are becoming more desirable for businesses and consumers. Over time this growing demand will become prevalent in the market and change the perception of building industry significantly.

Although sustainable practices get more and more attention, there is still a lack of research in this area and some issues that are still not solved. Among them is a neglect of a whole perspective necessary for the effective LCA assessment. The focus lies primarily on individual building components or specific phases of the life cycle (Atsushi Takano, 2014). Another example is problematic comparability between different LCA methods for the same projects due to differences in databases of building materials, different system boundaries, and functional units. This thesis aims to address this issue by comparing different LCA methods applied to one building project and identifying the differences. The findings of this analysis will provide valuable information about the individual advantages and disadvantages of each method and the causes of discrepancies in the results.

1.3 Scope

The scope of this thesis covers a comprehensive analysis of different life cycle assessment methods in order to discover their differences in methodologies, results, and user experience. The findings will provide a foundation for a discussion about the causes of differences in results of calculations and ways to achieve transparency in calculations and avoid factors, which lead to discrepancies in assessments.

The focus of the literature research is primarily on life cycle assessment methods and the environmental performance of the case study. Secondary focus is on certification systems and the ways they can be incorporated into examined calculation methods. The thesis will describe the main certification systems such as BREEAM, DGNB, and LEED, including their characteristics and features. However, the analysis of certification systems is outside of the scope of this study.

A literature review and case study will be conducted in the frames of this thesis. The life cycle assessment methods will be applied to a case study and deliver valuable findings for research.

The analysis is conducted for a residential building located in Vienna, Austria. The construction of the building takes place in 2024.

The scope of this thesis involves comparing and analyzing three specific Life Cycle Assessment (LCA) methods: OneClick LCA, Oi3-Index, and EU-Taxonomy. Each method offers unique approaches to evaluating the environmental impacts of residential buildings, considering factors such as embodied carbon, energy consumption, and resource depletion.

The findings will be analyzed and used as a foundation to create a perspective of assessment calculation in general. The comparison will demonstrate differences, similarities, weak and strong points of each calculation method, improving an understanding of aspects which have significant effects on results.

2. Methodology

This section outlines the approach adopted to achieve the objectives of comparing and analyzing three different life cycle assessment (LCA) methods: OneClick LCA, OI3-Index, and EU-Taxonomy, in the context of environmental impact assessments for buildings.

Literature Review: A literature review has involved detailed information about the chosen LCA methods and their characteristics, such as system boundaries, life cycle phases, environmental indicators, and databases. In addition, certification systems have been reviewed as well, in relation to their main features and applicability to LCA methods.

Case Study: The selected LCA methods will be practically applied to a residential building in Vienna. Each of these methods will be conducted for the same calculation periods and identical bill of materials.

Comparison and Analysis: The results of life cycle assessments for various life stages will be compared and analyzed to identify discrepancies and their causes.

Recommendations: Based on the findings resulting from comparison and analysis, recommendations for future practitioners to improve LCA calculations in the building industry will be provided.

By following this methodology, the study aims to contribute to the advancement of knowledge in the field of environmental impact assessments for buildings and provide valuable insights for practitioners and researchers alike.

3. Literature review

3.1 European Standards for LCA

European standards for LCA provide guidance for an assessment of products and processes in a consistent and reliable manner. The environmental impact can be evaluated for the entire life cycle, from raw material extraction to end-of-life disposal and recycling.

- EN ISO 14040: Environmental management - Life cycle assessment - Principles and framework

  This standard provides guidance on defining the scope and goal of a life cycle assessment. This involves identifying the intended application, boundaries, functional unit, and other relevant aspects. EN ISO 14040 describes the process of collecting input and output data and environmental impacts associated with each stage of the product life cycle. It informs how important interpretation of life cycle assessment results is due to uncertainties and limitations of LCA methods. This document acts as guidance for documenting final results of assessments. (EN ISO 14040, 2006)
- EN ISO 14044: Environmental management - Life cycle assessment - Requirements and guidelines

  It is a standard that compliments EN ISO 14040 and provides a detailed description of performing a life cycle inventory, methodologies for assessing and comparing environmental impacts. EN ISO 14044 helps to identify significant issues, to conduct sensitivity analysis, and to improve the quality of data. The standard focuses on the requirements for reporting and documenting the results of life cycle assessment. It emphasizes the importance of integrating LCA into a decision-making process. (EN ISO 14044, 2006)
- EN 15978: Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method

  The function of this document is to provide calculation rules for the assessment of new and existing buildings. EN 15978 supports the decision-making process and describes the social and economic aspects of assessment. The technical and functional characteristics of the buildings are not included in this standard. (EN 15978 , 2011)

- EN 15804: Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
  The standard identifies set of rules and requirements to ensure that Environmental Product Declarations (EPD) for construction products are properly presented and verified. (EN 15804, 2012)
- EN 15643: Sustainability of construction works – Framework for assessment of buildings and civil engineering works
  It provides general requirements for sustainable assessment and civil engineering works using a life cycle approach and quantifiable indicators. (EN 15643, 2021)

3.2 General Information about LCA

3.2.1 Scope and intended use

According to EN 15978 the goal of a life cycle purpose of the assessment is to measure the environmental impact of materials. The most important thing before carrying out an assessment is to define the scope and the purpose of the assessment, which shall fulfill the requirements of European Standards.

The intended use of the assessment may be one of the following:

a) assistance in a decision-making process: comparing different design options, comparison between refurbishment, reconstruction, new construction, potential environmental performance improvements;
b) declaring performance with respect to legal requirements;
c) documenting the environmental performance of buildings for a certification, declaring environmental performance, labelling, marketing;
d) support for policy development;

The Level of detail of data used for calculations depends on the scope and the intended use of an assessment. The calculation method remains the same. (EN 15978 , 2011)

3.2.2 Temporary system boundaries and functional unit

System boundaries define the scope of the assessment by identifying which elements and components are included or excluded from the analysis. In EN 15978, system boundaries cover all stages of the building's life cycle, starting from the Product stage to Beyond the Building Life Cycle Stage. (EN 15978 , 2011)

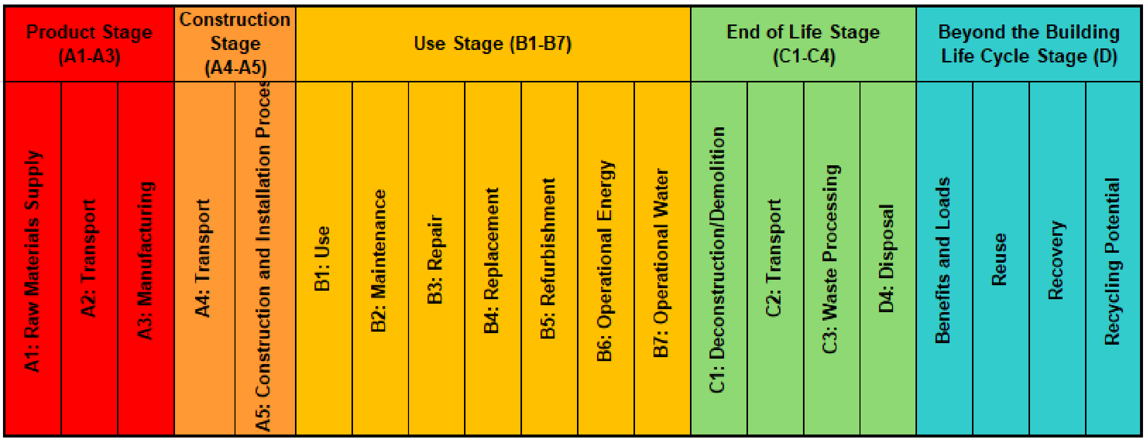


Figure 1. Stages of the building assessment

A new building includes all the stages represented in Figure 1, whereas an existing building excludes the product stage. The processes which took place after the construction process stage should be assigned to the stage where they occur. For example, new windows would be assigned to a “Repair” in the Use Stage and the impacts of production, transport, packaging waste etc. shall be considered in calculations.

The building life cycle consists of 4 boundaries such as:

- Boundary of the product stage (Modules A1 to A3)

  The first stage contains of “cradle to gate” processes for the materials used for a construction.

- Boundary of the construction process stage (Modules A4 and A5)

  The transport of materials and equipment necessary for the building process are represented in Module 4. The Module A5 covers processes such as transport and storage of the material within the site and installation.

- Boundaries of the Use stage (Modules B1 to B7)

  The use stage involves the time frame after the construction work is done and before the building approaches its final phase of life – deconstruction/demolition. This period takes into account functions such as operational energy use (heating, cooling, lighting, water supply), maintenance (cleaning of interior and exterior of the building); repair, replacement, and refurbishment include the production and transportation of a new component, the installation process, waste management and end of life stage of the removed component.

  Moreover, appliances that are not building related, for example, washing machines, refrigerators, office electronics and their energy use may be assessed as well in a separate calculation.

The exported energy should be documented and reported but not deducted from the import energy.

- Boundary of the end-of-life stage (Modules C1 to C4)

  When the building reaches its last phase of life, the process of demolition/deconstruction starts. This involves all the in-site and off-site operations and transportation necessary for the deconstruction process. After this the site shall be removed from all the materials and ready for future use. The materials of the building can be recovered, reused, recycled, or disposed on landfills and incinerations. These scenarios are determined by the system boundary.

Functional unit is a reference unit that defines what is being studied and to which the input and output data is related. The functional units can be expressed in m, m^2, m^3, kg etc. Unfortunately, the functional unit is related to a specific material and does not represent the impact of a whole building and can lead to inaccurate results.

The **reference period** defines the amount of time over which the environmental impacts of a building are assessed. According to EN 15978, the reference period typically covers the entire life cycle of the building, from raw material extraction and construction to use, maintenance, renovation, and end-of-life disposal or recycling. However, the duration of the reference period may vary depending on the specific goals and scope of the assessment but is typically long enough to capture significant environmental impacts associated with the building's life cycle. (EN 15978 , 2011)

3.2.3 Environmental indicators

These indicators represent the environmental impacts caused by material or a product of assessment. Having such indicators helps scientists, investors, and politicians to compare the climate impacts of different substances and materials. (EN 15804, 2012).

Here are the most used indicators:

- **Global warming potential-total, GWP-total**

  This indicator describes the ability of greenhouse gases to trap the heat compared to a carbon dioxide, which is the reference gas with a GWP of 1. For example, methane has a GWP of 28-36, which means it is 28-36 times the warming potential of CO_2. It is used to calculate an impact over a specific period of time, usually 100 years. The indicator "GWP-total" is the sum of GWP-fossil and GWP-biogenic. (baubook GmbH, 2024)

- **Global warming potential – fossil, GWP-fossil**

  The GWP fossil indicator evaluates the global warming potential of greenhouse gas emissions and sequestration resulting from the oxidation or reduction of fossil fuels or fossil carbon-containing substances, such as combustion and landfilling. Additionally, it includes the binding or emission of greenhouse gases in inorganic materials, for example, calcination and carbonation of cement- or lime-based building materials. The impacts of greenhouse gases are measured over a 100-year time horizon in kilograms of CO2-equivalents (kg CO2-equivalent) using characterization factors from ÖNORM EN 15804, Annex C.

  Due to the importance of GWP-fossil and GWP-biogenic in providing essential information about GWP, it is recommended to present GWP-fossil and GWP-biogenic separately. Only data that includes this information can be used to calculate the Oekoindex (OI). (baubook GmbH, 2024)

- **Global warming potential – biogenic, GWP-biogenic**

  The indicator "GWP-biogenic" takes into account the amount of CO_2 absorbed from the atmosphere during the growth of biomass and bound over the lifetime of the material, as well as biogenic emissions into the air through oxidation or decay of biomass (e.g. combustion). Transfers of biogenic carbon from previous product systems into the product system under investigation or transitions into subsequent product systems (e.g. wood recycling) must also be taken into account. The uptake of biogenic CO_2 into biomass and transitions from previous product systems must be presented in the life cycle assessment as a negative value (-1 kg CO_2-equ./kg CO_2), emissions of biogenic CO_2 from biomass and transitions from biomass into subsequent product systems must be characterized as a positive value (+1 kg CO_2-equ./kg CO_2). (baubook GmbH, 2024)

- **Depletion potential of the stratospheric ozone layer, ODP**

  ODP measures the ability of a substance to deplete the ozone layer. The ODP is a dimensionless ratio relative to the ozone-depleting potential of trichlorofluoromethane (CFC-11), which is equal to 1. (baubook GmbH, 2024)

- **Acidification potential of land and water, AP**

  Some of the substances are able to increase the acidity of soil and water and harm soil quality, plant health, aquatic life, and ecosystem functioning. (baubook GmbH, 2024)

- **Eutrophication potential, EP**

  This environmental indicator indicates an excessive amount of nutrients in different water bodies. However, the increased level of eutrophication can lead to negative impacts as a result of rapid growth of algae. Algal blooms can block the sunlight, making it difficult for other aquatic vegetation to grow. Some of the algae produce harmful toxins. Additionally, during the decomposition process of an algae, bacteria consume oxygen, and this results in a lowered level of oxygen, which can harm aquatic creatures. Eutrophication potential indicates the ability of substances to contribute to the process described above. (baubook GmbH, 2024)

- **Formation potential of tropospheric ozone photochemical oxidants, POCP**

  Some substances can contribute to the formation of ozone and other oxidizing pollutants in the lower atmosphere, in other words troposphere. Increased concentration of tropospheric ozone photochemical oxidants can reduce crop yield, loss of biodiversity and cause medical conditions (asthma and chronic obstructive pulmonary disease). (baubook GmbH, 2024)

- **Primary energy non-renewable total, PENRT**

  The amount of energy required for production is taken from non-renewable sources such as fossil fuels (coal, oil, natural gas), nuclear power, and other non-renewable resources. (baubook GmbH, 2024)

- **PENRT Primary energy non-renewable – total**

  The total amount of energy which is required to produce a product is called primary energy (PE). The PE is specified in MJ and calculated from the lower calorific value of the energy resources deployed. The primary non-renewable energy indicates all non-renewable resources (crude oil, coal, etc.). (baubook GmbH, 2024)

- **PERT Primary energy renewable - total**

  The total energy resources required to produce a product or service are collectively referred to as the primary energy content (PE for short). The PE is specified in MJ and calculated from the lower calorific value of the energy resources deployed. (baubook GmbH, 2024)

- **PERE Primary energy renewable - energy resources**
  The total energy resources required to produce a product or service are collectively referred to as the **primary energy content** (**PE** for short). The PE is specified in MJ and calculated from the lower calorific value of the energy resources deployed. (baubook GmbH, 2024)
- **PERM Primary energy renewable - material**
  The total energy resources required to produce a product or service are collectively referred to as the **primary energy content** (**PE** for short). The PE is specified in MJ and calculated from the lower calorific value of the energy resources deployed. (baubook GmbH, 2024)

3.2.4 Database

The accuracy of results of any life cycle assessment depends primarily on available data. Database provides necessary input data for a life cycle assessment – environmental impact. Below is a list of sources where this information can be found.

1. **EPD (Environmental Product Declaration) Databases**:
    - Ökobaudat and baubook offers information about building materials, which are used in Austria and Germany.
2. **Life Cycle Inventory (LCI) Databases**:
    - Ecoinvent and GaBi considered to be some of the largest databases with building materials, processes and products. These databases can be applied to various countries and are relevant to construction in Austria.
3. **Building Material Certification Databases**:
    - BREEAM International and DGNB Navigator provide information about building materials and products and are compliant with their certification systems.
4. **Environmental Databases**:
    - Austrian Standards Institute (Österreichisches Normungsinstitut, ON): Provides access to Austrian and European standards related to building materials, environmental performance, and sustainability, offering guidance for LCA practitioners in Austria.

3.2.5 Embodied carbon vs. operational carbon

Prior to the comparison and analysis of LCA results, it is essential to differentiate carbon emissions. They are divided into two groups: embodied and operational. The operational emissions are caused by the operation of a building, which takes place in the following life cycle stages:

- B6: Energy Operation
- B7: Operational Water

In other words, this encompasses lighting, heating, ventilation, cooling, or air conditioning, and general power usage throughout the building.

The total amount of operational emissions is produced over a specific period of time, for example a lifetime use of building, which could be 50 or more years.

The embodied carbon consists of greenhouse gas emissions, which were generated before the building is completed and encompasses manufacture of materials and construction processes. (One Click LCA Ltd., 2024)

3.3 Certification systems

3.3.1 BREEAM

BREEAM (Building Research Establishment Environmental Assessment Method) was developed by BRE in the United Kingdom and is widely used for assessment and certification of buildings and construction internationally. By now BREEAM has certified 590,000 buildings and das been applied in over 85 countries. (BREEAM, 2024) Several various BREEAM schemes were developed for UK and Internationally to assess buildings at different stages in their life cycle, such as:

- New construction
- In-use
- Refurbishment and fit-out
- Communities
- BREEAM infrastructure

Here only the key features and components of BREEAM International New Construction v6 will be discussed.

The primary goal of BREEAM is to reduce the negative environmental impacts of buildings in a robust and cost-effective manner.

First, it is necessary to determine the scope of a project that is needed: shell only or shell and core. After that, the number of credits for each of the nine sections will be determined. The percentage of credits will be calculated for each section, then multiplied by the corresponding section weighting. The scores are added together and compared to the BREEAM rating benchmark levels. All the minimum standards must be met. If the innovation credits are achieved, then 1% will be additionally added to the final score.

The following are environmental sections with a few categories as an example, which are assessed in BREEAM. These categories must be fulfilled to earn points:

- Management is a category that promotes sustainable management practices in design, construction, commissioning, handover, and aftercare. Sustainable objectives must be set and followed throughout the process.
- Health and wellbeing focuses on visual and thermal comfort, air quality, health, and safety of building occupants. The category encourages the creation of a safe and healthy environment inside and outside of a building. Important criteria are ensuring natural and artificial lightning, appropriate ventilation and thermal comfort levels, sound insulation, accessibility to and from a building.
- Category "Energy" specializes on energy efficient building solutions and equipment that supports the sustainable use of energy in the buildings.
- Transport encourages accessibility of public transport and other alternative solutions such reducing car parking capacity, providing space and services for home office, and other modes of transport. This reduces the CO_2 emissions over the whole life cycle of a building.
- Water promotes conscious water use, reduction of water use, monitoring, detecting, and preventing leaks, modern equipment.
- Materials aim to source material in a responsible way, lower the impacts of extraction, processing and manufacture, recycling, make sure that the materials are produced for durability and resilience, encourage material optimization.
- It is crucial for BREEAM to ensure the reduction of waste from the construction and operation of a building, its diversion from landfill and avoid waste as a result of altering a building.
- Land use and ecology supports the biodiversity and its habitat by encouraging using a previously occupied land, enhancing the value of the site and minimizing the impact in the surrounding area and its biodiversity.

- Pollution addresses the prevention and control of pollution and surface water run-off associated with the building, reduction of air, light, sound, and water pollution.
- Innovation gives an opportunity of innovations to be recognized, which were not included in other criteria.

The building types that can be assessed:

- Residential
- Commercial (offices, industrial, retail)
- Education (schools, universities)
- Residential institutions (care homes, shelters, military barracks)
- Hotel and residential institutions (hotels, hostels, residential training centers)
- Non-standard building types (library, cinema, police station, museum, place of worship)

The schemes in a rating system very from “Pass” (less than 30 points) and “Excellent” (85 or more points). Most of the building, around 75% are rated as “Pass” and less than 1% with are “Outstanding”, they are also called innovators.

To achieve a flexible system, BREEAM offers an opportunity to trade credits from other areas. However, to make sure that the main categories are not overlooked, the certification system created minimum standards for key areas, e.g. energy, water, waste etc. (BREEAM, 2024)

3.3.2 DGNB

DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen) is a non-profit organization that was founded in 2007 with the aim to promote sustainable practices and to accelerate a transformation towards a climate-positive environment. This certification system has spread internationally and has been applied to 10.000 projects in 30 different countries. (DGNB GmbH, 2024)

The rating system for buildings and urban developments consists of six topics including ecology, economics, socio-cultural and functional aspects, technology, processes, and location. The first three are equally weighted in the evaluation, meaning that economic and socio-cultural aspects have the same importance as ecological criteria. This is one of the main differences between DGNB and other certification systems. The other three have a cross-section function within the system and are weighted differently. The evaluation is always based on the entire life cycle, and the specific criteria varies on the project type.

ÖGNI (Austrian sustainable building council) is a non-profit organization, which operates in Austria and was based in 2009 according to principles of DGNB. This certification system assesses the performance of the buildings and real estate developments based on the same criteria as DGNB.

Figure 2. Structure of DGNB system, *(DGNB GmbH, 2024)*

The focus of ecological quality is on the minimization of impacts on the environment, waste generation and conscious use of resources over all life stages of buildings.

Economic quality considers the costs of the whole life cycle and makes sure that the financial resources are used in a meaningful manner. To obtain economically optimal solutions of buildings on a long term, the life cycle calculations should be carried out more regularly and in the early stages of planning. This way an efficient comparison between cost calculations of buildings with similar use and functionality can be determined, which can also let the project participants understand how good their project is in comparison to others. Therefore, the cost calculations in early stages and their optimization are positively graded and granted additional points.

Socio-cultural quality aims to evaluate thermal comfort of the building, air quality, sound insulation, which are contributors to the well-being and health of those who use these buildings. Visual comfort is another criterion for assessment. This criterion takes into consideration the amount of natural light because of its positive effect on the physical and mental health of humans and its energy-saving potential. Amenities to provide additional service or recreation opportunities enhance the overall experience and functionality of a building and increase its value.

For a technical quality it's important to design a good building envelope. It is important for thermal comfort and to minimize the energy costs. Another criterion is the ability to incorporate renewable energy technics as well as a possibility to adapt to the changing technical advancements with minimal effort. Circular economy and sustainable design of a transport infrastructure are also subjects to evaluation in DGNB.

Process quality aims to increase the quality and transparency of planning and construction processes, to integrate sustainability aspects already in a tender phase, to minimize negative effects from a construction site on the environment etc.

Location quality assesses the impacts of a project on the environment and vice versa. Meaning protection of people and buildings against extreme natural events. Here DGNB also focuses on reducing the number of motorized vehicles by improving a transport infrastructure, making it more sustainable and convenient. Moreover, the proximity to social and commercial facilities is vital in frames of DGNB ranking system. The satisfaction level of people from a project is improved by having short distances to facilities of daily needs, pedestrian and bicycle ways and reduced number of motorized vehicles, therefore lower values of sound pollution.

The projects will be evaluated according to the quality standards described above. In overall, there are 4 levels of certification. (DGNB GmbH, 2024)

	DGNB PLATIN	DGNB GOLD	DGNB SILBER	DGNB BRONZE*
Gesamterfüllungsgrad	ab 80%	ab 65%	ab 50%	ab 35%
Mindesterfüllungsgrad	65%	50%	35%	— %

Figure 3. Grading system of DGNB, *(DGNB GmbH, 2024)*

3.3.3 LEED

LEED stands for Leadership in Energy and Environmental Design and was developed be non-profit organization U.S. Green Building Council (USGBC). This rating system provides a framework for building design, construction, operation, sustainable buildings, and infrastructure projects. LEED is widely used and was applied to 197,000 projects in 186 countries and territories. (U.S. Green Building Council, 2020)

The rating systems of LEED cover a wide range of project types, such as:

- Building Design and Construction (BD+C) includes new constructions and major renovations
- Interior Design and Construction (ID+C) for complete interior fit-out projects
- Building Operations and Maintenance (O+M) includes improvement works for existing buildings
- Neighborhood Development (ND) for projects containing residential and non-residential building
- Homes for single or multi-family homes
- Cities for entire cities and its sub-sections

Firstly, the project must prove that it fulfills the three minimum program requirements:

1. Must be in a permanent location on existing land

   This means that the movable buildings are not subject to LEED and modular structures must be installed on land.
2. Must use reasonable LEED boundaries

   The project must include all the areas and facilities that support the operations of a building. The LEED boundary cannot exclude portion of land or space to give an advantage in fulfilling the requirements.
3. Must comply with project size requirements

   There is a limit for the size of a project that LEED system can accurately assess. For LEED BD+C the project must include minimum 1,000 ft^2 (93 m^2) of gross floor area.

LEED requires minimum 40 points for a certification. Overall, 110 points are available. There are four levels of certification:

- Certified: 40-49 points
- Silver: 50-59
- Gold: 60-79
- Platinum: 80+

For LEED building Design and Construction, the criteria are:

- Integrative Process

  In this criterion it is required to improve the performance and cost-effectiveness of a project and includes the establishment of energy and water performance targets, to improve resilience to natural hazards.

- Location and Transportation

  This criterion supports the creation of comfortable and healthy communities for humans and protecting the land and wildlife habitat at the same time. This involves reducing vehicle distance traveled, promoting walkability, bicycling and low or no carbon transportation, minimizing the parking lots and promoting alternative to fueled automobiles, and building in area with existing infrastructure.
- Sustainable Site

  The goal is to mitigate pollution from construction activities and to create a pleasant environment for natural habitats. This involves control of soil erosion and waterway sedimentation, creation of open spaces for interactions with the environment, social interactions, and physical activities, enhancement of nighttime visibility and reducing heat islands.
- Water Efficiency

  It is required to reduce water consumption and apply additional water-saving opportunities.
- Energy and Atmosphere

  Reduction of energy use and greenhouse gas emissions, their environmental and economic impacts, application of alternative solutions to energy saving, and elimination/reduction of ozone depletion and global warming potential.
- Materials and Resources

  The objectives are to reduce waste generation and encourage recycling, responsible sourcing and manufacturing methods, reducing the release of toxic chemicals, promoting material reuse, waste prevention, and sustainable building practices.
- Indoor Environmental Quality

  The goal is to create a healthy and comfortable indoor environment. The solutions are improvement of indoor air quality, prevention of exposure to tobacco smoke, enhancement of ventilation and filtration, comfortable temperature and sufficient lighting.
- Innovation

  Credits of this criterion are granted to projects which achieve exceptional or innovative performance to increase human and environmental health. (U.S. Green Building Council, 2020)

3.4 EU-Taxonomy

The general goal of the EU-Taxonomy is to address global environmental challenges by establishing the criteria to determine whether a financial investment can be considered environmentally sustainable or not. It makes it possible to reorient the financial flows towards sustainable activities. It was developed by the European Union as part of a bigger effort to promote sustainability. The European Commission played a crucial role in developing the taxonomy framework. To ensure the effectiveness of the EU-Taxonomy a collaborative effort of a wide range of experts from various environmental organizations, academia, financial institutions, and relevant parties was necessary.

On 18 June 2020 the EU Taxonomy Regulation (EU) 2020/852) was officially adopted and established the framework for the taxonomy. According to this regulation a financial activity can be qualified as environmentally friendly if it contributes to one or more environmental objectives:

- climate change mitigation
- climate change adaptation
- sustainable resource use and protection of water and marine resources
- transition to a circular economy
- pollution prevention and control
- protection and restoration of biodiversity and ecosystems.

Apart from this the Regulation requires companies and financial provide information on the environmental sustainability of economic activities and ensure that they are aligned with the taxonomy criteria. This way the investments are being channeled into activities with transparency and accountability. The EU-Taxonomy aims to remain effective and has established various activities, such as guidelines, stakeholder consultation, monitoring, and reviews. In addition, the EU Taxonomy aligns with scientific discoveries and technological advancements and updates its framework. (European Parlament, 2020)

3.4.1 LCA in EU-Taxonomy

The LCA can be conducted using EN 15978: Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method.

"Platform on sustainable finance: technical working group part b – Annex: Technical screening criteria" document itself is not a substitute for comprehensive LCA guidelines such as EN 15978 or ISO 14040/14044, it can complement LCA methodologies by providing insight into the specific environmental objectives and criteria relevant to sustainable finance and investment decisions. It can help ensure that LCA studies conducted within the context of the EU Taxonomy are aligned with the taxonomy's criteria and objectives. (Platfrom on sustainable finance, 2022)

The calculation tool used for an LCA in Austria is an online tool on the platform baubook.at.

For the EU the BG 6 is usually used.

The following indicators are calculated in EU-Taxonomy:

- Impact indicator over the life cycle including end-of-life phase without operating energy and transport for phases A1-A3, B4 and C1-C4
- Special case of Global Warming Potential GWP
- Impact indicator for a production phase A1-A3
- Global Warming Potential according to EU-Taxonomy

3.5 Oekoindex OI3

The Austrian Institute for Building and Ecology (IBO) is a research and consulting institute, which was founded in 1985 in Vienna, Austria. IBO helps to promote sustainability in architecture and construction sector of Austria by conducting research projects, providing consulting services, offering training programs, and developing regulations and standards on international level.

IBO also focuses on building certification and assessment. This includes development and implementation of certification systems and assessment tools to evaluate the environmental performance of buildings such as OI3 calculation method for building materials, constructions, and whole buildings. It was developed in 2003 and based on the IBO reference value table for building materials, which can be used in various computer programs such as eco2soft. This tool simplifies the calculation for a life cycle assessment for all spacial system boundaries (from BG0 to BG6) and calculates environmental indicators. Users are able to predefine components and achieve detailed calculation with high quality results. eco2soft provides a large catalog with reference building components.

Nowadays eco2soft is working on implementing BIM and calculation with GaBi-based data. (baubook GmbH, 2024)

3.5.1 Indicators and characteristic values

OI3 calculation method defines the following basic indicators:

- ΔOI3 – indicator for a building material
  Demonstrates how much a material influenced an amount of points of $\Delta IO3_{KON}$
- $IO3_{KON}$ – indicator for a square meter of a construction
- Oeko-Indicator OI3 for a building

Apart from this the OI3 focuses on greenhouse gas emissions potential (GWP), acidification potential (AP), and non-renewable primary energy (PENRT). The OI3-Indicators can be referred to Gross Floor Area (BGF), reference are (GZF), characteristic length (lc).

To perform the OI3 calculation it is important to use materials with physical and ecological characteristic values. The calculation is to be carried out according to IBO guidelines. (IBO GmbH, September 2023)

3.5.2 Spatial system boundaries

In the context of this method IBO has developed special system boundaries, which define which elements, parts and components of buildings should be evaluated, and whether their service life should be considered or not. IBO has offered six flexible spatial system boundaries starting from BG0 (TGH), which describes the thermal envelope of the building. Due to the importance of material efficiency the system boundary BG3 is recommended. BG2 and BG4 are currently not used. (IBO GmbH, September 2023)

Table 1. Concept of spatial system boundaries, *(IBO GmbH, September 2023)*

System boundary	Description
BG0	Components of the thermal building envelope excluding roof covering, moisture seals, rear-ventilated facades including intermediate slabs
BG 1	Components of the thermal building envelope (complete components) including intermediate slabs
BG 2	BG1 including interior walls (dividing components, excluding door elements)
BG 3	BG1 incl. interior walls (total, excluding door elements) incl. basement components (incl. cellar partition walls, strip or point foundations) incl. unheated buffer rooms (structure complete) excl. open access areas (staircases, arcades, loggias, balconies, etc.)

BG 4	BG3 including open access areas
BG 5	BG3 including open access areas including building services
BG 6	BG5 including all outdoor facilities (carport, bicycle parking spaces, etc.) including outbuildings

3.5.3 Specifications for time system boundaries

The cycles of material replacement will be calculated based on the service lives of materials. OI3 calculation provides a list of standardized service lives for various materials. They can be changed only in exceptional cases.

The calculation period for all buildings can be a maximum of 50 years due to the conversion of energy systems.

Replacement of materials is not included in BG0. In some cases, it can be included in BG1 and starting from BG3, the replacement must be included. Disposal phase C1-C4 can be included in BG5 and BG6. (IBO GmbH, September 2023)

Table 2. Service life catalog 2018, *(IBO GmbH, September 2023)*

Construction	Description	Service life
Primary construction	Load-bearing constructions	100 years
Secondary construction	All construction layers except: windows, WDVS, building seals/films, Floor coverings and building technology components	50 years
Windows	Glazing, frames, window components	35 years
Thermal insulation	Thermal insulation composite systems made of MW plaster base boards, EPS-F, mineral foam panels, cork insulation panels, Hemp insulation panels, etc.	35 years
Mortar	Plasters including substrates	35 years
Seals/Foils: 35a	Aluminum-bitumen sealing membranes, aluminum	35 years

	vapor barrier, bitumen, bitumen paint, bitumen cardboard, etc.	
Seals/Foils: 25a	Construction films made of rubber (EPDM), PE and PVC sealing membranes, construction paper, others. Waterproofing except bituminous Seals, metal-clad foils, etc.	25 years
Floor coverings: 50a	Solid wood floors, solid parquet, ceramic Tiles, natural stone, artificial stone, etc.	50 years
Floor coverings: 25a	Multi-layer parquet, laminate floors, linoleum, PVC flooring, polyolefin flooring Base of PE and PU, rubber flooring, Rubber studded covering, etc.	25 years
Floor coverings: 10a	Cork, corkment, textile floor coverings, etc.	10 years
Floor and wall finishes	Screed coatings, varnishes, wall paints, wallpapers, etc.	10 years
Tertiary construction	Technical building equipment TGA (depending on components)	20, 50 years

3.5.4 Interpretation of results

For a simplicity of understanding the calculation results, OI3 has developed OI-Classes, identical to energy certificates. The classes are defined for each system boundary to better demonstrate optimization potential. Classes can also be used to represent partial results, for example GWP and EI10 for all system boundaries. (IBO GmbH, September 2023)

3.6 OneClick LCA

OneClick LCA is a user-friendly online software platform that was developed specifically for Life Cycle Assessment (LCA) and environmental performance analysis for building, products, and infrastructure. The company behind OneClick LCA is Bionova Ltd. has been involved in the field of sustainability and environmental consulting for many years.

The platform is able to conduct an analysis across all the stages of life cycle: from raw material extraction to end-of-life disposal and beyond the building life cycle stage: reuse, recovery, and recycling. (One Click LCA Ltd., 2024)

One Click LCA calculated the following environmental indicators:

- Global warming [kg CO2e]
- Biogenic carbon storage [kg CO2e bio]
- Ozone Depletion [kg CFC11e]
- Acidification [kg SO2e]
- Eutrophication [kg PO4e]
- Formation of ozone of lower atmosphere [kg Ethenee]
- Abiotic depletion potential (ADP-elements) for non-fossil resources [kg Sbe]
- Abiotic depletion potential (ADP-fossil fuels) for fossil resources [MJ]

It is possible to overview the different environmental impacts, such as greenhouse gas emissions, energy consumption, water use etc. in detail, which allows to make decisions for improvements easier. Apart from that, the calculations for carbon footprints are reported automatically. The users are provided with detailed diagrams, which allow to analyze and quantify the carbon emissions of a project. The tool creates customized visualizations to communicate the LCA results to other project participants and stakeholders.

Another progressive feature of this platform is the possibility to import building models into the platform and integrate the Building Information Modeling (BIM) software such as Revit, ArchiCAD and Tekla.

Service life values for materials to calculate impacts from replacement and disposal can be set by default or changed according to users´ needs. Each material needs to be delivered from a manufacturer to a building site. This distance is an important variable in calculation and must be defined either by a default transportation distance or the value must be edited by user.

The impacts from manufacturing the building materials depend on the manufacturing country. The local compensation factor aims to adjust the values for an electricity and represent the manufacturing in the chosen location. OneClick LCA uses the methodology of CEN/TR 15941:2010 to transform the values and match them to different location. (One Click LCA Ltd., 2024)

3.6.1 Database

OneClick LCA has access to various databases of environmental construction data, which consists of freely and publicly available LCA data, which undergoes a quality control system before becoming a part of this database. This verification is approved by Building Research Establishment (BRE)[1]. The platform also has a wide range of EPDs from all around the world. Moreover manufacture-specific data from European and international material producers are present in a database, which improves the precision of calculations. Country specific average data is also integrated into OneClick LCA (Ökobaudat, INIES etc.). If areas for which an assessment needs to be completed do not have a comprehensive database, then the tool can offer a local compensation methodology. This allows users to get data that matches the local conditions. Manufacturers are welcome to become a part of the One Click LCA database and submit their data. Among the data sources are baubook, ecoinvent, Oköbaudat, IBU and many others. (One Click LCA Ltd., 2024)

The tool offers three options for finding and selecting materials:

1. Exact materials

   In this case the user needs to choose the exact or similar material from a manufacturer that is going to be used for a project.

2. Closest match

   If it is not possible to find an exact material it is allowed to find a similar construction product from the same or neighboring country.

3. Use generic data

   Choosing a generic product is another possibility to find suitable data.

   Generic data might have a format of EPD, but it is based on average emissions and can be chosen when the user is not sure which material to use or when it is not possible to find the exact material. There are three sources of generic materials:

   - Generic data in the form of EPD

     The association of manufacturers of specific products creates a generic EPD based on the range of these specific products existing on the market.

[1] BRE is research and consulting organization, established in 1921 in United Kingdom. This organization aims to improve the environmental performance and sustainability of areas such as architecture, construction, and real estate.

- Generic data from generic databases (carbon tools)
  This data can be found in local and global carbon tools, which offer data that is often carbon only. There are not many locally relevant generic databases for many countries.
- Generic data from OneClick LCA
  Specialists of OneClick LCA have been creating generic data and publishing new options regularly. There are already hundreds of generics that are paired with the tool. (One Click LCA Ltd., 2024)

3.6.2 Compliance with certification systems

OneClick LCA can be used in conjunction with 80+ certification systems, including LEED, BREEM, DGNB and others. The users are able to ensure that the assessment is adapted properly and fulfills the necessary requirements.

DGNB

In OneClick LCA it is possible to complete the entire DGNB certification progress and to obtain additional points for the DGNB criteria, such as ENV1.1 "Analyze of impacts on a life cycle" and ENV 2.1 "LCA Primary energy" available for DGNB German 2012-2015-2018 and DGNB International 2012-2015 and 2020.

The scope of DGNB includes the life cycle stages A1-A3, B4, B6 and C3-C4. D1 and D2 are also included but are reported separately.

Users can input data such as building materials, energy and water consumption, waste generation etc. and analyze this data to assess the environmental impact over the whole life cycle of a building. The platform provides guidance on how to meet the criteria of DGNB and to track the progress and identify areas for improvements to achieve certification. Users are provided with reports and documentation that describe compliance with DGNB and enable modifications in choice of materials, operational strategies, when needed.

BREEAM

OneClick LCA is a great tool to conduct a BREEAM assessment. It was awarded a 100% quality score by BRE and delivers the maximal LCA credits for any international BREEAM project.

The concept is the same as for DGNB. Users import the data, for example energy performance and a list of materials. Then the received data is automatically calculated and transformed into an LCA report. After this, users can identify the hot spots and make improvements and deliver better results. Moreover, the database is supported by a localization mechanism and ensures compliant results. (One Click LCA Ltd., 2024)

OneClick LCA allows to achieve the maximum score and exemplary credits, if available, for several criteria. As an example, Mat 01: "Life Cycle Impacts" (5 credits + 1 exemplary credit + 1 EPD credit). The better the analysis, the more points users will be able to achieve. The quality depends on the LCA tool, which defines 70% of the credit potential) and the assessment scope (30% of the credit potential). The more different building materials are included in a calculation the better. And because the OneClick LCA is the highest rated tool for BREEAM, users can already gain 70% of the score.

Not all the stages of a life cycle need to be included in a calculation to achieve Mat 01: A1-A3, A4, A5, B1, B4-B5, B6, B7, C1-C4 & D.

The platform (One Click LCA Ltd., 2024) allows users to choose calculation period and therefore define the number of replacements. The service life of materials is also dependent on the selected calculation period. The costs for refurbishment and replacement of materials will be calculated based on the area of a building. Operational costs depend on energy and water consumption.

Other criteria, which can be assessed in OneClick LCA:

Man 02:

- Life Cycle Cost and Service Life Planning, including elemental Life Cycle Cost (2 credits)
- Component level Life Cycle Cost (1 credit)

Man 03:

- Responsible Construction Practices and Monitoring of Construction Site Impacts (2 credits)

Man 05:

- Aftercare (1 exemplary credit)

Mat 03:

- Responsible for Sourcing of Construction Products (3 credits + 1 exemplary credit)

Ene 04:

- Low and Zero Carbon Technologies (1+1 credits, applicable up to version BREEAM International 2013) (One Click LCA Ltd., 2024)

LEED

To perform a Whole Building LCA according to LEED requirements, users should create a baseline design by importing BIM models or manually input data. Then assess the project and analyze the results. After that demonstrate design alternatives and deliver reports (One Click LCA Ltd., 2024).

There are a few options for creating a baseline offered by OneClick LCA:

- Option 1: Using the proposed building analysis

It is believed to be the most efficient strategy for the majority of projects. To perform the analysis, users must create a copy of the existing design, evaluate different alternatives, and then compare the existing design with the proposed design and analyze the percentage difference. Meanwhile, it is vital that floor area, locations, function, energy performance remain the same.

- Option 2: Using an energy model

For this strategy the baseline for comparison in environmental performance of building design is an energy model. The baseline model should comply with ASHRAE 90.1 appendix G, which is required for LEED v4: 2010 or LEED v4.1: 2016 certifications.

The floor area and directorial exposure must be the same for different variants. The site of the windows and skylight should remain similar. The alternative model must have similar R-value, U-value, F-factor to maintain similar energy performance between existing and alternative buildings. Like in the previous option, users should create a copy of the existing design, consider alternatives while maintaining equivalent energy performance, saving final results, and compare the results.

- Option 3: Using early stages or alternative design models

This approach allows having suitable alternatives for a project in the early stages. However, if the project design has undergone significant changes, users might need to change their design as well. Materials of alternative design should have similar R-value, U-value, F-factor to maintain similar energy loss. To complete the analysis, users should create alternative copies of the design in early stages.

- Option 4: Using a benchmark or archetype building

If previous options are not feasible, creating an archetype building with typical local structures can serve as the baseline. The alternative geometry can be chosen as long as floor area, directorial exposure, window size and placement remain the same. Model alternative enclosure materials with similar R-value/U-value/F-factor to maintain consistent energy loss through the structure. (One Click LCA Ltd., 2024)

4. Case study

4.1 Methodology

The goal of this case study is to perform a life-cycle assessment for a new residential building, calculate its environmental performance using three different methods such as OneClick LCA, Oi3-Index and EU-Taxonomy, identify which components are responsible for the main impacts, conduct a comprehensive comparison of three different results, find out how much the environmental impacts of materials vary, and which factors have caused these deviations. The process of calculations will be documented, describing the specifications and issues that have occurred during the input of data and calculation. The results will be compared and used in the further discussion.

The Institute of Building and Industrial Construction has provided a 3D-model of a project in pnl-format and an extensive Excel-file containing information about the floor area, celling heights, construction elements, their components, and dimensions.

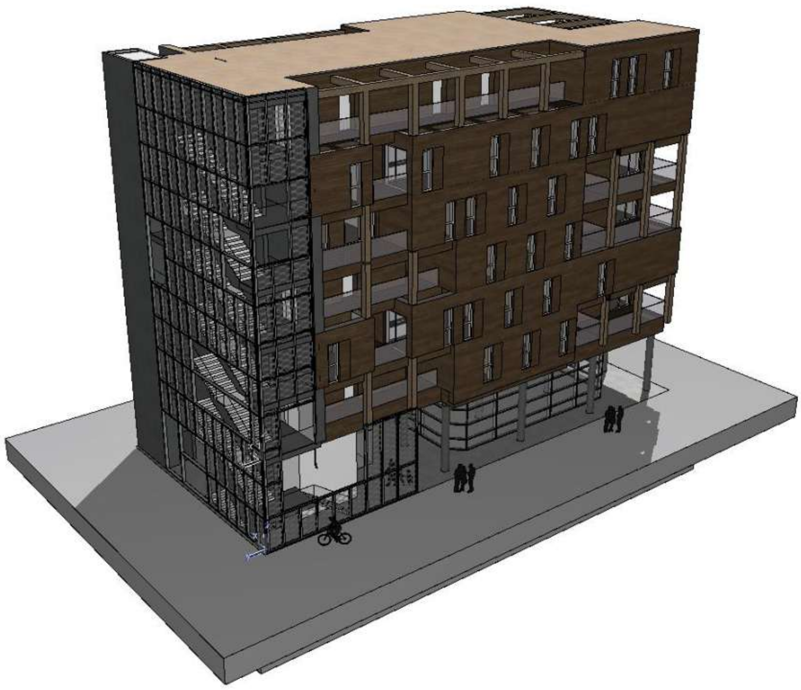


Figure 4. Case study, 3D-Model

Table 3. Key data

Building type	Apartment building
Gross Floor Area	3.577
Gross Volume	11.929
Number of storeys	9
Construction	Wood load-bearing structure

The calculation period for the case study is 50 years and 100 years, which covers extraction of materials and construction to use phases. The Gross Floor Area of the building is 3.357 m^2.

The end-of-life phase and cost calculations are beyond the research and will not be discussed in frames of this thesis.

4.2 Description

The selected case study is designed to be located on Eileen-Gray-Gasse 2, 1220 Vienna, Austria, a 7-storey residential building with a rectangular shape in profile and layout. The northern half of the ground floor is equipped with 2 open storage spaces for bicycles, the construction system is made of timber frame. which are located across the outer side of the building and 3 more storage spaces within the ground floor area, as well as garbage room, storage space for strollers, small free space for residents. The southern part of the ground floor is designed for a non-heated space covered in a glass facade and could be used for commercial purposes. On premises on the east side of the building playing ground with a sand pit, grass surfaces and a parking spot for a fire engine are located. The residential building has one underground floor equipped with storage rooms for residents. The upper floors are purposed for dwellings, hallways, and common loggias, which from an irregular layout for each floor. The dwellings and the hallways have access to open loggias.

The building structure consists of reinforced concrete walls and columns in the underground and ground floor. The vertical bearing elements of upper floors primarily consist of timber columns and cross-laminated timber walls, the horizontal bearing elements are made of cross-laminated timber. There is one staircase, and one elevator shaft located in the northern side of the building, they form a separated section, and their structure consists of reinforced concrete going all the way from the ground floor to the 7th floor.

The envelope around apartments consists of cladding wood, fiber-cement plates, air chamber, wind break, insulation, and vapor barrier. The envelope of the staircase partially consists of thermal insulation with a final coating on top or no layers on the concrete if the staircase connects to non-heated spaces. The other part is covered with steel façade panels with openings. Some of the spaces on the ground floor use a metal grid and the area for commercial purposes is covered with glass façade.

The flooring in the ground is covered with cement-mortar-based coverings. The same is partially used for the ground floor, the rest of the flooring is made of concrete tiles. In the apartments there are wooden floors and glass fiber reinforced plastic on the ceilings. Ceramic tiles in bathrooms fully cover the walls and floors. Hallways on the upper floors are covered with wooden boards on the floor and glass fiber reinforced plastic on the ceiling. The 7th floor is covered with vegetation including layers like filter fabric, drainage element, protection layer and thermal insulation.

4.3 Building materials

Before proceeding to calculations, it is essential to evaluate building elements, its components and information that is available based on a 3D-Model and list of materials, which were acquired from Institute of Building and Industrial Construction. The following are aspects which were incorporated or taken into account for all three LCA methods:

- Steel reinforcement for concrete structures has been incorporated into the calculations, as it is a valuable material from the structural point of view and has a high impact on results due to its large density.
- Service life of building materials plays a significant role in life cycle assessment. Mostly layers have different service lives and replacement periods have to be adapted to each other. For example, the slab "DE07_Decke unter Freibereich" has a floor system, which contains 10 layers (Figure 6). Some of the materials that were chosen from a database of One Click LCA have various service lives (20-30 years) and include rubber floor coverings (25 years), EPDM waterproofing membrane (30 years), and bitumen-polymer waterproofing membrane (20 years). The materials that last as long a building are solid wood flooring, mineral wool insulation, cross-laminated timber, and gypsum plaster boards. To ensure that the

replacement of materials is included into the calculation correctly, it is necessary to edit the service life of the components with lower durability. Therefore, all the components above bitumen-polymer waterproofing membrane must be replaced after 20 years as well in order to protect load-bearing element from moisture. Therefore, it is required to edit the service life in the input data.

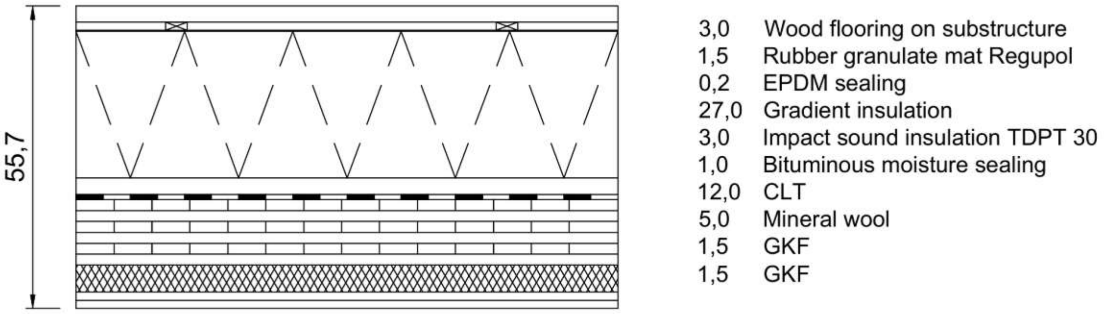


Figure 5. Floor system of DE07 Decke unter Freibereich**.**

- Often the only function of these materials is to separate wet and dry layers during the installation period. After this such materials don't have any function and must not be replaced and can remain within a construction until the demolition of a building. For example, in Figure 7, polyethylene foil separates the EPS insulation plate and screed. After the screed is dried the polyethylene foil doesn't have another purpose. Therefore, the service life of this layer was increased and as a result the material will not be changed during the calculation period.

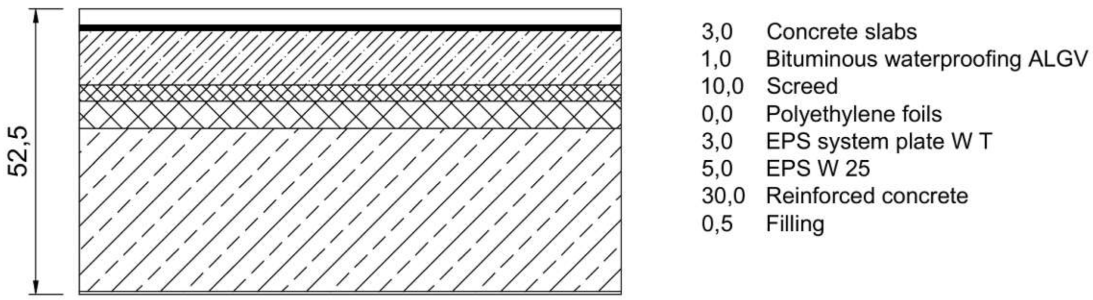


Figure 6. Floor system of DE02 Müllraum gegen beheizt.

4.4 OneClick LCA Calculation

In the next section, a life cycle assessment using an online tool OneClick LCA is described. The necessary settings, input data, results and unique features of the tool are explained in detail and will be used as a basis for the analysis demonstrated in Chapter 5 "Comparison of LCA results", where the results of different methodologies will be discussed.

4.4.1 Project parameters

After completing the account registration process and getting access to a free student license, it is possible to start creating a project and performing the calculations. Customizing settings before the calculation is an important step, which ensures that the analysis is performed correctly, and all the specifications of a building are considered. In the beginning, the user is required to fill out basic information, such as license key, name of a project, building type, country of location, and address.

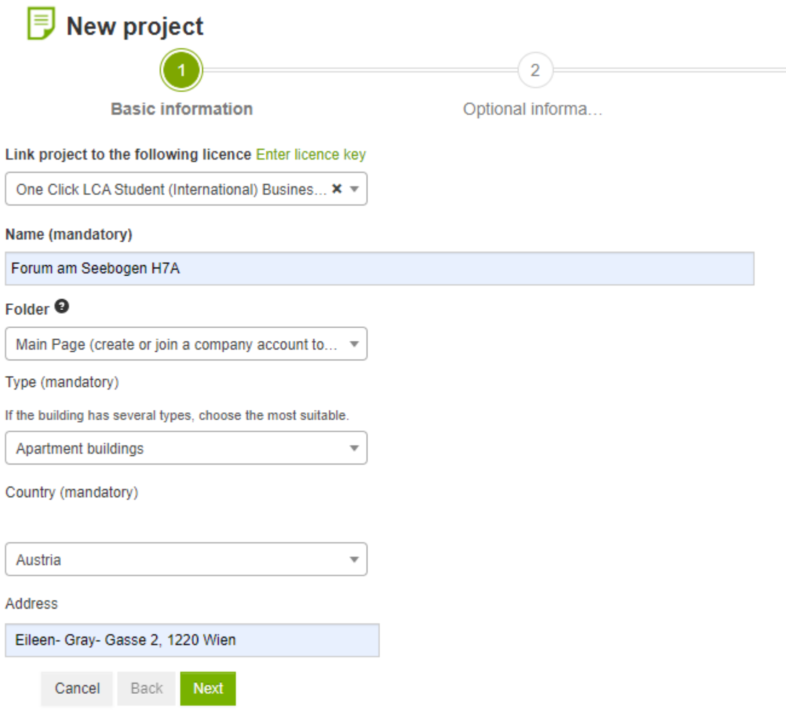


Figure 7. Creating a new project, step 1, *(One Click LCA Ltd., 2024)*

The next step is to add information like Gross Floor Area, number of floors above ground, frame type, etc. Optionally, users can choose the certification system that they pursue. Since an assessment according to a certification system is outside of the scope of this research, the window for pursued certification system remains empty.

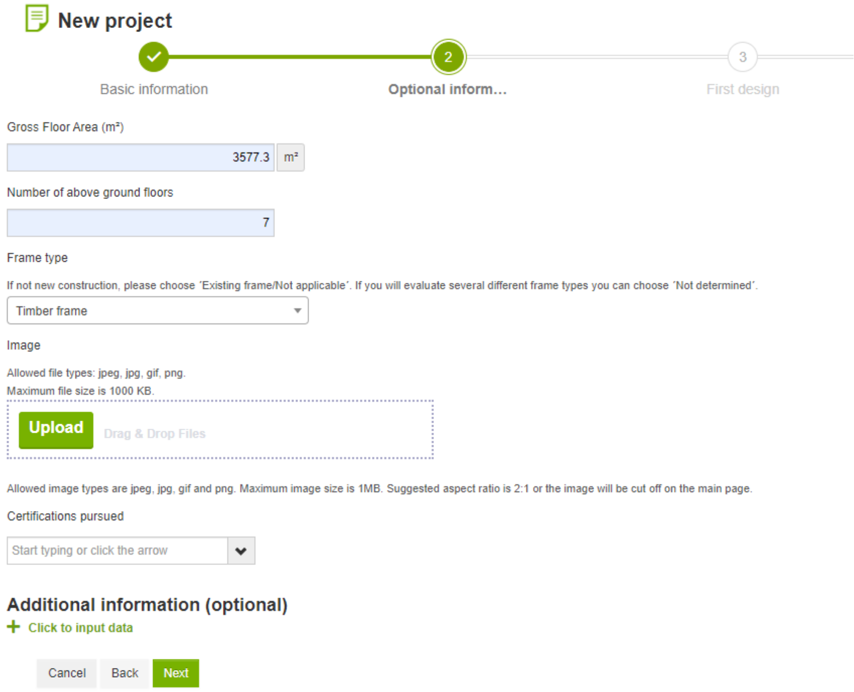


Figure 8. Creating a new project, step 2, *(One Click LCA Ltd., 2024)*

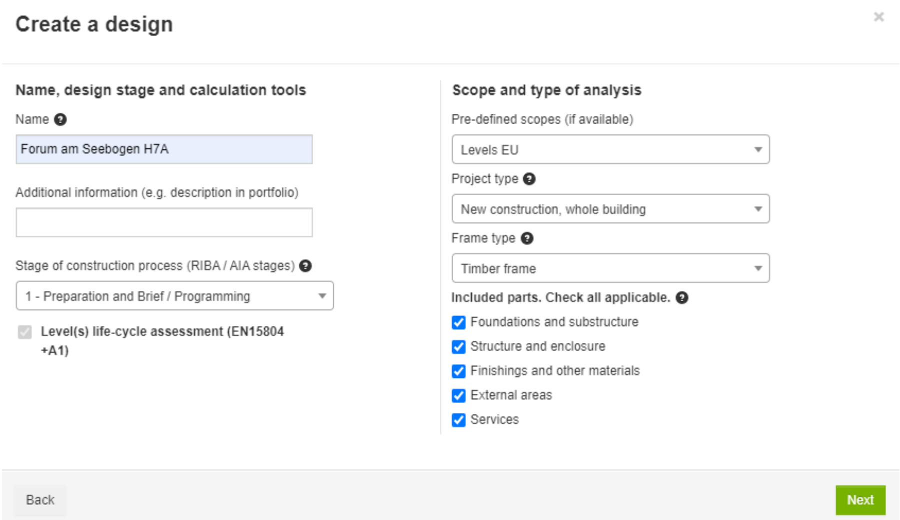


Figure 9. Calculation settings, *(One Click LCA Ltd., 2024)*

As it was mentioned before, the analysis is going to be performed according to Level(s), the building is a new construction, and the frame type is designed in timber. The case study does not include information about the external areas and services.

Life-Cycle Assessment Parameters can be adjusted by a user. Alternatively, default parameters can be chosen, which was the choice for the case study.

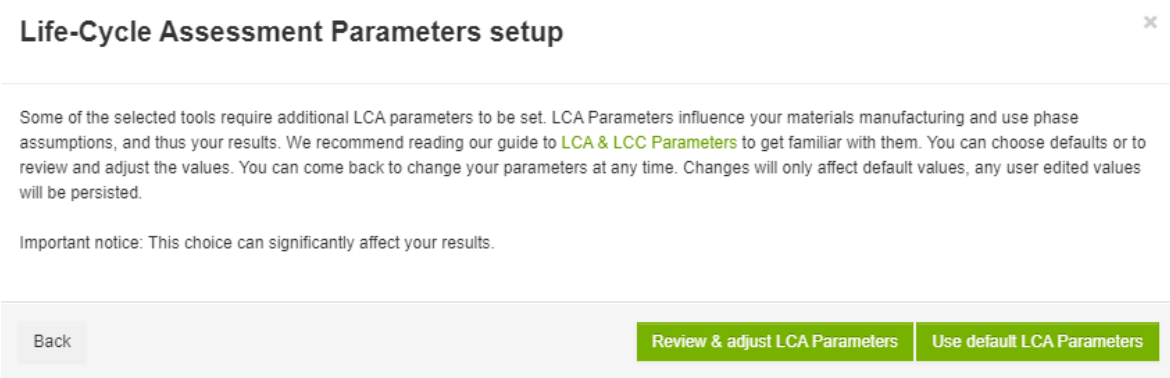


Figure 10. Parameters setup, *(One Click LCA Ltd., 2024)*

4.4.2 Input data

A bill of materials can be created manually by adding materials one be one. Another option available on One Click LCA is to import an Excel file that contains necessary information about building materials such as names and quantities. The list of templates for Excel file is available on the official website. The template needs to be filled in according to classes in table 4 and imported into the project.

Table 4. Classes for building materials according to a template from One Click LCA *(One Click LCA Ltd., 2024)*

CLASS	Building element	Sub-Element
FOUNDATION	Foundations and substructure	Foundation, sub-surface, basement and retaining walls
WALL	Vertical structures and facade	External walls and facade
EXTERNAL WALL	Vertical structures and facade	External walls and facade
INTERNAL WALL	Vertical structures and facade	Internal walls and non-bearing structures
COLUMN	Vertical structures and facade	Columns and load-bearing vertical structures
SLAB	Horizontal structures: beams, floors and roofs	Floor slabs, ceilings, roofing decks, beams and roof
ROOF	Horizontal structures: beams, floors and roofs	Floor slabs, ceilings, roofing decks, beams and roof
BEAM	Horizontal structures: beams, floors and roofs	Floor slabs, ceilings, roofing decks, beams and roof
STAIRS	Other structures and materials	Other structures and materials
OTHER	Other structures and materials	Other structures and materials
DOOR	Other structures and materials	Windows and doors
WINDOW	Other structures and materials	Windows and doors
HORIZONTAL FINISH	Horizontal structures: beams, floors and roofs	Floor slabs, ceilings, roofing decks, beams and roof
VERTICAL FINISH	Vertical structures and facade	Internal walls and non-bearing structures
FINISH	Other structures and materials	Finishes and coverings
COVERINGS	Other structures and materials	Finishes and coverings
SYSTEM	Building Technology	Building systems and installations
BUILDINGTECH	Building Technology	Building systems and installations

FURNITURE	Building Technology	Building systems and installations
SITE	External areas and site elements	Materials and constructions for external areas

To have a better overview the elements were imported into the project in groups: external walls, internal walls, slabs, foundation, roof, columns, and beams. Table 5 demonstrates the list of external walls that were imported first as an example.

Class and IFCMATERIAL can be used to automatically map the materials to the label in OneClick LCA. In case a material cannot be automatically recognized it has to be chosen from the database before the file is imported or marked as "Decide later", in other case the material gets deleted from the bill. The tool will display such materials after the import as "Unidentified material" and user can find a match for this material later.

Values such as IFC material, quantity, quantity type, thickness, were taken directly from the BoM. The values for transportation and service life were left empty and will be filled by the values from a database depending on which materials will be chosen. The comment section is used as additional information for anything a user might need to know. In this case it was used to see to which type of building element these materials belong. This data can be edited after the file is already imported and mapped to labels.

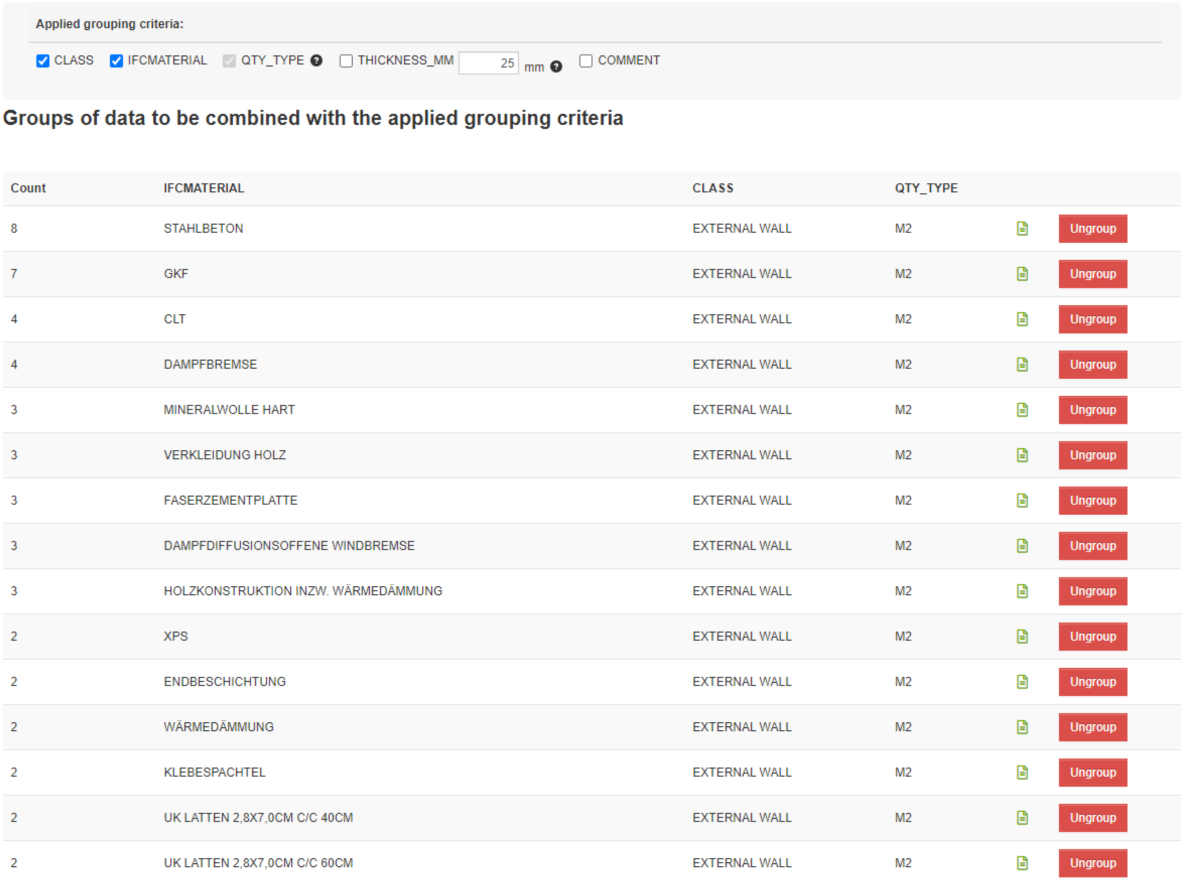
The uploaded rows from Excel file with similar values can be grouped together by CLASS, IFCMATERIAL, thickness or comment. In the table 5 the rows are grouped by CLASS and IFCMATERIAL, and in the column named "Count" it is shown how many rows are in this group. Since CLASS is the same for all rows, they are filtered only by name of the material. (One Click LCA Ltd., 2024)

Table 5. Example of a filled in template for import

CLASS	IFCMATERIAL	QUAN-TITY	QTY_TYPE	THICKNESS_MM	TRANSPORT_KM	TRANSPORTDISTANCE_KMLEG2	YM_TRANSPORTATION_KM	COMMENT	SERVICE LIFE
EXTERNAL WALL	XPS	41.3	M2	120				AW01_ Kelleraußenwand 25STB+12WD	
EXTERNAL WALL	Stahlbeton	41.3	M2	250				AW01_ Kelleraußenwand 25STB+12WD	
EXTERNAL WALL	Stahlbeton	312.6	M2	300				AW01_ Kelleraußenwand 30STB+17WD	
EXTERNAL WALL	XPS	312.6	M2	170				AW01_ Kelleraußenwand 30STB+17WD	
EXTERNAL WALL	Mineralwolle hart	188.6	M2	120				AW02_ Außenwand 25STB+12WD	
EXTERNAL WALL	Stahlbeton	188.6	M2	250				AW02_ Außenwand 25STB+12WD	
EXTERNAL WALL	Verkleidung Holz	1471	M2	36				AW03_ Außenraum gegen beheizt	
EXTERNAL WALL	Faserzementplatte	1471	M2	15				AW03_ Außenraum gegen beheizt	
EXTERNAL WALL	UK Latten 2,8x7,0cm c/c 60cm	0	M2	30				AW03_ Außenraum gegen beheizt	
EXTERNAL WALL	UK Latten 2,8x7,0cm c/c 40cm	0	M2	30				AW03_ Außenraum gegen beheizt	
EXTERNAL WALL	Dampfdiffusionsoffene Windbremse	1471	M2	1				AW03_ Außenraum gegen beheizt	
EXTERNAL WALL	Holzkonstruktion inzw. Wärmedämmung	1471	M2	195				AW03_ Außenraum gegen beheizt	
EXTERNAL WALL	CLT	1471	M2	100				AW03_ Außenraum gegen beheizt	
EXTERNAL WALL	Dampfbremse	1377.3	M2	0				AW03_ Außenraum gegen beheizt	
EXTERNAL WALL	GKF	1377.3	M2	15				AW03_ Außenraum gegen beheizt	
EXTERNAL WALL	GKF	1377.3	M2	15				AW03_ Außenraum gegen beheizt	
EXTERNAL WALL	Stahlbeton	143.2	M2	250				AW05_ Stgh gegen Beheizt OG2-OG6 1	
EXTERNAL WALL	Mineralwolle hart	133.8	M2	130				AW05_ Stgh gegen Beheizt OG2-OG6 2	
EXTERNAL WALL	CLT	133.8	M2	100				AW05_ Stgh gegen Beheizt OG2-OG6 3	
EXTERNAL WALL	GKF	133.8	M2	15				AW05_ Stgh gegen Beheizt OG2-OG6 4	
EXTERNAL WALL	Dampfbremse	133.8	M2	0				AW05_ Stgh gegen Beheizt OG2-OG6 5	

EXTERNAL WALL	GKF	133.8	M2	15				AW05_ Stgh gegen Beheizt OG2-OG6 6	
EXTERNAL WALL	Stahlbeton	27	M2	250				AW05a_ Stgh gegen Naßzelle OG2-OG6 1	
EXTERNAL WALL	Mineralwolle hart	24.5	M2	130				AW05a_ Stgh gegen Naßzelle OG2-OG6 2	
EXTERNAL WALL	CLT	24.5	M2	100				AW05a_ Stgh gegen Naßzelle OG2-OG6 3	
EXTERNAL WALL	Dampfbremse	24.5	M2	0				AW05a_ Stgh gegen Naßzelle OG2-OG6 4	
EXTERNAL WALL	CW-Profil dzw MW-W	24.5	M2	85				AW05a_ Stgh gegen Naßzelle OG2-OG6 5	
EXTERNAL WALL	GKF	24.5	M2	15				AW05a_ Stgh gegen Naßzelle OG2-OG6 6	
EXTERNAL WALL	Keramische Fliesen	24.5	M2	10				AW05a_ Stgh gegen Naßzelle OG2-OG6 7	
EXTERNAL WALL	Endbeschichtung	28.3	M2	5				AW05b_ Stgh gegen Beheizt OG1	
EXTERNAL WALL	Wärmedämmung	28.3	M2	120				AW05b_ Stgh gegen Beheizt OG2	
EXTERNAL WALL	Klebespachtel	28.3	M2	5				AW05b_ Stgh gegen Beheizt OG3	
EXTERNAL WALL	Stahlbeton	28.3	M2	250				AW05b_ Stgh gegen Beheizt OG4	
EXTERNAL WALL	Mineralwolle weich	28.3	M2	130				AW05b_ Stgh gegen Beheizt OG5	
EXTERNAL WALL	CLT	28.3	M2	100				AW05b_ Stgh gegen Beheizt OG6	
EXTERNAL WALL	GKF	28.3	M2	15				AW05b_ Stgh gegen Beheizt OG7	
EXTERNAL WALL	Dampfbremse	28.3	M2	0				AW05b_ Stgh gegen Beheizt OG8	
EXTERNAL WALL	GKF	28.3	M2	15				AW05b_ Stgh gegen Beheizt OG9	
EXTERNAL WALL	Endbeschichtung	19.4	M2	5				AW05c_ Stgh gegen Unbeheizt	
EXTERNAL WALL	Wärmedämmung	19.4	M2	120				AW05c_ Stgh gegen Unbeheizt	
EXTERNAL WALL	Klebespachtel	19.4	M2	5				AW05c_ Stgh gegen Unbeheizt	
EXTERNAL WALL	Stahlbeton	19.4	M2	250				AW05c_ Stgh gegen Unbeheizt	
EXTERNAL WALL	Holzkonstruktion inzw. Wärmedämmung	19.4	M2	160				AW05c_ Stgh gegen Unbeheizt	
EXTERNAL WALL	Dampfdiffusionsoffene Windbremse	19.4	M2	1				AW05c_ Stgh gegen Unbeheizt	

EXTERNAL WALL	UK Latten 2,8x7,0cm c/c 40cm	19.4	M2	30				AW05c_ Stgh gegen Unbeheizt	
EXTERNAL WALL	UK Latten 2,8x7,0cm c/c 60cm	19.4	M2	30				AW05c_ Stgh gegen Unbeheizt	
EXTERNAL WALL	Faserzementplatte	19.4	M2	15				AW05c_ Stgh gegen Unbeheizt	
EXTERNAL WALL	Verkleidung Holz	19.4	M2	36				AW05c_ Stgh gegen Unbeheizt	
EXTERNAL WALL	Stahlbeton	51	M2	250				AW05d_ Stgh gegen Unbeheizt OG2-OG6 1	
EXTERNAL WALL	Holzkonstruktion inzw. Wärmedämmung	51	M2	290				AW05d_ Stgh gegen Unbeheizt OG2-OG6 2	
EXTERNAL WALL	Dampfdiffusionsoffene Windbremse	51	M2	1				AW05d_ Stgh gegen Unbeheizt OG2-OG6 3	
EXTERNAL WALL	UK Latten 2,8x7,0cm c/c 40cm	51	M2	30				AW05d_ Stgh gegen Unbeheizt OG2-OG6 4	
EXTERNAL WALL	UK Latten 2,8x7,0cm c/c 60cm	51	M2	30				AW05d_ Stgh gegen Unbeheizt OG2-OG6 5	
EXTERNAL WALL	Faserzementplatte	51	M2	15				AW05d_ Stgh gegen Unbeheizt OG2-OG6 6	
EXTERNAL WALL	Verkleidung Holz	51	M2	36				AW05d_ Stgh gegen Unbeheizt OG2-OG6 7	



Applied grouping criteria:

☑ CLASS ☑ IFCMATERIAL ☑ QTY_TYPE ☐ THICKNESS_MM 25 mm ☐ COMMENT

Groups of data to be combined with the applied grouping criteria

Count	IFCMATERIAL	CLASS	QTY_TYPE		
8	STAHLBETON	EXTERNAL WALL	M2		Ungroup
7	GKF	EXTERNAL WALL	M2		Ungroup
4	CLT	EXTERNAL WALL	M2		Ungroup
4	DAMPFBREMSE	EXTERNAL WALL	M2		Ungroup
3	MINERALWOLLE HART	EXTERNAL WALL	M2		Ungroup
3	VERKLEIDUNG HOLZ	EXTERNAL WALL	M2		Ungroup
3	FASERZEMENTPLATTE	EXTERNAL WALL	M2		Ungroup
3	DAMPFDIFFUSIONSOFFENE WINDBREMSE	EXTERNAL WALL	M2		Ungroup
3	HOLZKONSTRUKTION INZW. WÄRMEDÄMMUNG	EXTERNAL WALL	M2		Ungroup
2	XPS	EXTERNAL WALL	M2		Ungroup
2	ENDBESCHICHTUNG	EXTERNAL WALL	M2		Ungroup
2	WÄRMEDÄMMUNG	EXTERNAL WALL	M2		Ungroup
2	KLEBESPACHTEL	EXTERNAL WALL	M2		Ungroup
2	UK LATTEN 2,8X7,0CM C/C 40CM	EXTERNAL WALL	M2		Ungroup
2	UK LATTEN 2,8X7,0CM C/C 60CM	EXTERNAL WALL	M2		Ungroup

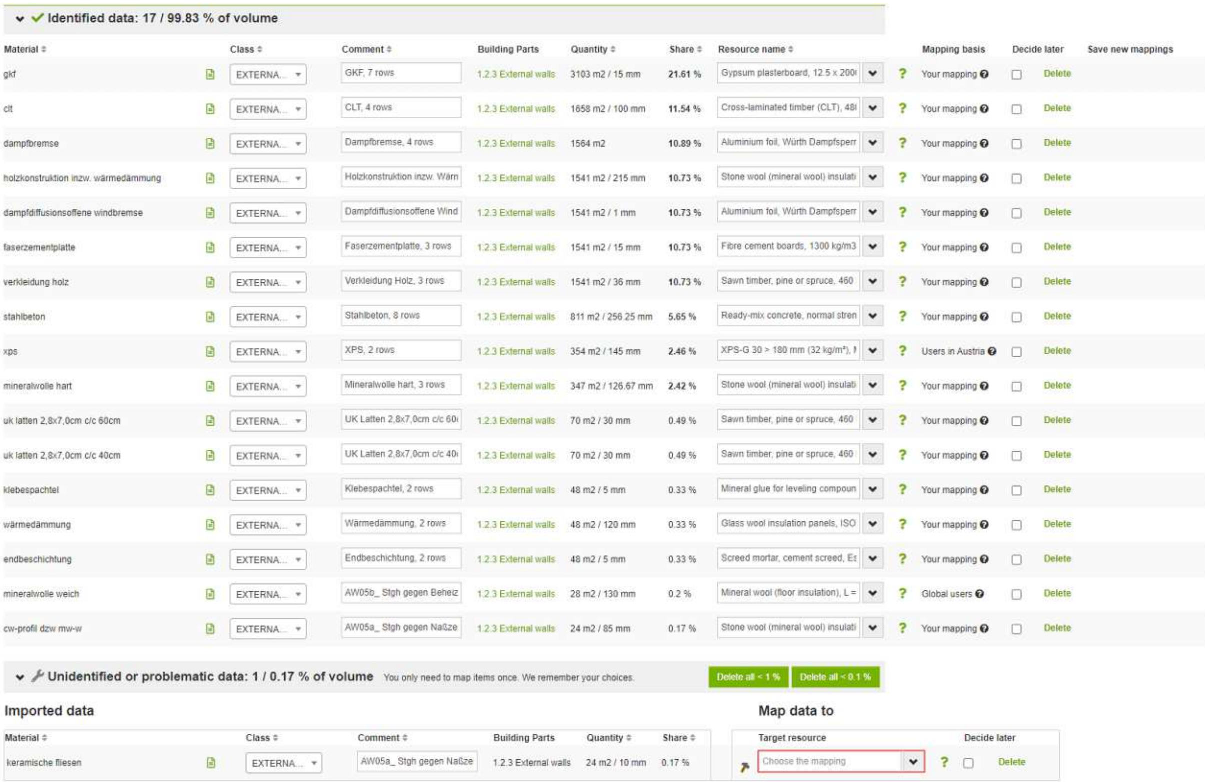
Figure 11. Input data is grouped before import.

The material will be chosen from manufacture specific database (EPDs), country specific (ecoinvent, GaBi) and generic database (in form of EPD or created by One Click LCA).

An example of how materials are being imported is shown on the figure 13, 19 rows of the data (99,83%) were mapped automatically and only 1 row "Keramische Fließen" (0.17%) was not mapped. It means that this row needs to be mapped manually and to be chosen from the database. By clicking on "Target resource" open a search bar and type "Ceramic tiles". Since the project is located in Austria, the options for this country appear on the top of the list. The final choice is "Ceramic glazed tile, 20 kg/m2", it is a generic data from One Click LCA.

Although the rest of the materials were mapped automatically, there is still a chance of making a mistake or finding a better match. The automatically mapped data needs to be checked before the final upload.

After importing the rest of the materials, letting One Click LCA find mapping on its own and finding the best possible matches for the materials, which were not identified by the tool, it is now possible to overview the first results.



Identified data: 17 / 99.83 % of volume

Material	Class	Comment	Building Parts	Quantity	Share	Resource name	Mapping basis	Decide later	Save new mappings
gkf	EXTERNA...	GKF, 7 rows	1.2.3 External walls	3103 m2 / 15 mm	21.61 %	Gypsum plasterboard, 12.5 x 200	Your mapping		Delete
clt	EXTERNA...	CLT, 4 rows	1.2.3 External walls	1658 m2 / 100 mm	11.54 %	Cross-laminated timber (CLT), 48	Your mapping		Delete
dampfbremse	EXTERNA...	Dampfbremse, 4 rows	1.2.3 External walls	1564 m2	10.89 %	Aluminium foil, Würth Dampfsperr	Your mapping		Delete
holzkonstruktion inzw. wärmedämmung	EXTERNA...	Holzkonstruktion inzw. Wärn	1.2.3 External walls	1541 m2 / 215 mm	10.73 %	Stone wool (mineral wool) insulati	Your mapping		Delete
dampfdiffusionsoffene windbremse	EXTERNA...	Dampfdiffusionsoffene Wind	1.2.3 External walls	1541 m2 / 1 mm	10.73 %	Aluminium foil, Würth Dampfsperr	Your mapping		Delete
faserzementplatte	EXTERNA...	Faserzementplatte, 3 rows	1.2.3 External walls	1541 m2 / 15 mm	10.73 %	Fibre cement boards, 1300 kg/m3	Your mapping		Delete
verkleidung holz	EXTERNA...	Verkleidung Holz, 3 rows	1.2.3 External walls	1541 m2 / 36 mm	10.73 %	Sawn timber, pine or spruce, 460	Your mapping		Delete
stahlbeton	EXTERNA...	Stahlbeton, 8 rows	1.2.3 External walls	811 m2 / 256.25 mm	5.65 %	Ready-mix concrete, normal stren	Your mapping		Delete
xps	EXTERNA...	XPS, 2 rows	1.2.3 External walls	354 m2 / 145 mm	2.46 %	XPS-G 30 > 180 mm (32 kg/m³), !	Users in Austria		Delete
mineralwolle hart	EXTERNA...	Mineralwolle hart, 3 rows	1.2.3 External walls	347 m2 / 126.67 mm	2.42 %	Stone wool (mineral wool) insulati	Your mapping		Delete
uk latten 2,8x7,0cm c/c 60cm	EXTERNA...	UK Latten 2,8x7,0cm c/c 60	1.2.3 External walls	70 m2 / 30 mm	0.49 %	Sawn timber, pine or spruce, 460	Your mapping		Delete
uk latten 2,8x7,0cm c/c 40cm	EXTERNA...	UK Latten 2,8x7,0cm c/c 40	1.2.3 External walls	70 m2 / 30 mm	0.49 %	Sawn timber, pine or spruce, 460	Your mapping		Delete
klebespachtel	EXTERNA...	Klebespachtel, 2 rows	1.2.3 External walls	48 m2 / 5 mm	0.33 %	Mineral glue for leveling compoun	Your mapping		Delete
wärmedämmung	EXTERNA...	Wärmedämmung, 2 rows	1.2.3 External walls	48 m2 / 120 mm	0.33 %	Glass wool insulation panels, ISO	Your mapping		Delete
endbeschichtung	EXTERNA...	Endbeschichtung, 2 rows	1.2.3 External walls	48 m2 / 5 mm	0.33 %	Screed mortar, cement screed, Es	Your mapping		Delete
mineralwolle weich	EXTERNA...	AW05b_ Stgh gegen Beheiz	1.2.3 External walls	28 m2 / 130 mm	0.2 %	Mineral wool (floor insulation), L =	Global users		Delete
cw-profil dzw mw-w	EXTERNA...	AW05a_ Stgh gegen Naßze	1.2.3 External walls	24 m2 / 85 mm	0.17 %	Stone wool (mineral wool) insulati	Your mapping		Delete

Unidentified or problematic data: 1 / 0.17 % of volume You only need to map items once. We remember your choices. Delete all < 1 % Delete all < 0.1 %

Imported data / Map data to

Material	Class	Comment	Building Parts	Quantity	Share	Target resource	Decide later	
keramische fliesen	EXTERNA...	AW05a_ Stgh gegen Naßze	1.2.3 External walls	24 m2 / 10 mm	0.17 %	Choose the mapping		Delete

Figure 12. List of identified and not identified data.

One Click LCA informs users if there is anything wrong with the calculation. On the result page there is a section named "Completeness and plausibility checker". LCA Checker is a feature that evaluates the calculation depending on the building area, project type, selected type of frame. It informs users if the project data is incomplete and in which sections additional information must be provided. For example, there is a list of required and recommended elements that need to be present in the design. To eliminate this warning, some of the imported materials need to be assigned to these building parts, such as foundation, load bearing structural frame, non-load bearing structural frame, and facades. The elements that are not present in the case study are parking facilities, core, fittings and furnishes, in-built lighting system, energy system, ventilation system, sanitary system, other system, and external works. The tool recommends putting a material with 0 quantity. The rest of the elements listed below for utilities and landscaping were also added to the bill of materials with 0 quantity.

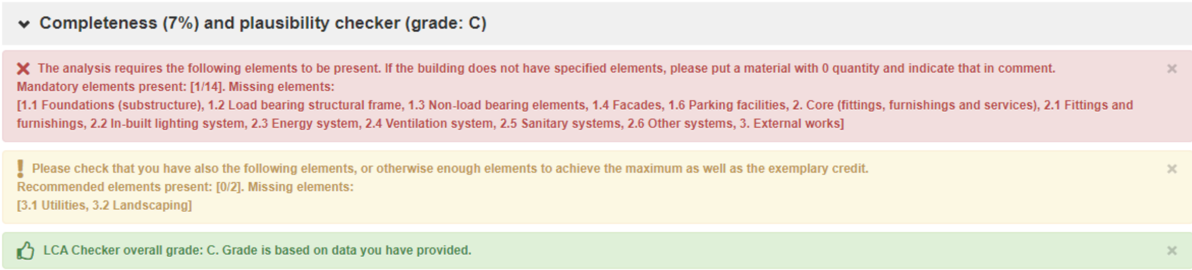
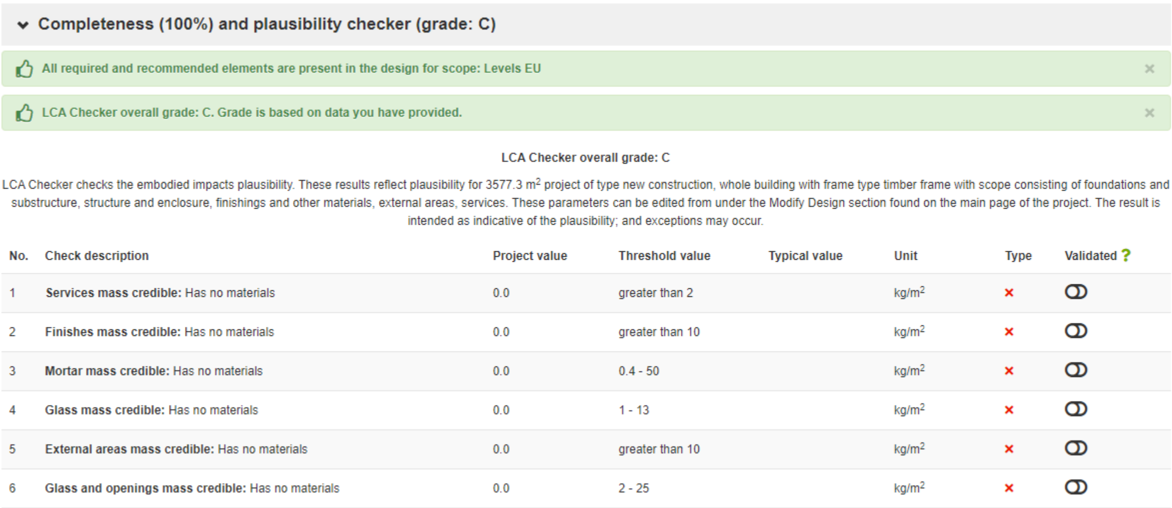


Figure 13. Requirements and recommendations from LCA Checker.

Another function of LCA Checker is to give a design an overall grade, based on how complete the project data is. Figure 15 shows that no materials were given for services, finishes, mortar, glass, external areas, and opening. Since these materials are not a part of the system boundaries that are used for this case study, these checks can be manually validated.



No.	Check description	Project value	Threshold value	Typical value	Unit	Type	Validated ?
1	**Services mass credible:** Has no materials	0.0	greater than 2		kg/m²	×	
2	**Finishes mass credible:** Has no materials	0.0	greater than 10		kg/m²	×	
3	**Mortar mass credible:** Has no materials	0.0	0.4 - 50		kg/m²	×	
4	**Glass mass credible:** Has no materials	0.0	1 - 13		kg/m²	×	
5	**External areas mass credible:** Has no materials	0.0	greater than 10		kg/m²	×	
6	**Glass and openings mass credible:** Has no materials	0.0	2 - 25		kg/m²	×	

Figure 14. Completeness and plausibility checker.

Next aspect that is crucial for the calculation is a service life of materials. As it was said before, this value is given automatically after assigning the material from a database. The service life of some materials was adjusted due to differences between neighboring layers according to explanation given in chapter 4.3 “Building materials”.

4.4.3 Results

The One Click LCA results can demonstrate a comprehensive overview of the environmental performance of a design throughout all life stages.

Results are divided into 3 main groups:

- Life-Cycle Assessment for Level(s) in compliance with EN 15978
- Indicators describing the usage of primary energy and water
- Site impacts (energy, water, transportation monitoring)

Figure 16 demonstrates all the life phases and their total value for GWP-total in kg CO_2e. Here it is shown that the major influence on environmental impacts is caused by the Product Phase A1-A3. The rest of the phases have significantly lower influence.

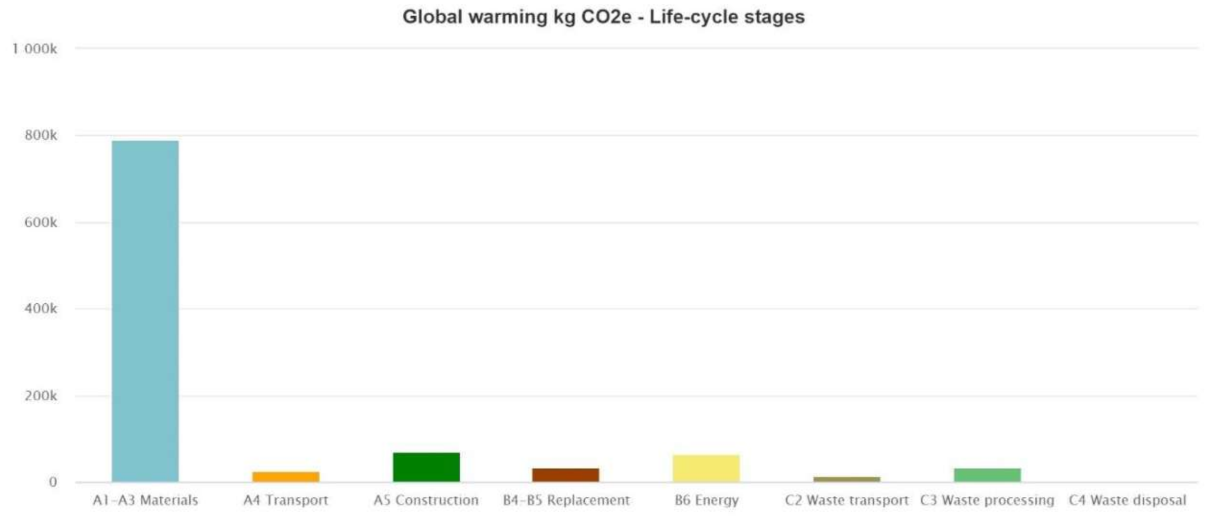


Figure 15. Environmental indicators by life cycle stage.

A1-A3 Materials - Results

The value of global warming potential is equal to 788,763.23 kg CO_2e. Firstly, in order to interpret these results correctly, it is important to understand which materials cause such a great value for GWP-total. The tool offers a list of most contributing materials in terms of GWP-total values according to its calculations. For evaluation purposes it is decided to overview top 5 from the list of materials with the highest GWP-total value. The rest of them have a lower GWP-value and percentage from a total mass, and therefore do not influence the results significantly.

Most contributing materials (Global warming) Compare data (3)

No.	Resource	Cradle to gate impacts (A1-A3)	Of cradle to gate (A1-A3)	Sustainable alternatives	
1.	Ready-mix concrete, normal strength, generic, C25/30 (3600/4400 PSI), with CEM I, 0% recycled binders (280 kg/m3; 17.5 lbs/ft3 total cement) ?	238 tonnes CO_2e	30.1 %	Show sustainable alternatives	Add to compare
2.	Stone wool (mineral wool) insulation, unfaced, L = 0.0325 W/mK, R = 1 m2K/W, 32.5mm, 5.04 kg/m2, 155 kg/m3, (Range: 113-200kg/m3), 22% slag content, high pressure suitable ?	178 tonnes CO_2e	22.5 %	Show sustainable alternatives	Add to compare
3.	Cross-laminated timber (CLT), 480 kg/m3 ?	120 tonnes CO_2e	15.2 %	Show sustainable alternatives	Add to compare
4.	Aluminium foil, ?	59 tonnes CO_2e	7.4 %	Show sustainable alternatives	Add to compare
5.	Reinforcement for concrete (rebar), diameter: 6-40 mm, 7850 kg/m3 ?	26 tonnes CO_2e	3.3 %	Show sustainable alternatives	Add to compare

Figure 16. Most contributing materials according to OneClick LCA

Another aspect to consider during evaluation is timber materials. The reason for this is that OneClick LCA uses a value of GWP-total for timber materials that is different from the value provided by EPD. As an example, a calculation for cross laminated timber KLH will be explained closely. According to EPD of KLH cross-laminated timber panels the GWP-total has a negative value and is equal to -601.3 kg CO2. But it is not the value that OneClick CLA used for the calculation. Instead, the value of 192.9 kg CO2 equivalent per cubic meter (m^3) of KLH is used in Life Cycle Assessment represents what is required to produce this material. The greenhouse potential during the wood growth in the forest before production is equal to -794.2. It is negative due to the substantial amount of CO2 absorbed by the wood during its growth. The final adjusted GWP provided in EPD is a sum of these two values, which is still a negative value, -601.3 kg CO2. Cross-laminated timber is a load-bearing material and influences the overall GWP results of a building to a high degree. Therefore, it has been decided to create 2 different scenarios, which consider both values, 192.9 kg CO2 and -601.3 kg CO2, to make it possible to deliver results from two different approaches and to compare OneClick LCA method to the rest of them (OI3-Index and EU-Taxonomy).

The table 6 represents the amount of kg CO_2e for GWP-total of materials according to Scenario 1. The first primary material is ready-mix concrete C25/30, which was used for load-bearing materials in basement and ground floor. Despite the fact that cross-laminated timber was used in great volumes aa well, concrete still has the highest impact among all the material used in a project and contributes to a striking 237,651.61 kg CO2.

Stone wool insulation (155 kg/m3) was used for various external, internal walls and slabs. Due to its large volume and density, this material stands on the second place of the list.

Next on the list is a cross-laminated timber (CLT). This is a primary load-bearing material in a building. Nevertheless, the amount of CO2 emissions is considerably lower than of concrete and stone wool insulation.

Aluminum foil was used as a vapor barrier and this specific material was chosen automatically and despite of a small volume still became a very influential material. The problem is that in OneClick LCA this is the only option that can be used for a vapor barrier. Unfortunately, aluminum foil causes a lot of CO2 emissions, 58,584.35 kg CO2, which is very high value.

Reinforcement for concrete is a material that was not included in the bill of materials, but due to its importance, it was implemented in the calculation, and its value for GWP-total is significant and equal to 26,330.64 kg CO2.

Table 6. SCENARIO 1: Most contributing materials and their GWP-total values

Materials	Volume, m^3	GWP-total, kg CO_2e
Ready-mix concrete, normal strength, generic, C25/30 (3600/4400 PSI), with CEM I, 0% recycled binders (280 kg/m3; 17.5 lbs/ft3 total cement)	993.06	237 651.61
Stone wool (mineral wool) insulation, unfaced, L = 0.0325 W/mK, R = 1 m2K/W, 32.5mm, 5.04 kg/m2, 155 kg/m3, (Range: 113-200kg/m3), 22% slag content, high pressure suitable (One Click LCA)	848.40	177 765.38
Cross-laminated timber (CLT), 480 kg/m3 (KLH Massivholz)	613.84	119 818.26
Aluminium foil, Würth Dampfsperre Wütop DS Alu (Würth Handelsges.m.b.H.)	1.40	58 584.35
Reinforcement for concrete (rebar), diameter: 6-40 mm, 7850 kg/m3 (Badische Stahlwerke)	18.71	26 330.64

In the Scenario 2 it is shown that cross-laminated timber (CLT) is replaced with another material – gypsum plasterboard. This material has been used in numerous building elements and has a large GWP-total value of 26,106.98 kg CO2, which makes it one of the primary materials in scenario 2.

Table 7. SCENARIO 2: Most contributing materials and their GWP-total values

Materials	Volume, m^3	GWP-total, kg CO_2e
Ready-mix concrete, normal strength, generic, C25/30 (3600/4400 PSI), with CEM I, 0% recycled binders (280 kg/m3; 17.5 lbs/ft3 total cement)	993.06	237 651.61
Stone wool (mineral wool) insulation, unfaced, L = 0.0325 W/mK, R = 1 m2K/W, 32.5mm, 5.04 kg/m2, 155 kg/m3, (Range: 113-200kg/m3), 22% slag content, high pressure suitable (One Click LCA)	848.40	177 765.38
Aluminium foil, Würth Dampfsperre Wütop DS Alu (Würth Handelsges.m.b.H.)	1.40	58 584.35
Reinforcement for concrete (rebar), diameter: 6-40 mm, 7850 kg/m3 (Badische Stahlwerke)	18.71	26 330.64
Gypsum plasterboard, standard, biogenic CO2 not subtracted, 15 mm, 12 kg/m2, 800 kg/m3, RB (Rigips)	217.66	26 106.98

Next criteria that is also vital to overview is least contributing materials. In other words, materials, which were a good choice and caused the least CO2-emissions during the A1-A3 Product Phase. To eliminate materials with a very small mass, it was decided to consider materials with a mass percentage more than 1% only. Additionally, two different scenarios were taken into consideration.

Table 8. SCENARIO 1: Least contributing materials

Materials	GWP-total, kg CO_2e	Mass percentage, %
Gravel, dry bulk density, 1680 kg/m3	285.38	2.233
Fresh sawn timber, biogenic CO2 not substracted, wood moisture at delivery 70 %, 740 kg/m3 (Fritz EGGER)	1 714.03	2.158
Sawn timber, pine or spruce, 460 kg/m3, 15-140 mm, 10-20% moisture content, Classic Sawn (Stora Enso)	2 627.43	1.048
Floor screed mortar, cement screed, 1500 kg/m3, EPD coverage: > 1500 kg/m3 (quickmix Gruppe GmbH & Co. KG)	7 107.11	1.512
Oriented Strand Board (OSB), 6 - 40 x 590 - 1250 x 1840 - 6250 mm, 600 kg/m3, AGEPAN (Sonae Indústria)	9 454.68	1.226

As it was mentioned before, the scenario 1 calculates positive values of GWP-total (energy use for production) for timber materials and the scenario 2 – negative values. Therefore, the lists of the least contributing materials are slightly different. In table 8 the best material according to OneClick LCA is gravel. This material requires minimal processing compared to other building materials, produces fewer emissions during its production phase, and consumes less energy.

Next two materials have similar values: timber with density of 740 kg/m3 is used for load-bearing elements such as columns and beams, and timber with density of 460 kg/m3 for façade. Sawn timber and oriented strand boards (OSB) usually undergo less processing than other materials, which reduces their environmental footprints.

Table 9. SCENARIO 2: Least contributing materials

Materials	GWP-total, kg CO_2e	Mass percentage, %
Cross-laminated timber (CLT), 480 kg/m3 (KLH Massivholz)	-373 492.58	8.818
Fresh sawn timber, biogenic CO2 not substracted, wood moisture at delivery 70 %, 740 kg/m3 (Fritz EGGER)	-76 809.40	2.158
Oriented Strand Board (OSB), 6 - 40 x 590 - 1250 x 1840 - 6250 mm, 600 kg/m3, AGEPAN (Sonae Indústria)	-57 134.75	1.226
Sawn timber, pine or spruce, 460 kg/m3, 15-140 mm, 10-20% moisture content, Classic Sawn (Stora Enso)	-53 794.86	1.048
Gravel, dry bulk density, 1680 kg/m3	285.38	2.233

As can be seen from table 9 the timber materials have taken over the list and represent the negative values of GWP-total. The first in the list is cross-laminated timber, as it has the largest mass among all timber materials and therefore the lowest, most negative value for GWP-total. Next are sawn timber and oriented strand boards. Finally, gravel as one of the most ecological building materials closes the list of the least contributing materials for scenario 2.

To clarify the difference between the scenarios, table 10 shows the values for GWP-total in detail.

Table 10. Different values for GWP-Total

Materials	GWP-total, kg CO_2e/m3 (scenario 1)	GWP-total, kg CO_2e/m3 (scenario 2)	Volume, m3
Cross-laminated timber (CLT), 480 kg/m3 (KLH Massivholz)	173.04	-601.30	613.84
Fresh sawn timber, biogenic CO2 not substracted, wood moisture at delivery 70 %, 740 kg/m3 (Fritz EGGER)	192.90	-779.00	98.60
Oriented Strand Board (OSB), 6 - 40 x 590 - 1250 x 1840 - 6250 mm, 600 kg/m3, AGEPAN (Sonae Indústria)	173.04	-826.96	69.09
Sawn timber, pine or spruce, 460 kg/m3, 15-140 mm, 10-20% moisture content, Classic Sawn (Stora Enso)	34.09	-698.00	77.07
Parquet, multilayered, biogenic CO2 not substracted, 7 kg/m2 (Scheucher)	6.49	-5.10	23.86

A4-Transport – Results

The A4 stage in the life cycle assessment (LCA) focuses on the environmental impacts associated with the transportation process, including the emissions from vehicles used and the distance covered.

Table 11. OneCLick LCA Results - A4 Transport

Materials	Volume, m3	GWP-total, kg CO_2e
Ready-mix concrete, normal strength, generic, C25/30 (3600/4400 PSI), with CEM I, 0% recycled binders (280 kg/m3; 17.5 lbs/ft3 total cement)	993.06	17 374.21
Cross-laminated timber (CLT), 480 kg/m3 (KLH Massivholz)	613.84	2 511.71
Reinforcement for concrete (rebar), diameter: 6-40 mm, 7850 kg/m3 (Badische Stahlwerke)	18.71	2 080.94
Fresh sawn timber, biogenic CO2 not substracted, wood moisture at delivery 70 %, 740 kg/m3 (Fritz EGGER)	98.60	614.67
Oriented Strand Board (OSB), 6 - 40 x 590 - 1250 x 1840 - 6250 mm, 600 kg/m3, AGEPAN (Sonae Indústria)	69.09	539.71
Total:		**25 451.20**

Ready-mix concrete (C25/30) has the highest GWP contribution with 17,374.21 kg CO_2e. This is expected due to the large volume required for construction and the significant emissions associated with transporting such heavy material.

Cross-laminated timber (CLT) and reinforcement for concrete (rebar) also have substantial GWP values (2,511.71 kg CO_2e and 2,080.94 kg CO_2e, respectively). These materials are crucial structural components, and their transportation emissions reflect their importance in construction.

Fresh-sawn timber and Oriented Strand Board (OSB) have lower GWP values (614.67 kg CO_2e and 539.71 kg CO_2e, respectively). These materials are lighter and less dense, resulting in lower transportation emissions.

From this analysis, it can be stated that the volume and density of materials have an impact on the GWP in stage A4 Transport. Materials with high density can contribute significantly to transportation emissions due to their weight.

A5 Construction – Results

The A5 stage in the life cycle assessment (LCA) captures the environmental impacts associated with the assembly of materials on-site, including energy consumption, machinery use, and other construction activities.

Table 12. OneCLick LCA Results - A5 Construction

Materials	Volume, m^3	GWP-total, kg CO_2e
Cross-laminated timber (CLT), 480 kg/m3 (KLH Massivholz)	613.84	21 259.94
Stone wool (mineral wool) insulation, unfaced, L = 0.0325 W/mK, R = 1 m2K/W, 32.5mm, 5.04 kg/m2, 155 kg/m3, (Range: 113-200kg/m3), 22% slag content, high pressure suitable (One Click LCA)	848.40	14 305.9
Ready-mix concrete, normal strength, generic, C25/30 (3600/4400 PSI), with CEM I, 0% recycled binders (280 kg/m3; 17.5 lbs/ft3 total cement)	993.06	10 359.1
Aluminium foil, Würth Dampfsperre Wütop DS Alu (Würth Handelsges.m.b.H.)	1.40	4 401.48
Gypsum plasterboard, standard, biogenic CO2 not subtracted, 15 mm, 12 kg/m2, 800 kg/m3, RB (Rigips)	217.66	3 715.97

Cross-laminated timber (CLT) has the highest GWP contribution with 21,259.94 kg CO_2e. This is indicative of the energy-intensive processes involved in the construction and installation of CLT on-site.

Stone wool insulation and ready-mix concrete also have substantial GWP values (14,305.90 kg CO_2e and 10,359.10 kg CO_2e, respectively). The installation of thermal insulation and concrete requires intensive labor and typically involves significant energy use.

Aluminium foil has a notably high GWP of 4,401.48 kg CO_2e despite its small volume (1.40 m^3). This reflects the high energy consumption and emissions associated with the production and installation of aluminum materials.

Gypsum plasterboard contributes 3,279.57 kg CO_2e to the GWP, which is lower than the other materials but still significant. Its installation process is less energy-intensive compared to CLT and concrete.

The analysis highlights the significant impact of material volume on the GWP during the A5 stage. Large volumes of CLT, stone wool insulation, and concrete contribute heavily to the overall GWP.

B3 Repair - Results

The B3 stage in the life cycle assessment (LCA) captures the environmental impacts associated with the repair of materials or components of a building. The zero GWP for the B3 stage in your LCA results indicates that no repair activities were considered necessary for the materials within the service life of the building.

B4-B5 Replacement – Results

In the context of a Life Cycle Assessment (LCA), the B4-B5 stages focus on the replacement and refurbishment phases of a building's materials over its lifespan. The following sections provide an analysis of the Global Warming Potential (GWP) for different materials used in the case study, based on their service life and corresponding GWP values. This analysis helps in understanding the environmental impacts associated with the maintenance and replacement of these materials.

Table 13. OneCLick LCA Results -B4-B5 Replacement for 50 years

Materials	GWP-total, kg CO_2e (Scenario 1)	GWP-total, kg CO_2e (Scenario 2)
Aluminium foil, Würth Dampfsperre Wütop DS Alu (Würth Handelsges.m.b.H.)	58 686.47	58 686.47
EPDM waterproofing membrane, 1.5 mm, 1.95 kg/m2 (One Click LCA)	12 760.35	12 760.35
Parquet, multilayered, biogenic CO2 not substracted, 7 kg/m2 (Scheucher)	11 365.08	-8 690.91
Rubber floor covering with foam coating, 3.82 kg/m2	9 557.85	9 557.85
Bitumen-polymer waterproofing membrane, Soprema E-4-SK (Soprema GmbH)	3 523.00	3 523.00
Mineral glue for leveling compounds, Universal-Spachtelmasse USP 32 S (PCI Augsburg GmbH)	3 177.83	3 177.83
Extensive green roof system, 40mm, 23.34 kg/m2, Urbanspace (Knauf)	1 980.85	1 980.85
Ceramic tiles and slabs, 17.97 kg/m2 (Bundesverband Keramische Fliesen)	1 441.95	1 441.95
Waterproofing membrane for green roof systems, 2 mm, 2 kg/m2, Sarnafil® TG 66 (Sika Deutschland)	1 310.54	1 310.54
Ceramic glazed tile, 20 kg/m2 (One Click LCA)	179.73	179.73
Polyethylene vapour barrier membrane, 0.15 mm, 0.14 kg/m2 (One Click LCA)	97.97	97.97
Ceramic glazed tile, 20 kg/m2 (One Click LCA)	179.73	179.73
Polyethylene vapour barrier membrane, 0.15 mm, 0.14 kg/m2 (One Click LCA)	97.97	97.97
Total:	**104 081.62**	**84 025.63**

EPDM waterproofing membrane has a large surface area of 1,004,2 m^2 and has the highest contribution 12,760.35 kg CO_2e.

The bitumen-polymer waterproofing membrane has a high value of 9,557.85 kg CO_2e is. Materials like this one have a relatively high GWP value and should be carefully considered.

Ceramic tiles and slabs and polyethylene vapor barrier membranes are a more sustainable choice in terms of their environmental impact.

Materials like bitumen-polymer waterproofing membranes and mineral glue have shorter service lives and require frequent replacements, therefore having an impact on the overall GWP of a building.

The extensive green roof system has a GWP value of 1,980.85 kg CO_2e and offers additional benefits such as insulation and rainwater use. These features might offset some of its environmental impacts over a long period of time.

Table 14. OneCLick LCA Results -B4-B5 Replacement for 100 years

Materials	GWP-total, kg CO_2e (Scenario 1)	GWP-total, kg CO_2e (Scenario 2)
Aluminium foil, Würth Dampfsperre Wütop DS Alu (Würth Handelsges.m.b.H.)	117 372.95	117 372.95
EPDM waterproofing membrane, 1.5 mm, 1.95 kg/m2 (One Click LCA)	33 293.87	33 293.87
Rubber floor covering with foam coating, 3.82 kg/m2	28 673.56	28 673.56
Gypsum plasterboard, standard, biogenic CO2 not subtracted, 15 mm, 12 kg/m2, 800 kg/m3, RB (Rigips)	29 727.68	26 236.51
Parquet, multilayered, biogenic CO2 not substracted, 7 kg/m2 (Scheucher)	22 730.17	-8 690.91
Glass wool insulation panels, ISOVER TRITTSCHALL-DÄMMPLATTE S (Feb.2016) (Saint-Gobain Isover Austria GmbH)	13 727.36	13 727.36
Oriented Strand Board (OSB), 6 - 40 x 590 - 1250 x 1840 - 6250 mm, 600 kg/m3, AGEPAN (Sonae Indústria)	9 454.7	-57 134.75
Mineral glue for leveling compounds, Universal-Spachtelmasse USP 32 S (PCI Augsburg GmbH)	7 150.11	7 150.11
Bitumen-polymer waterproofing membrane, Soprema E-4-SK (Soprema GmbH)	7 045.99	7 045.99
Ceramic tiles and slabs, 17.97 kg/m2 (Bundesverband Keramische Fliesen)	4 325.86	4 325.86
Extensive green roof system, 40mm, 23.34 kg/m2, Urbanspace (Knauf)	3 961.69	3 961.69
Waterproofing membrane for green roof systems, 2 mm, 2 kg/m2, Sarnafil® TG 66 (Sika Deutschland)	2 621.08	2 621.08
Solidwood flooring, multiple species, thickness range: 8 - 22mm, 4.38kg/m2, 548 kg/m3 oven-dry, moisture content < 13% (One Click LCA)	1 908.99	1 908.99
Glass wool insulation panels, ISOVER MERINO (Saint-Gobain Isover Austria GmbH)	1 293.53	1 293.53
Glass wool insulation panels, ISOVER ULTIMATE UNTERSPARREN KLEMMFILZ 035 TWIN (Saint-Gobain Isover Austria GmbH)	1 208.20	1 208.20
Ceramic glazed tile, 20 kg/m2 (One Click LCA)	539.19	539.19
Polyethylene vapour barrier membrane, 0.15 mm, 0.14 kg/m2 (One Click LCA)	293.91	293.91
Screed mortar, cement screed, Estriche (Baumit GmbH)	84.21	84.21
Total:	**285 413.03**	**187 402.52**

C2 Waste Transport – Results

The C2 stage in the life cycle assessment (LCA) refers to the transportation of waste materials to the disposal site. This stage focuses on the environmental impacts associated with the transportation process, including the emissions from the vehicles used and the distance covered.

Table 15. OneCLick LCA Results - C2 Waste Transport

Materials	Volume, m^3	GWP-total, kg CO_2e
Reinforcement for concrete (rebar), diameter: 6-40 mm, 7850 kg/m3 (Badische Stahlwerke)	18.71	5 624.17
Ready-mix concrete, normal strength, generic, C25/30 (3600/4400 PSI), with CEM I, 0% recycled binders (280 kg/m3; 17.5 lbs/ft3 total cement)	993.06	3 534.08
Gypsum plasterboard, standard, biogenic CO2 not subtracted, 15 mm, 12 kg/m2, 800 kg/m3, RB (Rigips)	217.66	3 184.54
Cross-laminated timber (CLT), 480 kg/m3 (KLH Massivholz)	613.84	1 141.69
Stone wool (mineral wool) insulation, unfaced, L = 0.0325 W/mK, R = 1 m2K/W, 32.5mm, 5.04 kg/m2, 155 kg/m3, (Range: 113-200kg/m3), 22% slag content, high pressure suitable (One Click LCA)	848.40	395.86

The reinforcement for concrete (rebar) has the highest GWP contribution with 5,624.17 kg CO_2e, despite having a relatively small volume (18.71 m^3). This indicates that the transportation of heavy and dense materials significantly impacts the overall GWP in the C2 stage.

Ready-mix concrete and gypsum plasterboard also have substantial GWP values (3,534.08 kg CO_2e and 3,184.52 kg CO_2e, respectively). These materials are used in large volumes, contributing significantly to transportation emissions.

Stone wool insulation and cross-laminated timber (CLT) have lower GWP values (395.86 kg CO_2e and 1,141.69 kg CO_2e, respectively). These materials, being lighter and less dense, contribute less to transportation emissions.

The analysis shows that both the volume and the density of the materials play crucial roles in determining the GWP during the C2 stage. High-density materials, even in smaller volumes, can have a larger GWP due to their weight impacting transportation emissions.

C3 Waste Processing – Results

The C3 phase in the Life Cycle Assessment (LCA) of a building refers to the **"Waste Processing"** stage. The processes involved in handling, treating, and processing building materials and components once they have been deconstructed or demolished but before they are disposed of or recycled are featured in this phase. In other words, the environmental impacts associated with the treatment of these materials to prepare them for final disposal or recovery.

Table 16. OneClick LCA Results - C3 Waste Processing

Materials	Volume, m^3	GWP-total, kg CO_2e
EPS insulation panels, graphite, L= 0.033 W/mK, R= 3.03 m2K/W, 100 mm, 3 kg/m2, 30 kg/m3, compressive strength 220 kPa, 10% recycled polystyrene, Lambda=0.033 W/(m.K) (One Click LCA)	192.46	7 844.45
EPDM waterproofing membrane, 1.5 mm, 1.95 kg/m2 (One Click LCA)	1.51	4 044.38
XPS insulation with flame retardant, L = 0.032 W/mK, 20-200 x 1265 x 600 mm, 28-50 kg/m3, Lambda=0.032 W/(m.K), Styrodur (BASF)	58.44	3 922.75
Cross-laminated timber (CLT), 480 kg/m3 (KLH Massivholz)	613.84	3 833.35
Rubber floor covering with foam coating, 3.82 kg/m2	0.19	3 699.48

Even though EPS insulation panels consist of 10% recycled polystyrene, it still contributes significantly to the overall GWP at the end-of-life stage. With a volume of 192.46 m^3, these panels are associated with a total GWP of 7,844.45 kg CO_2e. This high value is reflective of the energy-intensive processes involved in recycling or disposing of polystyrene-based materials

The EPDM (ethylene propylene diene monomer) waterproofing membrane, utilized for its durability and weather resistance, has a smaller volume but a relatively high GWP of 4,044.38 kg CO_2e. This is due to the complex chemical composition and the challenges associated with recycling synthetic rubber materials.

Next material is known for its excellent thermal insulation properties and flame-retardant additives, XPS (extruded polystyrene) insulation has a total GWP of 3,922.75 kg CO_2e for a volume of 58.44 m^3. It is known that the manufacturing and disposal processes of XPS are energy intensive. XPS contributes significantly to the overall GWP despite its lower density compared to other insulation types.

Cross-laminated timber (CLT), a sustainable building material with a volume of 613.84 m^3, shows a total GWP of 3,833.35 kg CO_2e. CLT is notable for its carbon sequestration potential during its use phase, but at the end of its life, the disposal or recycling processes contribute to its GWP. Despite this, CLT remains a comparatively eco-friendly material due to its renewable nature and lower embodied energy.

Rubber floor covering with a foam coating has a minimal volume. However, it has a high GWP of 3,699.48 kg CO_2e. The production and disposal of rubber materials produces a lot of emissions and includes high energy consumption, as well as emissions during incineration or landfill processes.

C4 Waste Disposal – Results

This stage includes waste processing, recycling, and disposal activities.

Table 17. OneCLick LCA Results - C4 Waste Disposal

Materials	Volume, m^3	GWP-total, kg CO_2e
Stone wool (mineral wool) insulation, unfaced, L = 0.0325 W/mK, R = 1 m2K/W, 32.5mm, 5.04 kg/m2, 155 kg/m3, (Range: 113-200kg/m3), 22% slag content, high pressure suitable (One Click LCA)	848.40	351.75
Stone wool (mineral wool) insulation, unfaced, L = 0.0315 W/mK, R = 1 m2K/W, 31.5mm, 1.26 kg/m2, 40 kg/m3, (Range: 36-50kg/m3), 22% slag content (One Click LCA)	184.30	19.17
Extensive green roof system, 40mm, 23.34 kg/m2, Urbanspace (Knauf)	9.76	14.80
Glass wool insulation panels, ISOVER TRITTSCHALL-DÄMMPLATTE S (Feb.2016) (Saint-Gobain Isover Austria GmbH)	79.57	14.69
Bitumen-polymer waterproofing membrane, Soprema E-4-SK (Soprema GmbH)	4.05	11.59

The GWP-total of stone wool insulation, despite its significant volume of 848.40 m^3, is relatively low at 351.75 kg CO_2e. The inclusion of 22% slag content, a byproduct of industrial processes, which reduces the overall environmental burden of the material, results in the lower impact.

The stone wool insulation, with a density of 40 kg/m^3, has an even lower environmental impact. For a volume of 184.30 m^3, the GWP-total is only 19.17 kg CO_2e. Clearly lower-density materials demonstrate the ecological benefits.

The extensive green roof system, with a thickness of 40mm and a density of 23.34 kg/m^2, provides both environmental and aesthetic benefits. With a volume of 9.76 m^3, the GWP-total is 14.80 kg CO_2e. Green roofs contribute positively by supporting biodiversity and reducing urban heat island effects, while also having a relatively low end-of-life environmental impact.

The low environmental impact of glass wool insulation at the end-of-life stage is indicative of the efficiency in recycling and waste processing methods for glass wool, making it a sustainable insulation choice.

The bitumen-polymer waterproofing membrane, with its robust waterproofing properties, has a volume of 4.05 m^3 and a GWP-total of 11.59 kg CO_2e. Bitumen-based materials have petrochemical origins, and therefore higher environmental impacts. However, the relatively small volume used in this project helps to mitigate the overall GWP.

D Recycling – Results

Stage D is associated with recycling materials at the end of their life cycle and focuses on the potential credits, which can be obtained from recycling materials and offset the environmental impacts of their production and disposal. Below the results for various materials used in the case study, with volumes and total global warming potential (GWP) in kg CO_2e.

Table 18. OneCLick LCA Results - D Recycling

Materials	Volume, m^3	GWP-total, kg CO_2e
Cross-laminated timber (CLT), 480 kg/m3 (KLH Massivholz)	613.84	-134 471.05
Aluminium foil, Würth Dampfsperre Wütop DS Alu (Würth Handelsges.m.b.H.)	1.40	-44 637.34
Fresh sawn timber, biogenic CO2 not substracted, wood moisture at delivery 70 %, 740 kg/m3 (Fritz EGGER)	98.60	-33 246.69
Ready-mix concrete, normal strength, generic, C25/30 (3600/4400 PSI), with CEM I, 0% recycled binders (280 kg/m3; 17.5 lbs/ft3 total cement)	993.06	-19 708.74
Oriented Strand Board (OSB), 6 - 40 x 590 - 1250 x 1840 - 6250 mm, 600 kg/m3, AGEPAN (Sonae Indústria)	69.09	-18 588.81
Sawn timber, pine or spruce, 460 kg/m3, 15-140 mm, 10-20% moisture content, Classic Sawn (Stora Enso)	77.07	-16 154.11

Cross-laminated timber (CLT) shows a significant negative GWP-total of -134,471.05 kg CO_2e for a volume of 613.84 m^3. This substantial carbon credit is due to the biogenic carbon stored in the timber, which is released back into the environment if not properly managed but can be effectively offset through recycling. The negative GWP indicates that the recycling of CLT greatly benefits the environment by reducing carbon emissions.

Recycling aluminum is highly efficient, significantly reducing the need for energy-intensive primary aluminum production and thereby providing substantial environmental benefits.

Fresh sawn timber also provides a significant carbon offset. For a volume of 98.60 m^3, the GWP-total is -33,246.69 kg CO_2e. This negative GWP highlights the environmental benefits of recycling sawn timber.

Ready-mix concrete is a very high-volume material and contributes a notable carbon credit when recycled. For a volume of 993.06 m^3, the GWP-total is -19,708.74 kg CO_2e. The negative GWP reflects the potential reductions in carbon emissions achieved through recycling concrete, which can replace virgin materials in new construction.

Oriented Strand Board (OSB) also provides a substantial carbon offset upon recycling. For a volume of 69.09 m^3, the GWP-total is -18,588.81 kg CO_2e. OSB recycling offers significant environmental benefits by reducing the need for virgin materials.

Sawn timber provides notable environmental benefits when recycled. For a volume of 77.07 m^3, the GWP-total is -16,154.11 kg CO_2e. This negative GWP underscores the effectiveness of recycling timber.

Total Results – Summary

After conducting two calculations of Life-Cycle Assessment using online tool OneClick LCA for Scenario 1 and 2, it can be seen that using the negative values for timber constructions leads to significant differences, especially in Material and Replacement phase.

Table 19. SCENARIO 1: Original results, OneClick LCA

GWP-total, kg CO_2e							
A1-A3 Product Phase	A4 Trasport Phase	B4-B5 Replace-ment for 50 years	B4-B5 Replace-ment for 100 years	C2 Trans-port	C3 Waste Process -ing	C4 Dis-posal	D Recycling
784 456	25 451	104 081	285 413	15 093	32 334	427	-311 697

Table 20. SCENARIO 2: Modified results with negative values for timber elements, OneClick LCA

GWP-total, kg CO_2e							
A1-A3 Product Phase	A4 Transport Phase	B4-B5 Replacement for 50 years	B4-B5 Replacement for 100 years	C2 Transport	C3 Waste Processing	C4 Disposal	D Recycling
71 234	25 451	84 025	187 402	15 093	32 334	427	-311 696.5

4.5 OI3-Index Calculation

In the following section, an environmental impact of a case study will be conducted using an online tool baubook. It involves a description of the necessary information about the parameters, input data and results of the assessment. The outcomes of the calculation will be used in Chapter 5 “Comparison of LCA methods” for an extensive analysis of the three LCA methods.

4.5.1 Parameter

Eco2soft was used to perform a life cycle assessment for OI3-Index. To be able to use the online tool it is required to obtain a license. Baubook offers free access to students for educational purposes. Eco2soft has a user-friendly and easy to understand interface.

Figure 17. eco2soft interface, *(baubook GmbH, 2024)*

A new project requires a value for Gross Floor Area and secondary area. The latter is mandatory for IO BG2-calculation or higher. The calculation will be made for a new building with a calculation period of 50 and 100 years.

4.5.2 Input data

The materials are added to the project in the form of a building element (internal wall, external wall, slab, basement etc.). The tool does not allow an import of excel files or 3D models. Therefore, materials need to be added to a project manually. However, it is possible to import data from baubook calculator. The calculation of OI3-Index is performed in BG3.

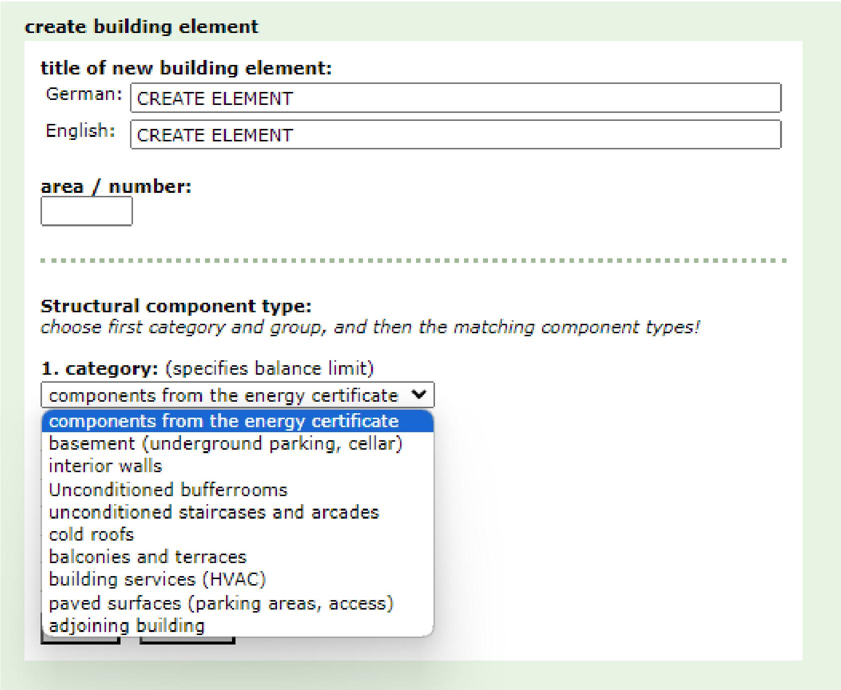
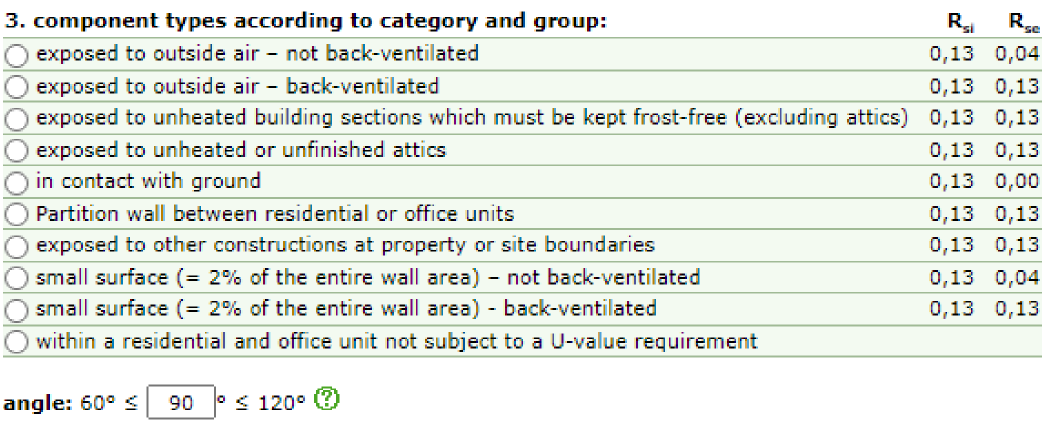


Figure 18. Creating a new building element in eco2soft, *(baubook GmbH, 2024)*



3. component types according to category and group:	R_{si}	R_{se}
exposed to outside air – not back-ventilated	0,13	0,04
exposed to outside air – back-ventilated	0,13	0,13
exposed to unheated building sections which must be kept frost-free (excluding attics)	0,13	0,13
exposed to unheated or unfinished attics	0,13	0,13
in contact with ground	0,13	0,00
Partition wall between residential or office units	0,13	0,13
exposed to other constructions at property or site boundaries	0,13	0,13
small surface (= 2% of the entire wall area) – not back-ventilated	0,13	0,04
small surface (= 2% of the entire wall area) - back-ventilated	0,13	0,13
within a residential and office unit not subject to a U-value requirement		

angle: 60° ≤ 90 ° ≤ 120°

Figure 19. component types in eco2soft, *(baubook GmbH, 2024)*

When making an input it is important to choose a category and a group of a building element. This feature will assign building elements to the system boundaries automatically. For most of the materials category, "components from energy certificate" was chosen. As a result, these building elements will be considered in the calculation from BG0. Basement walls and slabs were assigned to the category "basement" and will be calculated from BG3. The internal walls belong to the calculation starting from BG2. The group indicates the type of building element (wall, slab, roof, window or other). The interface demonstrates all the added building elements, their groups and system boundaries that they belong to.

In this case study the components of building materials were added as a combination of multiple homogenous layers. eco2soft offers to choose materials from a baubook catalog, which provides all the necessary data about a product.

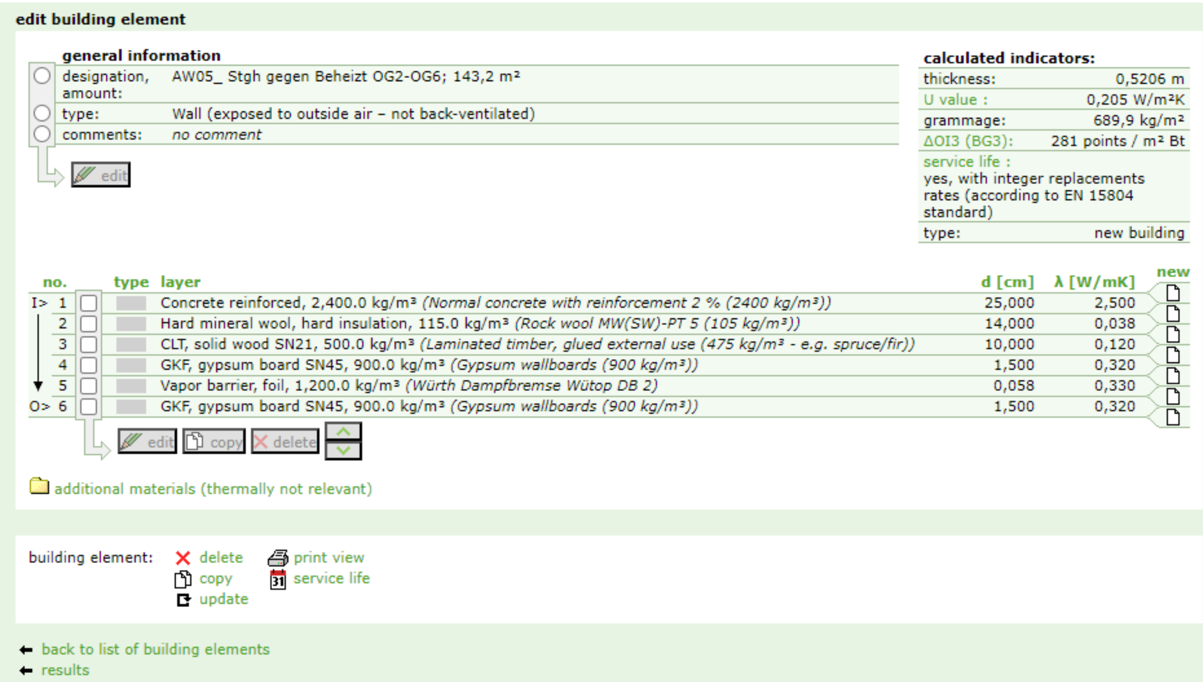


Figure 20. Input of a building element, *(baubook GmbH, 2024)*

The service life is automatically defined by a tool and can also be adjusted. Unfortunately, a lot of materials had an incorrect service life, and it was necessary to edit it, according to table 31. Some of the materials, such as rock wool and mineral insulation plates have a service life of 50 years, instead of the recommended 35 years. It can be due to outdated data based on catalog created in 2018. Changes in service life have a direct impact on calculation and should be adjusted accurately.

4.5.3 Results

After importing building elements and adjusting their service life it is possible now to overview the results. eco2soft demonstrates the values for environmental indicators such as:

- non-renewable primary energy (PENRT, PENRE, PENRM)
- renewable energy (PERT, PERE, PERM)
- global warming potential (GWP-total, GWP-fossil, GWP-biogenic)
- acidification potential (AP)
- eutrophication potential (EP)
- ozone depletion potential (ODP)
- photochemical ozone creation potential (POCP)

for a whole building, separately for each building elements and materials. These indicators refer to IBO benchmarks 2020, standards set by the Institute for Building and Ecology.

The results represent environmental indicators for all building materials. eco2soft generates detailed results for product phase (A1-A3), transport phase (A4), replacement phase (B4), and end-of-life phase (C1-C4). Additionally, it is possible to change the service life of specific layers in building materials, when necessary.

A1-A3 Product Phase – Results

Table 21. Most contributing materials according to ec2soft

Materials	Masse, kg	GWP-total, kg CO_2e
ÖKOBETON C25/30 XC1	2 320 740.00	229 057.04
Steinwolle MW(SW)-PT 5 (105 kg/m^3)	91 040.00	158 409.60
Gipswandbauplatten (900 kg/m^3)	179 874.00	40 651.52
Reinforcement for concrete (rebar), diameter: 6-40 mm, 7850 kg/m3 (Badische Stahlwerke)	146 873.50	26 330.64
AUSTROTHERM EPS W30	5 489.00	23 108.69

ÖKOBETON has the highest mass among the materials analyzed (2,320,740 kg), resulting in the highest total CO2 equivalents (229,057.04 kg CO_2e).

Steinwolle MW(SW)-PT 5 (105 kg/m^3), with a significantly lower mass than ÖKOBETON, still contributes a large amount of CO2 equivalents due to its higher GWP per unit mass. This indicates a high environmental impact relative to its weight.

Gipswandbauplatten shows a moderate mass and a lower GWP total compared to ÖKOBETON and Steinwolle. This makes it a more environmentally friendly option in terms of production phase emissions.

The steel reinforcement has a relatively high density, but its volume is only 2% of the concrete ÖKOBETON, therefore it results in a lower GWP total.

AUSTROTHERM EPS was used in a small quantity and has a low density, which makes it a feasible option for insulation with a moderate environmental impact.

Next section evaluates the environmental impact of materials that contribute the least to the Global Warming Potential (GWP) during the A1-A3 stages (production phase) of their life cycle. These materials demonstrate negative GWP values and offset carbon emissions.

Table 22. Least contributing materials according to eco2soft.

Materials	Masse, kg	GWP-total, kg CO_2e
Brettschichtholz, verleimt Aussenanwendung (475 kg/m^3 - zb Fichte/Tanne)	292 139.00	-350 566.80
Konstruktionsvollholz (KVH)	57 081.00	-82 196.64
Nutzholz (675 kg/m^3 - zB Eiche) - gehobelt, techn. getrocknet	37 449.00	-56 173.50
SterlingOSB/3-Zero	42 140.00	-48 461.00
Schüttungen aus Sand, Kies, Splitt (1800 kg/m^3)	88 005.00	623.08

The negative GWP indicates that a material has the ability to absorb CO_2, and this effect is greater than the amount of CO_2 that is emitted during its production. This way the carbon footprint of construction projects can be reduced.

KVH, or structural timber, shares the same ability to offset carbon emissions, by showing the negative GWP value, and contributing to lower overall carbon emissions for the project.

Nutzholz, using high-density oak, is another strong candidate for reducing the carbon footprint. The negative GWP indicates its role in sequestering carbon during its lifecycle.

SterlingOSB/3-Zero is a versatile and sustainable option, providing a negative GWP. This makes it a good alternative for projects aiming to reduce their carbon emissions.

"Schüttungen aus Sand, Kies, Splitt" shows a low GWP total, indicating a modest environmental impact in terms of CO2 emissions during the production phase. Its high mass and density make it suitable for foundational use, providing essential structural support while maintaining a relatively low carbon footprint.

The materials provide a negative GWP, thereby reducing the overall environmental impact of a construction project. Brettschichtholz and Konstruktionsvollholz stand out for their high mass and substantial negative GWP, making them ideal for projects aiming to maximize carbon sequestration. Nutzholz and SterlingOSB/3-Zero also provide substantial carbon offsets and should be considered for their potential to reduce the carbon footprint.

The general results for the Product Phase are shown in table 23.

Table 23. Building elements and their GWP-total values according to eco2soft.

Quantity	Building element	GWP-total, kg CO2 equ. pro ref. area
41,30 m^2	AW01_ Kelleraußenwand 25STB+12WD	3 004.9
312,60 m^2	AW01_ Kelleraußenwand 30STB+17WD	28 725.7
192,20 m^2	AW02_ Außenwand 25STB+12WD	15 597.0
1.471,00 m^2	AW03_ Außenraum gegen beheizt	-49 760.2
143,20 m^2	AW05_ Stgh gegen Beheizt OG2-OG6	4 865.1
27,00 m^2	AW05a_ Stgh gegen Naßzelle OG2-OG6	1 430.9
28,30 m^2	AW05b_ Stgh gegen Beheizt OG1	858.6
19,10 m^2	AW05c_ Stgh gegen Unbeheizt	1 681.3
51,00 m^2	AW05d_ Stgh gegen Unbeheizt	4 936.7
60,00 m^3	Bauholz Stütze	-41 067.4
38,60 m^3	Bauholz Unterzug	-26 436.2
291,40 m^2	DE01_Fußboden Außenraum gegen beheizt	36 095.0
32,40 m^2	DE02_Müllraum gegen beheizt	4 006.6
487,00 m^2	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	115 332.2
149,60 m^2	DE04_Forum	14 917.3
1.415,70 m^2	DE05_Decke Wohnung gegen Wohnung	-46 540.7
163,20 m^2	DE05a_Decke Wohnung gegen Naßzelle	-1 359.4
288,40 m^2	DE05b_Decke Wohnung 1OG	37 060.8
243,90 m^2	DE06_Extensives Gründach mit reduziertem Aufbau	-2 969.2
468,90 m^2	DE07_Decke unter Freibereich	-7 870.1
328,70 m^2	IW01_ Wohnung gegen Wohnung	-27 473.7
580,90 m^2	IW02_ Modultrennwand	-48 722.8
143,00 m^2	IW02a_ Modultrennwand einseitig	-5 795.2
345,30 m^2	IW03_ Gang gegen Wohnung	-13 665.3
1.139,60 m^2	IW04_LB 10cm einfach Metallständerwand	11 805.1
108,80 m^2	IW04a_LB 6,25cm einfach Vorsatzschale	608.1
100,80 m^2	IW04b_LB 7,5cm Vorsatzschale	894.3
35,28 m^3	STB Stütze	8 227.8
1,60 m^3	STB Unterzug	357.7
199,40 m^2	STB Wand 25 cm KG	11 805.1

44,00 m^2	STB Wand 50 cm KG	5 222.9
8.816,70 m^2	Total	**35 773.0**

Additionally, reinforcement for concrete and green roof should be added to the total result, as it was not calculated in eco2soft. The values are taken from the OneClick LCA calculation.

- Reinforcement for concrete (rebar), diameter: 6-40 mm, 7850 kg/m^3 (Badische Stahlwerke): 26 330 kg CO_2
- Extensive green roof system, 40mm, 23.34 kg/m^2, Urbanspace (Knauf): 939 kg CO_2

Results including all materials are:

35 773 + 26 330 + 939 = 63 042 kg CO_2

A4 Transport – Results

The transport phase refers to the transportation of building materials from the manufacturer to the construction site. The estimation includes vehicle emissions, fuel consumption and other related environmental impacts, which are caused by transportation. Another important criterion for this stage is the distance that vehicles need to travel, the type of transportation and fuel need to be determined. And lastly, the mass of the transported building materials. The calculation with baubook is not fully automated and requires choosing the transportation type and the distance from the manufacturer to the building site. The result obtained from eco2soft is 40066 kgCO_2e

B4 Replacement – Results

This section evaluates the environmental impact of various building materials during the B4 stage (use phase) of their life cycle. The analysis focuses on the Global Warming Potential (GWP), measured in kg CO2 equivalents per functional unit (FE), and the total CO2 equivalents for each material over their respective service lives.

As it was mentioned before, baubook creates building materials, which consist of layers. The service life of materials was partially edited, where it was necessary. As a result, the service life of some of the materials is not the same in all building elements. Below is a list of building elements containing materials with a service life less than 50 years.

Table 24. eco2soft results for 50 years - B4 Replacement

Building element	GWP-total, kg CO_2e	Surface area, m^2
AW02_ Außenwand 25STB+12WD	4 292.8	192.2
AW03_ Außenraum gegen beheizt	2 861.8	1471.0
AW05_ Stgh gegen Beheizt OG2-OG6	357.7	143.2
AW05b_ Stgh gegen Beheizt OG1	357.7	28.3
AW05c_ Stgh gegen Unbeheizt	357.7	19.1
DE01_Fußboden Außenraum gegen beheizt	1 430.9	291.4
DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	1 073.2	487.0
DE04_Forum	357.7	149.6
DE06_Extensives Gründach mit reduziertem Aufbau	11 447.4	243.9
DE07_Decke unter Freibereich	26 829.8	468.9
Total:	**49 366.7**	**3494.6**

For clarification, the calculation for the building element “AW03_ Außenraum gegen beheizt” is represented in the following table.

C1-C4 End-of-Life – Results

This stage describes the deconstruction, demolition, disposal and waste management process of building materials. Various environmental impacts are included in this calculation, such as energy use of machinery required for demolition, emissions from waste treatment processes, waste generation and recycling rates. The value also depends on the type of transport used to transport building materials from the construction site to the next destination (disposal or waste processing facilities). And finally, impacts associated with landfills or incineration plants, like decomposition and emissions from burning these materials. Additionally, some of the energy can be recovered, and this may reduce the negative environmental impact. All these criteria are combined in the value of GWP-total for this stage and according to eco2soft is equal to 876 439 kg CO_2e.

Table 25. Results of B4 Replacement for AW03_ Außenraum gegen beheizt

Building element	Material from eco2soft	Service life, years	Density, kg/m³	Thickness, cm	Surface area, m²	Masse, kg	GWP-total, kg CO2 equ./kg	GWP-total, kg CO_2 equ.
Verkleidung Holz	Nutzholz (675 kg/m³ - zB Eiche) - gehobelt, techn. getrocknet	50	675	3.6	1 471	35 745.3	-1.5	0
Faserzementplatte	Faserzementplatten (2000 kg/m³)	50	2 000	1.25	1 471	36 775	0.947	0
UK Latten 2,8x7,0cm c/c 60cm	Konstruktionsvollholz (KVH)	50	475	0.7	1 471	4 891.08	-1.44	0
UK Latten 2,8x7,0cm c/c 40cm	Konstruktionsvollholz (KVH)	50	475	0.7	1 471	4 891.08	-1.44	0
Dampfdiffusionsoffene Windbremse	Würth Dampfbremse Wütop DB 2	25	1 200	0.06	1 471	1 059.12	2.84	3 007.90
Holzkonstruktion inzw. Wärmedämmung	Steinwolle MW(SW)-PT 5 (105 kg/m³)	25	105	19.5	1 471	30 118.72	1.74	52 406.58
CLT	Brettschichtholz, verleimt Aussenanwendung (475 kg/m³ - zb Fichte/Tanne)	100	475	10	1 471	69 872.50	-1.2	0
Dampfbremse	Würth Dampfbremse Wütop DB 2	25	1 200	0.06	1 471	1 059.12	2.84	3 007.90
GKF	Gipswandbauplatten (900 kg/m³)	50	900	1.5	1 471	19 858.50	0.226	0
GKF	Gipswandbauplatten (900 kg/m³)	50	900	1.5	1 471	19 858.50	0.226	0
							Total:	58 422.38

Stone wool insulation material contributes significantly to the environmental impact, due to its high GWP of 52,406.58 kg CO_2e and a service life of 25 years.

Würth Dampfbremse with a shorter service life of 25 years, this material has a notable GWP of 3,007.90 kg CO_2e, reflecting its synthetic composition and the need for more frequent replacements.

Lower environmental impacts can be ensured by using materials with longer service lives, particularly those with carbon sequestration properties like wood, while those requiring more frequent replacement, such as stone wool insulation and synthetic barriers, contribute more significantly to the building's carbon footprint.

Table 26. eco2soft results for 100 years - B4 Replacement

Building element	GWP-total, kg CO_2e	Surface area, m^2
AW02_ Außenwand 25STB+12WD	7 154.6	192.2
AW03_ Außenraum gegen beheizt	60 814.1	1471
AW05_ Stgh gegen Beheizt OG2-OG6	3 577.3	143.2
AW05c_ Stgh gegen Unbeheizt	3 577.3	19.1
AW05d_ Stgh gegen Unbeheizt	3 577.3	51.0
DE01_Fußboden Außenraum gegen beheizt	7 154.6	291.4
DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	17 886.5	487.0
DE04_Forum	3 577.3	149.6
DE05_Decke Wohnung gegen Wohnung	132 360.1	1415.7
DE05a_Decke Wohnung gegen Naßzelle	14 309.2	163.2
DE05b_Decke Wohnung 1OG	21 463.8	288.4
DE06_Extensives Gründach mit reduziertem Aufbau	35 773.0	243.9
DE07_Decke unter Freibereich	89 432.5	468.9
IW01_ Wohnung gegen Wohnung	3 577.3	328.7
IW03_ Gang gegen Wohnung	7 154.6	345.3
IW04_LB 10cm einfach Metallständerwand	14 309.2	1139.6
Total:	**441 015.60**	**7 198.2**

eco2soft does not calculate GWP-biogenic, which leads to significant value for GWP-total. As it was mentioned before, the timber materials that were used in large amount for this case study have a negative GWP-total. To make the results of LCA comparable, it is necessary to calculate GWP-total for timber materials that are replaced during the calculation period. Since these materials have a service life of 50 or more years, the results of B4 Replacement phase for 50 years will not be adjusted. Below is the table with the list of timber materials and their negative values of GWP-total that should be conducted from the results shown above.

Table 27. Timber materials

Building element	GWP-total, kg CO_2e	Surface area, m^2
Verkleidung Holz	-56 184.0	1 541.4
OSB	-47 672.2	3 734.6
Parkett	-30 012.6	1 704.1
Holzbelag auf Unterkonstruktion	-6 393.5	468.9
Total:	**-140 262.3**	**7 449.0**

The total result for B4 Replacement for 100 years is:

441 015.6– 140 262.3 = 300 753.4 kg CO_2e

Table 28. eco2soft results

GWP-total, kg CO_2e			
A1-A3 Product Phase	B4 Replacement for 50 years	B4 Replacement for 100 years	B4 Replacement for 100 years (with negative GWP-total)
63 042.0	49 366.7	432 853.3	300 753.4

4.6 EU-Taxonomy Calculation

This section of a thesis covers an assessment made according to EU-Taxonomy using Excel and information from database available online. This section describes necessary steps in order to conduct a calculation of the environmental impact of building materials. The results of this LCA method will provide a foundation for the final analysis in Chapter 5 "Comparison of LCA methods".

4.6.1 Methodology

According to calculation guidelines, EU-Taxonomy includes the following life cycle phases: A1-A3, B4, and C1-C4.

This calculation is supposed to be performed with the data from baubook. But since it is also used for Oi3-Index it was necessary to find another database that could be used for EU-Taxonomy. Before making a final decision, an alternative option, which is in this case ÖKOBAUDAT, needs to be tested and compared to baubook, in order to understand how much the difference is. It was decided to choose 2 different materials and analyze their environmental indicators only for A1-A3 stages, due to baubook having these stages only.

Table 29. Environmental indicators for polyethylene foil from ÖKOBAUDAT and baubook

Indicators of environmental impact	ÖKOBAUDAT	baubook
GWP-total [kg CO2 eq.]	2.3	2.6
GWP-biogenic [kg CO2 eq.]	0.019	-0.046
GWP-fossil [kg CO2 eq.]	2.3	2.7
ODP [kg CFC-11 eq.]	1.59E-11	6.42E-7
POCP [kg NMVOC eq.]	0.004	0.002
AP [Mole of H+ eq.]	0.003	0.011
Indicators of resource use	ÖKOBAUDAT	baubook
PERE [MJ]	7.8	1.9
PERM [MJ]	0	0
PERT [MJ]	7.8	1.9
PENRE [MJ]	34.3	47.9
PENRM [MJ]	43.5	35.9
PENRT [MJ]	77.8	83.8

Table 30. Environmental indicators for stone wool from ÖKOBAUDAT and baubook

Indicators of environmental impact	ÖKOBAUDAT	baubook
GWP-total [kg CO2 eq.]	192.1	200.1
GWP-biogenic [kg CO2 eq.]	0.776	0
GWP-fossil [kg CO2 eq.]	191.3	200.1
ODP [kg CFC-11 eq.]	7.26E-10	8.06E-06
POCP [kg NMVOC eq.]	0.4675	0.5819
AP [Mole of H+ eq.]	1.505	1.357
Indicators of resource use	ÖKOBAUDAT	baubook
PERE [MJ]	360.3	90.275
PERM [MJ]	0	0
PERT [MJ]	360.3	90.275
PENRE [MJ]	2012	2449.5
PENRM [MJ]	17.52	0
PENRT [MJ]	2030	2449.5

4.6.2 Input data

The comparison of 2 databases has not shown a significant difference. Therefore, ÖKOBAUDAT was used for the calculation of environmental impact for EU-Taxonomy. The calculation was conducted in Excel, using a bill of materials and values taken directly from ÖKOBAUDAT.

Service lives are not mentioned in the current database. To solve this issue, OI3 – calculation guidelines were used to determine the service lives of materials. The following table demonstrates groups of materials and their service lives.

Table 31. Service life catalog, OI3-calculation guidelines, version 4.0

Constructions	Description	Service life, years
Primary constructions	Load-bearing constructions	100
Secondary constructions	all construction layers except windows, building waterproofing/foils, floor coverings and building services components	50
Insulation	Thermal insulation composite systems made of MW plasterboard, EPS-F, mineral foam boards, cork insulation boards, hemp insulation boards, etc.	35
Screed	Plasters including substrates	35
Seals/foils: 35a	Aluminum-bitumen sealing sheets, aluminum vapor barrier, bitumen materials	35
Seals/foils: 25a	Construction foils made of rubber (EPDM), PE and PVC sealing sheets, building paper, other seals excluding bituminous seals, metal-laminated films, etc.	25
Floor coverings: 50a	Solid wood floors, solid parquet, ceramic tiles, natural stone, artificial stone, etc.	50
Floor coverings: 25a	Multi-layer parquet, laminate flooring, linoleum, PVC flooring, polyolefin flooring based on PE and PU, rubber flooring, rubber studded flooring, etc.	25
Floor coverings: 10a	Cork, textile floor coverings, etc.	10
Floor and wall coatings	Screed coatings, varnishes, wall paints, wallpapers, etc.	10

4.6.3 Results

A1-A3 Materials – Results

Table 32 presents the top 5 of the most contributing materials according to the EU-Taxonomy calculation, highlighting their respective volumes and total GWPs.

Table 32. Most contributing materials according to EU-Taxonomy calculation

Material	Volume, m^3	GWP-total, kg CO_2e
Beton der Druckfestigkeitsklasse C 25/30 (2400 kg/m^3)	993.055	195 631.84
ROCKWOOL Steinwolle-Dämmstoff im hohen Rohdichtebereich (155 kg/m^3)	854.121	136 915.52
Bewehrungsstahl (7850 kg/m^3)	18.710	35 249.64
Gipsplatte Rigips GaBi Duraline bzw. Riduro - 15 mm; 14,85 kg / m^2 (990 kg/m^3)	195.978	30 180.54
ISOVER Trittschall-Dämmplatte S TDPS	170.768	25 704.00

Concrete of the C 25/30 class with a density of 2400 kg/m^3, is the highest contributor to GWP, as in previous calculations. Its extensive use and the energy-intensive processes involved in cement production result in a significant carbon footprint.

Stone wool insulation with a high density, also has a substantial GWP, due to emissions associated with the production process.

Production of reinforcement steel has an energy-intensive nature and involves both mining and processing, which results in considerable GWP.

This material is used for acoustic insulation and contributes notably to the overall GWP, reflecting the environmental impact of producing specialized insulation products.

Gypsum boards, used for interior finishes for multiple building elements, also contribute significantly to GWP due to the energy required in gypsum extraction and board manufacturing processes.

The list of least contributing materials consists primarily of timber materials, as the ÖKOBAUDAT, similar to baubook, uses the negative values of GWP-total. This indicates the sequestration of carbon dioxide, highlighting materials that contribute to reducing the overall carbon footprint.

Table 33. Least contributing materials according to EU-Taxonomy calculation

Material	Volume, m^3	GWP-total, kg CO_2e
Brettschichtholz - Standardformen (507.11 kg/m^3)	613.840	-410 167.89
Konstruktionsvollholz (492.92 kg/m^3)	98.596	-71 679.29
Schnittholz (459 kg/m^3)	77.070	-56 060.72
Oriented Strand Board (OSB) (600 kg/m^3)	69.090	-44 169.30
Mehrschichtparkett (410 kg/m^3)	34.082	-11 345.52
Lindura®-Holzboden (946 kg/m^3)	14.067	-11 181.99

Cross-laminated timber shows the most significant negative GWP, due to its ability to store carbon efficiently, making it the top contributor to carbon sequestration among the materials analyzed.

Structural timber, used for columns and beams, also demonstrates a significant negative GWP. Its lower density compared to cross laminated timber still contributes substantially to reducing the overall carbon footprint.

Structural timber, used for columns and beams, and sawn timber, with its moderate volume, was used for façade, also demonstrate a significant negative GWP and contribute substantially to reducing the overall carbon footprint.

OSB is known for its structural strength and versatility, also contributes significantly to carbon sequestration. Its production results in a notable negative GWP, emphasizing its environmental benefits.

Multi-layer parquet and Lindura® wood were used for internal and external flooring, together demonstrate a significant negative GWP.

Table 34. Total results for Product Phase A1-A3

Material	Volume, m^3	GWP-total, kg CO_2e
Zementestrich	54.2	14 935.5
A2-Betonpflaster- Standardstein grau mit Vorsatz	27.4	6 860.7
Schnittholz	77.1	-56 060.7
EPS-Hartschaum (Rohdichte 30 kg/m^3)	192.5	16 266.4
PE-HD mit PP-Vlies zur Abdichtung	0.3	1 336.0
Faserzementplatte	23.1	16 066.8
Extrudierter Polystyrol Dämmstoff	116.5	10 958.1
Gummi-Bodenbelag mit Schaumstoffbeschichtung EN 1816	7.0	20 274.1
Keramische Fliesen und Platten	1.9	1 777.5
EPS-Hartschaum (Rohdichte 30 kg/m^3)	58.3	5 113.5
Mineralwolle (Fassaden-Dämmung)	5.8	395.7
Mineralwolle (Boden-Dämmung)	114.6	14 907.5
EPS-Hartschaum (Rohdichte 15 kg/m^3)	20.1	910.8
Beton der Druckfestigkeitsklasse C 25/30	993.1	195 631.8
Bewehrungsstahl	18.7	35 249.6
Mineralwolle (Innenausbau-Dämmung)	128.4	5 044.1
Kunstharzputz	1.1	1 332.3
DuPont™ AirGuard® Dampfsperre (5816X)	1.8	14 405.8
Oriented Strand Board	69.1	-44 169.3
ROCKWOOL Steinwolle-Dämmstoff im hohen Rohdichtebereich	854.1	167 920.1
Gründach extensiv (ohne Geländer)		1 032.2
Fliesenkleber	0.2	127.5
Bitumenbahnen G 200 S4	9.9	2 632.8
Trockenestrich - Gipsfaserplatte/Tool	51.1	14 367.6
EPDM-Dach- und Dichtungsbahnen EVALASTIC®V,VG,VSGK	1.8	10 128.2
EPS-Hartschaum (Rohdichte 25 kg/m^3)	23.7	1 836.3
Brettschichtholz - Standardformen	613.8	-373 460.3
Rigips GaBi Duraline bzw. Riduro - 15 mm; 14,85 kg / m^2	196.0	30 180.5
Mehrschichtparkett (generisch)	48.1	-12 244.9
Kies (Korngröße 2/32)	48.9	237.0
Konstruktionsvollholz	98.6	-63 347.9
ISOVER Trittschall-Dämmplatte S TDPS	170.8	25 704.0
Total:	**4 047.6**	**66 349.3**

A4 Transport – Results

The GWP-total value of A4 Transport is associated with the environmental impact of the transportation of building materials from manufacturers to the building site. Every building material was automatically provided with the transportation type and a distance that needs to be covered. Other criteria such as fuel and emissions have also been incorporated into the final value for this stage. The GWP-total according to the calculation with OneClick LCA is 25 462,17 kg CO_2e.

B4 Replacement – Results

The service life of materials has been defined according to OI3 – calculation guidelines and adjusted in relation to neighboring materials, if necessary. As a result, the service life is not constant for materials in different building elements.

Below is table 35 representing results for a calculation period of 50 years.

Table 35. EU-Taxonomy B4 Replacement results for calculation period of 50 years

Material	Volume, m^3	GWP-total, kg CO_2e
EPS-Hartschaum (Rohdichte 30 kg/m^3)	192.5	16 266.4
PE-HD mit PP-Vlies zur Abdichtung	0.3	765.1
Gummi-Bodenbelag mit Schaumstoffbeschichtung EN 1816	7.0	20 274.1
Mineralwolle (Innenausbau-Dämmung)	128.4	213.7
Kunstharzputz	1.1	1 332.3
ROCKWOOL Steinwolle-Dämmstoff im hohen Rohdichtebereich	854.1	4 449.5
Gründach extensiv (ohne Geländer)	n/a	1 032.2
Bitumenbahnen G 200 S4	9.9	1 249.1
EPDM-Dach- und Dichtungsbahnen EVALASTIC®V,VG,VSGK	1.8	6 783.0
ISOVER Trittschall-Dämmplatte S TDPS	170.8	3 218.7
Total:	**4 047.6**	**55 584.0**

Table 36. EU-Taxonomy B4 Replacement results for calculation period of 100 years

Material	Volume, m^3	GWP-total, kg CO_2e
Zementestrich	54.2	2 247.3
A2-Betonpflaster- Standardstein grau mit Vorsatz	27.4	6 860.7
Schnittholz	77.1	-40 883.1
EPS-Hartschaum (Rohdichte 30 kg/m^3)	192.5	48 799.1
PE-HD mit PP-Vlies zur Abdichtung	0.3	2 295.3
Faserzementplatte	23.1	16 066.8

Gummi-Bodenbelag mit Schaumstoffbeschichtung EN 1816	7.0	60 822.2
Keramische Fliesen und Platten	1.9	1 777.5
Mineralwolle (Fassaden-Dämmung)	5.8	143.0
Mineralwolle (Boden-Dämmung)	114.6	14 907.5
Mineralwolle (Innenausbau-Dämmung)	128.4	5 257.7
Kunstharzputz	1.1	2 664.5
DuPont™ AirGuard® Dampfsperre (5816X)	1.8	400.9
Oriented Strand Board	69.1	-44 169.3
ROCKWOOL Steinwolle-Dämmstoff im hohen Rohdichtebereich	854.1	102 206.5
Gründach extensiv (ohne Geländer)	n/a	3 096.6
Fliesenkleber	0.2	51.9
Bitumenbahnen G 200 S4	9.9	3 833.8
Trockenestrich - Gipsfaserplatte/Tool	51.1	14 367.6
EPDM-Dach- und Dichtungsbahnen EVALASTIC®V,VG,VSGK	1.8	20 348.9
Rigips GaBi Duraline bzw. Riduro - 15 mm; 14,85 kg / m^2	196.0	30 180.5
Mehrschichtparkett (generisch)	48.1	-12 244.9
ISOVER Trittschall-Dämmplatte S TDPS	170.8	32 141.4
Total:	**4 047.6**	**271 172.5**

C1 Deconstruction – Results

The table below represents the top 5 materials with the highest values for GWP-Total calculated during the C1 Deconstruction phase.

Table 37. EU-Taxonomy results - C1 Deconstruction

Material	Volume, m^3	GWP-total, kg CO_2e
Beton der Druckfestigkeitsklasse C 25/30 (2400 kg/m^3)	993.06	3 078.47
Gipsplatte Rigips GaBi Duraline bzw. Riduro - 15 mm; 14,85 kg / m^2 (990 kg/m^3)	195.98	636.43
A2-Betonpflaster- Standardstein grau mit Vorsatz (2300 kg/m^3)	27.43	167.02
Bewehrungsstahl (7850 kg/m^3)	18.71	47.00
Kies (Korngröße 2/32) (1850 kg/m^3)	48.89	26.52

Concrete, due to its significant volume, has the highest GWP during deconstruction. The processes involved in breaking down and handling large quantities of concrete contribute to its relatively high carbon footprint.

Gypsum board, commonly used for interior walls and ceilings, shows a moderate GWP. The energy required to dismantle and process these panels results in a notable environmental impact.

The deconstruction of concrete paving blocks has a lower GWP compared to larger structural elements but still contributes to the overall carbon footprint due to the processes involved in their removal and disposal.

Reinforcement steel has a relatively low GWP during deconstruction. This is due to its smaller volume and the efficiency of steel recycling processes.

Gravel used in construction has the lowest GWP among the materials analyzed. Its deconstruction impact is minimal due to the ease of removal and low energy requirements.

C2 Trasport – Results

Table 38 summarizes the GWP results for different materials during the transport phase according to the EU-Taxonomy calculation.

Table 38. EU-Taxonomy results - C2 Transport

Material	Volume, m^3	GWP-total, kg CO_2e
Beton der Druckfestigkeitsklasse C 25/30 (2400 kg/m^3)	993.06	11 916.66
A2-Betonpflaster- Standardstein grau mit Vorsatz (2300 kg/m^3)	27.43	631.04
Gipsplatte Rigips GaBi Duraline bzw. Riduro - 15 mm; 14,85 kg / m^2 (990 kg/m^3)	195.98	609.28
Bewehrungsstahl (7850 kg/m^3)	18.71	521.55
Brettschichtholz - Standardformen (507.11 kg/m^3)	613.84	411.95

Transportation of concrete has the highest GWP due to its significant volume and weight, which require substantial fuel consumption for transport, leading to higher emissions.

Concrete paving blocks also contribute notably to transportation emissions due to their density, though their overall impact is lower compared to large volumes of concrete.

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Concrete paving blocks also contribute notably to transportation emissions due to their density, though their overall impact is lower compared to large volumes of concrete.

The transportation of gypsum boards and reinforcement steel results in a moderate GWP. Whereas CLT has the lowest GWP among the materials analyzed for transport. The light weight of CLT reduces the fuel required for transportation.

C3 Waste Processing – Results

Table 39 presents the GWP results for various materials during the waste processing phase according to the EU-Taxonomy calculation.

Table 39. EU-Taxonomy results - C3 Waste Processing

Material	Volume, m^3	GWP-total, kg CO_2e
Brettschichtholz - Standardformen (507.11 kg/m^3)	613.84	506 786.30
Konstruktionsvollholz (492.92 kg/m^3)	98.60	80 454.34
Oriented Strand Board (OSB) (600 kg/m^3)	69.09	67 929.39
Schnittholz (459 kg/m^3)	77.07	58 696.51
Mehrschichtparkett (410 kg/m^3)	34.08	21 471.66

The results from Stage C3 are associated with the waste processing of various building materials for reuse, recovery, and recycling. Cross laminated timber (CLT) shows the highest GWPs. It means that the energy-intensive processes for handling these materials contribute substantially to their carbon footprints. The same can be stated for the following materials: Oriented Strand Board (OSB), structural timber, sawn timber and multi-layer parquet.

C4 Disposal – Results

The results from Stage C4 highlight the environmental impacts associated with the disposal of various building materials. Gypsum board exhibits the highest GWPs, reflecting the significant emissions generated during its landfilling or incineration. Dry screed, extensive green roof systems and ROCKWOOL stone wool insulation also contribute notably to the carbon footprint during disposal. Fiber cement boards, while showing lower GWP compared to other materials, still present a substantial environmental impact.

Table 40. EU-Taxonomy results - C4 Disposal

Material	Volume, m^3	GWP-total, kg CO_2e
Gipsplatte Rigips GaBi Duraline bzw. Riduro - 15 mm; 14,85 kg / m^2 (990 kg/m^3)	195.98	12 891.29
Trockenestrich - Gipsfaserplatte/Tool (24 kg/m^2)	51.12	6 076.82
Gründach extensiv (ohne Geländer)	n/a	6 046.28
ROCKWOOL Steinwolle-Dämmstoff im hohen Rohdichtebereich (155 kg/m^3)	854.12	3 493.35
Faserzementplatte (1300 kg/m^3)	23.12	2 541.77

Table 41. EU-Taxonomy results

GWP-total, kg CO_2e						
A1-A3 Product Phase	B4 Replace-ment for 50 years	B4 Replace-ment for 100 years	C1 Decon-struction	C2 Transport	C3 Waste Processing	C4 Disposal
66 349.3	55 584.0	271 172.5	3 955.7	16 200.0	801 709.3	33 752.2

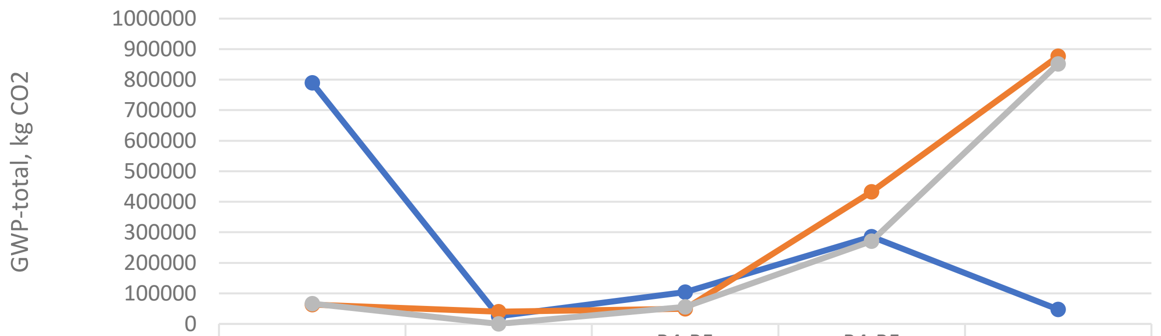
5. Comparison of LCA results

5.1 Analysis

After accomplishing three LCA calculations, the next essential step would be a detailed analysis and comparison of the results obtained. In this chapter, environmental impacts of building materials, specifically their GWP-total values, differentiate across various methods, phases and calculation periods. Additionally, the discussion involves different approaches of accounting for biogenic carbon in timber materials. The results of the analysis highlight discrepancies in GWP-results and the role of biogenic carbon in LCA outcomes.

5.1.1 A1-A3 Product Phase

Figures 22 and 23 show values of all life stages of a reference building for both scenarios, which were obtained from three LCA-methods. In general, the results of Scenario 1 seem to have a dramatic difference in the A1-A3 Product phase. This can be explained by the fact that timber materials in OneClick LCA have a different biogenic carbon accounting. The high GWP in Scenario 1 indicates that OneClick LCA does not consider the carbon sequestration during the wood's growth, only the emissions from its processing and use. As can be observed from Figure 21, OneClick LCA shows a dramatic reduction in GWP when biogenic carbon is included, dropping from 789 456.1 kg CO2e to 71 234.0 kg CO2e.



	A1-A3 Product Phase, Scenario 1	A4 Transport	B4-B5 Reaplacement Phase for 50 years	B4-B5 Reaplacement Phase for 100 years	C1-C4 End-of-Life
OneClick LCA	789456	25451	104081	285413	47855
eco2soft	63042	40066	49366	432853	876439
EU-taxonomy	66349	0	55584	271173	851661

Figure 21. SCENARIO 1: GWP-total values of three LCA-methods

On the contrary, in Scenario 2, the inclusion of biogenic carbon in OneClick LCA means that the carbon absorbed by the wood during growth is subtracted from the total emissions, resulting in a significantly lower GWP. The second approach leads to more favorable GWP results.

An observable similarity is detected between results of eco2soft and EU-Taxonomy. These results remain constant due to the inclusion of biogenic carbon in calculations, approximately 63 042.0 kg CO2e and 66 349.3 kg CO2e. These two methods have a different approach, where the impact of biogenic carbon is already integrated.

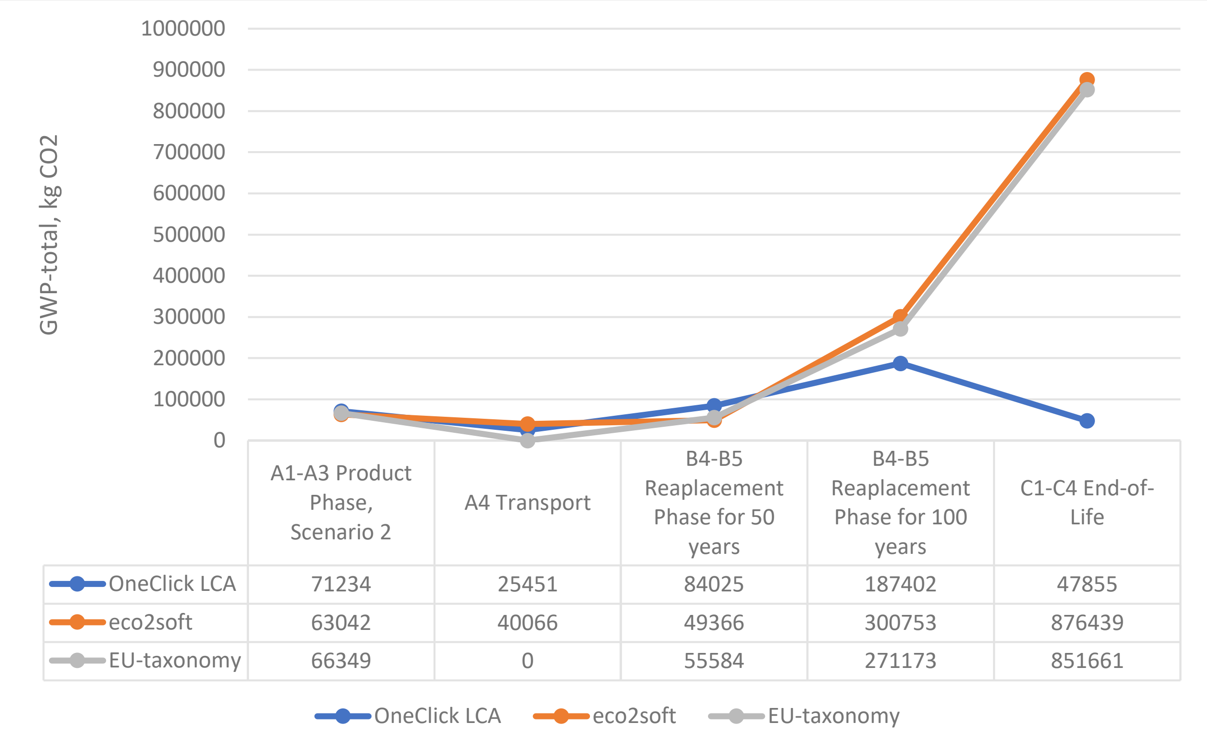


Figure 22. SCENARIO 2: GWP-total values of three LCA-methods

The large difference in OneClick LCA highlights the importance of understanding how LCA tools handle biogenic carbon in Material Phase A1-A3.

5.1.2 A4 Transport – OneClick LCA and eco2soft results

The discrepancy between these two outcomes can be explained by different approaches. OneClick LCA has provided a completely automated calculation for the A4 Transport stage, using its own pre-existing data background provided by the manufacturers. In contrast, eco2soft requires users to provide it with information, such as distance and type of transportation for each building material.

Table 42. Analysis of results A4 Transport

Impact Category	OneClick LCA	eco2soft
GWP-total (kg CO_2e)	25 451.2	40 065.7

5.1.3 B4-B5 Replacement Phase for 50 years

As can be seen, OneClick LCA shows a notable reduction in GWP when biogenic carbon is included, dropping from 104 081 kg CO_2e to 84 025 kg CO_2e.

EU-Taxonomy results remain constant at 55 584.0 kg CO_2e due to biogenic carbon being always integrated in an assessment. eco2soft, on the other hand, no longer includes biogenic carbon in calculations for B4 Replacement phase, but it remains at 49 366.7 kg CO_2e due to service life of timber materials, which is 50 years or more.

Table 43. Analysis of results B4-B5 Replacement Phase for 50 years

Impact Category	OneClick LCA	eco2soft	EU-Taxonomy
GWP-total (kg CO_2e), Scenario 1	104 081.6	49 366.7	55 584.0
GWP-total (kg CO_2e), Scenario 2	84 025	49 366.7	55 584.0

5.1.4 B4-B5 Replacement Phase for 100 years

In OneClick LCA the GWP in Scenario 1 is 275 958.3 kg CO_2e, while in Scenario 2, it drops to 184 402.5 kg CO_2e. The reduction is due to a material which has significant biogenic carbon and needs replacement within the period of 100 years.

Another good example of timber materials reducing the GWP-total is an assessment conducted with eco2soft. It can be observed that the results have a large difference (140 252.3 kg CO2e) and this results in a considerable impact on the overall GWP. Meanwhile the GWP results of EU-Taxonomy for both Scenario 1 and Scenario 2 remain consistent at 271 172.5 kg CO2e.

Table 44. Analysis of results B4-B5 Replacement Phase for 100 years

Impact Category	OneClick LCA	eco2soft	EU-Taxonomy
GWP-total (kg CO_2e), Scenario 1	285 413.0	432 853.3	271 172.5
GWP-total (kg CO_2e), Scenario 2	187 402.5	300 753.4	271 172.5

5.1.5 C1-C4 End-of-Life Phase

C1-C4 End-of-Life Phase – eco2sot results

The end-of-life phase refers to environmental impacts, which occur because of demolition, transportation of building materials from a construction site to waste processing facilities, waste treatment processes and disposal of waste through incineration or landfilling. Results obtained from eco2soft represent an overall value for End-of-Life Stage including all 4 stages. The necessary input data for an automatic calculation is mass of building materials and an end-of-life scenario. The value of GWP-total is equal to 876 439 kg CO_2e.

C2 Transport Phase – OneClick LCA and EU-Taxonomy results

Before analyzing the results for C2 Transport Phase, it is necessary to highlight that EU-Taxonomy assessment has used ÖKOBAUDAT as a database, which states that in Module C2 transport by truck over a distance of 50 km is used as a representative scenario. Which means that these results do not represent real values that can be applied to a case study that is located in Vienna, Austria.

Table 45. C2 Transport Phase results

Impact Category	OneClick LCA	EU-Taxonomy
GWP-total (kg CO_2e)	14 988.5	16 200

OneClick LCA may use actual or project-specific transport distances and modes, which could be more or less than the representative 50 km scenario. Additionally, OneClick LCA uses the exact weights and volumes of materials transported, which results in more precise results. It is also known that this tool can incorporate regional specifics, such as fuel and vehicle types.

At the same time, EU-Taxonomy uses generalized values, which might be average factors. In general, EU-Taxonomy uses a more generic approach, which leads to less accurate results.

Nevertheless, the results have a minor discrepancy between the GWP values.

C3 Waste Processing Phase – OneClick LCA and EU-Taxonomy results

The GWP value reported by OneClick LCA (32 331 kg CO_2e) is significantly lower than that reported by the EU-Taxonomy method (801 709 kg CO_2e). This discrepancy indicates a substantial difference in the approach or data sources used by the two methods.

The potential cause for discrepancy could be assumptions and data sources. OneClick LCA uses a specific dataset or set of assumptions that significantly differ from those used in the EU-Taxonomy. This could include different emission factors, waste processing technologies, or geographic considerations.

Table 46. C3 Waste Processing Phase results

Impact Category	OneClick LCA	EU-Taxonomy
GWP-total (kg CO_2e)	32 331.5	801 709.3

This large difference can be explained with a small example with cross laminated timber. This material is one of the dominating materials in a case study (613.8 m3) and has a great impact on results of C3 Waste Processing Phase. According to OneClick LCA the calculation utilizes a much lower GWP value for waste wood and wood products incineration compared to the value specified in the EPD: 0.0128 kg CO_2e/kg instead of 808.39 kg CO_2e/m3 according to EPD.

Table 47. Calculation of cross-laminated timber

Reviewed material	OneClick LCA	EPD used in OneClick LCA
KLH cross-laminated timber panels	3 833.4	502 124.8

This example highlights how different assumptions and data sources can lead to substantial discrepancies in LCA results. OneClick LCA might use regional or specific datasets with lower emission factors for waste wood incineration. Another assumption is a different approach to the treatment of biogenic carbon in waste wood, which could also lead to varied GWP values.

C4 Disposal – OneClick LCA and EU-Taxonomy results

The results shown in the table below lead to assumptions that OneClick LCA assumes that most materials are either recycled or disposed of with low GWP impacts. For example, it might include modern, efficient waste management practices that minimize emissions. Or use specific data with lower emission factors for disposal processes. While EU-Taxonomy could assume more traditional or less efficient waste disposal methods, leading to higher GWP impacts. It might consider scenarios like landfilling without methane capture or inefficient incineration. Additionally, EPDs use higher emission factors and reflect worst-case or more conservative estimates.

Table 48. C4 Disposal results

Impact Category	OneClick LCA	EU-Taxonomy
GWP-total (kg CO_2e)	427.3	33 752.2

5.2 Methodological differences

Generally, results demonstrate a major disadvantage of life cycle assessment, which is a lack of unification in approaches i.e. different methods applied to an identical case study show different results in various life cycles of building. The issues of comparison of different LCA results have been discussed in many studies and remained unresolved until today.

Functional unit

One of the main issues is a functional unit that has not been unified among conducted methods. Differences in functional units can lead to significant deviations in results and lead to false assumptions and affect a decision-making process. (Chirjiv Kaur Anand, 2017)

Table 49. Types of functional units employed in various LCA methods

Material in focus	Functional unit		
	OneClick LCA	eco2soft	EU-Taxonomy
Load bearing structural frame	m^2, m^3	kg	m^3
Frame (beams, columns and slabs)	m^2, m^3	kg	m^3
External walls	m^2	kg	kg, m^2, m^3
Non-load bearing elements	m^2	kg	m^3
Internal walls, partitions and doors	m^2	kg	m^3
Facades	m^2	kg	m^3
Roof	m^2	kg	kg, m^3
Insulation	m^2	kg	m^3
Steel reinforcement	kg	kg	kg
Wall and ceiling finishes	m^2, m^3	kg	m^3
Floor coverings and finishes	m^2	kg	m^2, m^3
Paving and other hard surfacing	m^2, m^3	kg	m^2, m^3

As can be seen from the table above, there are various functional units that were employed in LCA methods. Interestingly, eco2soft has set a single functional unit, which is applied to all materials of a case study - kg. Meanwhile, EU-Taxonomy and OneClick LCA have incorporated three functional units kg, m2, and m3.

Spatial System boundaries

Next common issue is system boundary. In frames of this work, it was decided to apply a universal system boundary to all three methods to avoid complications.

Database

Comparing LCA results from different methods is challenging because they are based on different data backgrounds. This leads to large numerical differences for identical materials. In 2015 this issue had been studied by Takano et el., where five different databases have been compared, including baubook, GaBi, ecoinvent, CFP and Synergia. The discrepancies in results of a whole building have reached 33% and up to 183% for individual materials. (Atsushi Takano, 2014)

Additionally, a single database is not sufficient due to lack of variety for some materials. This limitation of flexibility requires either an additional effort to adapt or choose a material that does not entirely match characteristics and consequently affects the results. Here is an example of the least contributing materials for A1-A3 Product Phase in frames of this study.

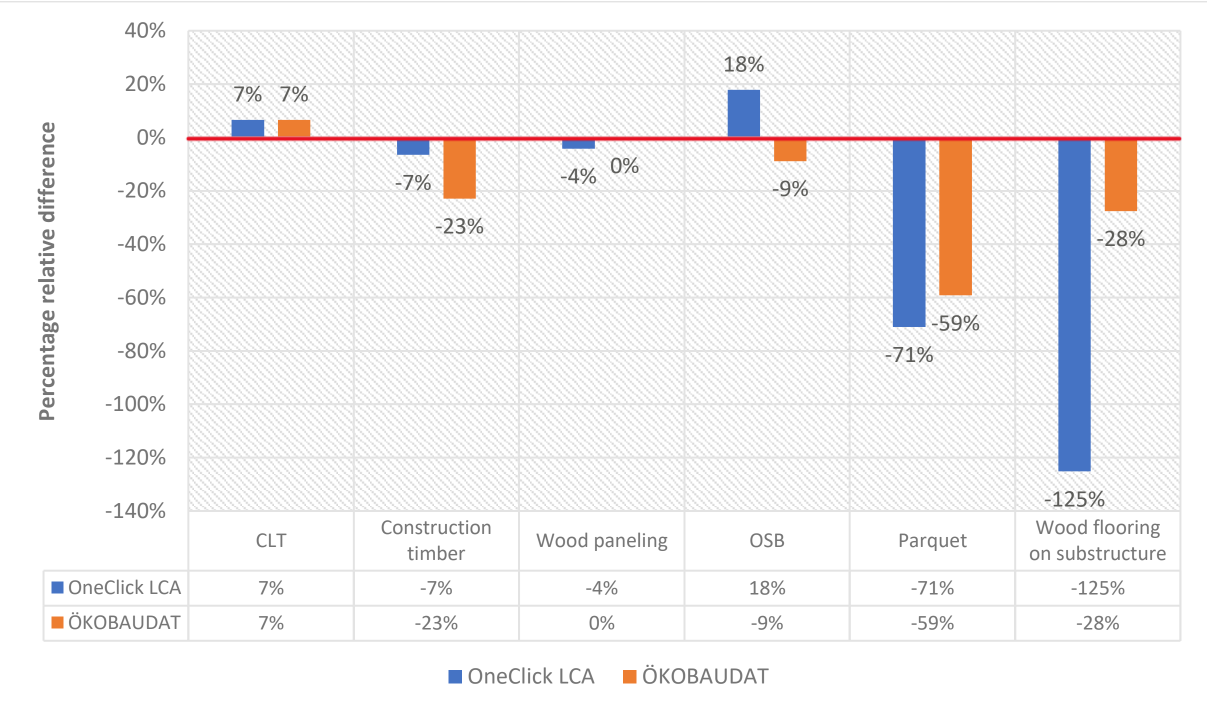
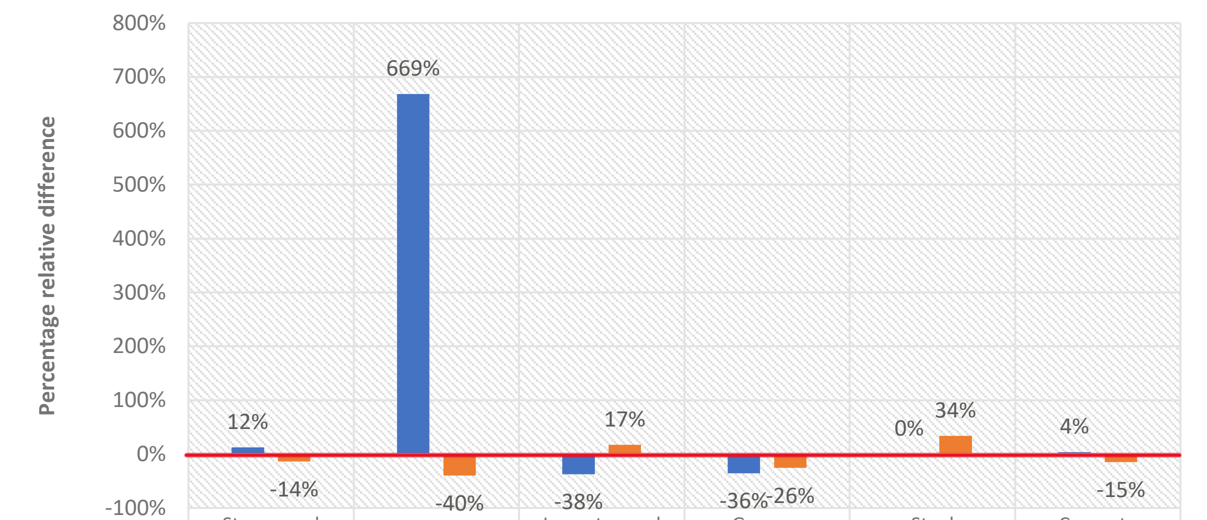


Figure 23. Percentage relative differences in the assessment results for least contributing materials (reference result is eco2soft)

Figure 24 represents the PRD of timber materials used in a case study. As can be seen from it, major differences can be seen in the values of parquet and wood flooring substructure. These different values cause deviations in results. Meanwhile the values of CLT and wood paneling do not differentiate a lot between the databases of these methods.

Figure 25 is another example of how different databases affect LCA results. Next diagram represents values of GWP-total for most contributing materials.



	Stone wool insulation	Aluminum foil	Impact sound insulation	Gypsum plasterboard	Steel reinforcement	Concrete C25/30
OneClick LCA	12%	669%	-38%	-36%	0%	4%
ÖKOBAUDAT	-14%	-40%	17%	-26%	34%	-15%

Figure 24. Percentage relative differences in the assessment results for most contributing materials (reference result is eco2soft)

The most difference is demonstrated in the results between OneClick LCA and other LCA methods is a vapor barrier – aluminum foil, was which used in various horizontal and vertical building elements and is one of the most contributing materials due to its high density (1800 kg/m3). The reason for this significant discrepancy is a limited variety of materials in OneClick LCA. In this case, the only option to choose from OneClick LCA database was aluminum foil with extremely large values. Naturally, these numbers have affected results and as can be seen from the previous chapter, OneClick LCA has shown the least favorable environmental performance in Product phase A1-A3.

Table 50. GWP-total and databases of LCA-methods in case of vapor barrier.

LCA – method	OneClick LCA	eco2soft	EU-Taxonomy
GWP-total, kg CO2	58 584.35	7 622.56	4 578.88
Material in focus	Aluminium foil, Würth Dampfsperre Wütop DS Alu (Würth Handelsges.m.b.H.)	Würth Dampfbremse Wütop DB 2	DuPont™ AirGuard® Dampfsperre (5816X)
Database	One Click LCA	baubook	ÖKOBAUDAT

Gypsum plasterboard in eco2soft has significantly higher values than in OneClick LCA and EU-Taxonomy, 36% and 26% respectively. Impact sound insulation has a wide range of GWP-total as well. Stone wool has demonstrated a significant influence on environmental performance of a project. Each method evaluated stone wool insulation with slightly different properties: variations in density, thickness, and other material characteristics. It can be stated that a precise choice of materials is a crucial element of a successful life cycle assessment.

The values for concrete do not differ as much as other materials, giving a small difference, despite that concrete has the largest volume. It happened due to unified production process and global availability of concrete.

And finally, steel reinforcement of concrete, which is one of the dominant materials, due to the density of 7800 kg/m3, has also demonstrated differences in GWP-total values in EU-Taxonomy (34%), which makes a great contribution to final results.

The analysis had proven that databases have a limited variety of materials and in some cases, it was only possible to choose a material that did not match a description entirely. For example, vapor barrier was used in various horizontal and vertical building elements and is one of the most contributing materials as well.

Another issue that must be mentioned is incomplete information about some materials, especially in eco2soft. There have been a few cases where building materials did not have all the important environmental indicators. Therefore, it was impossible to make a calculation. As a result, another material must be chosen, which did not match a description entirely.

5.3 Strengths and weaknesses of each method

This chapter describes advantages, unique features and limitations of the three life cycle assessment tools used to evaluate environmental impacts of case study.

OneClick LCA

Strengths:

1. User-friendly interface

   OneClick LCA has a user-friendly interface and is accessible to users with varying levels of expertise in LCA.

2. Automatization

   OneClick LCA allows to import data to automatically match it to the database and find suitable materials.

   Additionally, automatically produced graphs and lists, which are helpful in interpreting results, as well as delivering information to stakeholders.

3. Extensive database

   The tool has access to various databases and environmental product declarations, as well as generic data that was created by OneClick LCA.

4. BIM and other integrations

   OneClick LCA makes it possible to integrate BIM software like Revit, ArchiCAD, Tekla etc., facilitating the incorporation of life cycle assessment into the design process.

5. Compatibility with certifications

   It can be successfully used for various certifications such as LEED, BREEAM and DGNB.

Weaknesses:

1. Incomplete data

   Although OneClick LCA has created a wide range of data that can be used in calculations, it still has significant limitations, which has led to negative consequences in results.

2. GWP values

   When evaluating the environmental performance of timber materials, it was discovered that the tool has ignored the negative value of GWP resulting from the growth of a tree in a forest. Such a tendency has not been stated in the other two methods. Hence additional manual calculations for these materials, to enable a comparison of results.

eco2soft

Strengths:

1. Applicability for Austria

   eco2soft was designed to conduct life cycle assessment for Austria and accordingly provides a variety of building materials that are produced locally, which makes an assessment relatively easy compared to other tools.

2. Building elements

   The tool offers to create separate building elements and evaluates the environmental performance of them. Dur to this it is convenient to make changes anytime and see a direct impact on final results.

Weaknesses:

1. Market focus

   As it was mentioned before, eco2soft can be easily applied in Austria, but at the same time has significant limitations in applicability in other regions.

2. Integration limitations

   BIM software and other digital tools cannot be integrated, which can hinder workflow efficiency.

3. Limited life cycle phases

   Assessment with the help of eco2soft does not cover the whole life cycle of a building (A1-A3, A4, B4, C1-C4). To conduct a more extensive assessment it is necessary to make a choice towards another tool.

4. Transport

   To obtain environmental impacts from transportation, the type of transport and the distance must be defined by a user. Often this information cannot be known precisely, which results in one of the disadvantages of eco2soft.

EU-Taxonomy

Strengths:

1. Coverage of almost whole life cycle of a building

   With EU-Taxonomy it is possible to perform an assessment from cradle-to-cradle (except Transport Phase A4), which is something that not all tools are able to provide.

2. Compliance with various databases

   In frames of the case study, it was decided to use ÖKOBAUDAT instead of baubook. The reason for this was a limitation in life cycle stages of Austrian database. As it has been proved, a different database has been implemented in the case study successfully.

Weaknesses:

1. Manual calculations

   EU-Taxonomy does not have a tool or a template that can be used for conducting an assessment. Results have been calculated in Excel and input data taken from a database of choice. On one hand, it has provided an opportunity for micromanaging and enabled to avoid mistakes, which also led to more precise calculations. On the other hand, such an approach requires much longer time.

2. Environmental impacts due to transportation to site

   Transport of building materials to site cannot be calculated in EU-Taxonomy due to incomplete data.

Understanding these strengths and weaknesses is essential for selecting the most appropriate LCA tool, ensuring accurate and reliable environmental assessments.

6. Conclusion

The central theme of this thesis is to compare GWP results derived from different LCA methods (OneClick LCA. Eco1soft, EU-Taxonomy) for various life cycle stages for an apartment building in Vienna, Austria. The comparison is supposed to identify causes of discrepancies in GWP results, as well as strengths and weaknesses of each method, and finally to propose recommendations for improving LCA practices.

6.1 Summary of key findings

The life cycle assessment covers two scenarios – the first one excludes biogenic carbon (Scenario 1), and the second one includes biogenic carbon (Scenario 2). The calculations were conducted for periods of 50 and 100 years.

The comparison has encompassed the following life cycle stages:

- A1-A3 Product Phase
- B4-B5 Replacement Phase
- C2 Transport Phase
- C3 Waste Processing Phase
- C4 Disposal Phase

Variation in Global Warming Potential (GWP) results:

- **Product Phase (A1-A3):** Overall the GWP results across the three LCA methodologies demonstrate significant discrepancies. OneClick LCA has delivered the highest GWP for both scenarios, while eco2soft and EU-Taxonomy present lower and relatively consistent values. This discrepancy highlights the influence of different databases, functional units, and calculation approaches on the final GWP values.
- **Transport Phase (A4):** GWP results from eco2soft and OneClick LCA have shown a moderate discrepancy due to different approaches in calculating the distances from manufacturers to the building site and choice of transport vehicle. The data form OneClick LCA provides accurate information about the variables of building materials for calculating environmental impact from transportation. Whilst eco2soft requires a user to provide this data. To make results more compatible, the distances and transportation type for eco2soft calculation have been chosen, similar to OneClick LCA.

- **Replacement Phase (B4-B5)**: Looking at GWP results for the Replacement Phase over 50 years similar tendency can be noticed. OneClick LCA again shows the highest values, indicating a higher environmental impact for both scenarios compared to eco2soft and EU-Taxonomy. The calculation for 100 years demonstrated a different outcome. The highest GWP for both scenarios is provided by eco2soft. The reason for such a change between 50 and 100 years is the service lives of building materials. Also, it is important to note that the inclusion of biogenic carbon (Scenario 2) reduces the GWP in all methodologies, but the extent of this reduction varies.
- **Deconstruction/Demolition Phase (C1):** eco2soft has provided a general GWP-value for the whole end-life-stage (all phases combined). Therefore, it is not possible to evaluate an environmental impact for this phase. OneClick LCA and EU-Taxonomy do not have an ability to calculate this phase.
- **Transport Phase (C2):** GWP values provided by OneClick LCA and EU-Taxonomy are relatively close. The data from eco2soft is not provided due to limitations of a calculation tool.
- **Waste Processing Phase (C3):** OneClick LCA has shown a much lower result compared to EU-Taxonomy. The data from eco2soft is not provided.
- **Disposal Phase (C4):** Similar to Waste Processing Phase C3 OneClick LCA demonstrates a significantly lower value than EU-Taxonomy. The results from eco2soft could not be obtained.

6.2 Recommendations for practitioners

Functional unit

To address one of the main challenges in comparison of LCA results, which causes difficulties in interpretation of results, communication with stakeholders and undermines a decision-making process, it is important to unify a functional unit (Jana Gerta Backes, 2023). Without it a comparison of different LCA becomes problematic, as each study uses different functional units, such as weight, volume, area etc. This variation directly impacts the accountability of results, their interpretation and does not represent all the impacts of a building (Chirjiv Kaur Anand, 2017).

Life span of a building

The service life of a building is usually variable and does represent the real lifespan of a building. As can be seen from the results mentioned previously, the calculation period plays a key role in life cycle assessment. Wrong assumptions can cause errors in LCA, which emphasizes the necessity of additional analysis for the average life span of a building (Chirjiv Kaur Anand, 2017). However, nowadays, even though a reference study period is still a subject for a debate, the period of 50 years has been the most common in the recent years (Zoe Batjot, 2024).

Spatial system boundary

Even though, for this study, a system boundary has been unified and, as a result, did not affect the outcome, spatial system boundaries are crucial for LCA and must be taken into account. The inclusion or exclusion of specific materials and processes can greatly impact LCA outcomes. At present moment, system boundaries are not standardized among different methods and are not consistently applied, which leads to complications in verifications of LCA results and incomplete conclusions. By establishing standardized system boundaries, it is possible to enhance the reliability and comparability of LCA methods, which leads to more effective sustainability decisions. (Jana Gerta Backes, 2023)

Database

Even though OneClick LCA stands out for its wide range of implemented databases and dedicated data background, it has been challenging to find a proper match for some of the materials or the values from different databases have shown significant discrepancies. Similar obstacles were identified in a study (Atsushi Takano, 2014), where 5 different LCA databases were examined, and the differences of some individual materials have reached up to 183%.

Essentially consistency and comparability across different life cycle assessment methods and regions needs to be established. To improve interoperability various databases can collaborate, enabling users to adjust data from multiple sources, such as transport, fuel, distances etc. In frames of case study, it has been challenging to calculate environmental impact caused by transport and to find exact materials or materials that have similar characteristics. Therefore, expanded databases with a wider range of materials and adjusting the data for different regions would ensure a vast improvement in quality of assessments. (A.Martínez-Rocamoran, 2016)

Lack of completeness of data refers to incomplete data, which leads to results that do not cover all life cycle stages (raw material extraction, manufacturing, transportation, use and end-of-life) (Salim Barbhuiya, 2023). This tendency can be seen in the conducted study, where the chosen methods did not provide complete data, and essentially, it was not possible to conduct a throughout comparison. A comprehensive analysis requires all the data of the life cycle of a building.

6.3 Future outlook

The future role of Life Cycle Assessment in the architecture and construction industry is expected to gain more weight. As it can be seen today sustainability is becoming increasingly prioritized and will expand its influence through technological advancements and optimization lead to low-carbon alternatives and more efficient environmental solutions, political regulations and transform the industry towards more environmentally friendly trends furthermore (Salim Barbhuiya, 2023).

The standardization of LCA methodologies and databases is one of the vital steps for future development. This way the limitations described in the previous section hinder comparability of results and consequently can jeopardize the decision-making process. To avoid this, standardization and harmonization shall be made on an international level, databases shall be integrated on a larger scale and be able to adjust to regional specifications. International collaboration among industries and institutions would improve common knowledge and experience (Salim Barbhuiya, 2023).

The rapid development of artificial intelligence offers great opportunities for automation of data processing and up-to-date adjustments, making the assessment process faster and easier for practitioners of the future.

Advancements in circularity such as reuse, and recycling, extending lifespan and replacement periods of building materials will play a more critical role in LCA reports. As a result, this will increase the importance of implementing circular practices in building projects (Jacinta Dsilva, 2023).

In conclusion, the outlook of Life Cycle Assessment will develop in many ways and overcome many of the issues that practitioners face today and advance in circular, technological, regulatory and standardization ways.

List of illustrations

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Attachment A – Floor areas and volumes

Table A.1. Floor areas

Floor	Gross floor area [m²]	Net floor area [m²]
7	278.5	269.0
6	378.5	313.9
5	394.4	339.8
4	382.5	334.3
3	382.7	324.0
2	391.3	339.9
1	409.3	324.6
0	472.6	431.5
-1	487.5	395.4
	3577.3	**3072.4**

Table A.2. Volumes

Floor	Gross volume [m²]	Net volume [m³]
7	214.45	207.13
6	946.25	784.75
5	1226.58	1056.78
4	1185.75	1036.33
3	1194.02	1010.88
2	1216.94	1057.09
1	1272.92	1009.51
0	2575.67	2351.68
-1	2096.25	1700.22
	11928.84	**10214.36**

Attachment B – Bill of materials

Table B.1. Bill of materials

Description	Building element	Building material	Thickness [m]	Area [m²]	Volume [m³]
Decke	DE01_Fußboden Außenraum gegen beheizt	Gravel	0.06	291.4	17.484
Decke	DE01_Fußboden Außenraum gegen beheizt	EPDM sealing	0.05	291.4	14.570
Decke	DE01_Fußboden Außenraum gegen beheizt	EPS W 30 plus	0.002	291.4	0.583
Decke	DE01_Fußboden Außenraum gegen beheizt	Vapor barrier	0.2	291.4	58.280
Decke	DE01_Fußboden Außenraum gegen beheizt	Sloping screed	0.001	291.4	0.291
Decke	DE01_Fußboden Außenraum gegen beheizt	Reinforced concrete	0.03	291.4	8.742
Decke	DE01_Fußboden Außenraum gegen beheizt	Concrete slabs	0.3	291.4	87.420
Decke	DE02_Müllraum gegen beheizt	Bituminous waterproofing ALGV	0.03	32.4	0.972
Decke	DE02_Müllraum gegen beheizt	Screed	0.01	32.4	0.324
Decke	DE02_Müllraum gegen beheizt	Polyethylene foils	0.1	32.4	3.240
Decke	DE02_Müllraum gegen beheizt	EPS system slab W T	0.001	32.4	0.032
Decke	DE02_Müllraum gegen beheizt	EPS W 25	0.03	32.4	0.972
Decke	DE02_Müllraum gegen beheizt	Filling	0.05	32.4	1.620
Decke	DE02_Müllraum gegen beheizt	Reinforced concrete	0.122	32.4	3.953
Decke	DE02_Müllraum gegen beheizt	Filling	0.3	32.4	9.720
Decke	DE02_Müllraum gegen beheizt	Screed concrete	0.005	32.4	0.162
Fundament	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	EPS system slab W T	0.07	487	34.090
Fundament	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	Vapor barrier	0.03	487	14.610
Fundament	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	EPS granulate	0	487	0.000
Fundament	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	Bituminous waterproofing ALGV	0.03	487	14.610
Fundament	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	Reinforced concrete	0.01	487	4.870
Fundament	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	XPS	0.8	487	389.600

Description	Building element	Building material	Thickness [m]	Area [m²]	Volume [m³]
Fundament	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	Concrete slabs	0.12	487	58.440
Decke Außenraum	DE04_Forum	EPS system slab W T	0.06	149.6	8.976
Decke Außenraum	DE04_Forum	Polyethylene foils	0.03	149.6	4.488
Decke Außenraum	DE04_Forum	EPS granulate	0	149.6	0.000
Decke Außenraum	DE04_Forum	Filling	0.05	149.6	7.480
Decke Außenraum	DE04_Forum	Reinforced concrete	0.203	149.6	30.369
Decke Außenraum	DE04_Forum	Filling	0.3	149.6	44.880
Decke Außenraum	DE04_Forum	Parquet	0.005	149.6	0.748
Decke	DE05_Decke Wohnung gegen Wohnung	Gypsum fibre screed elements	0.02	1415.7	28.314
Decke	DE05_Decke Wohnung gegen Wohnung	Impact sound insulation	0.03	1415.7	42.471
Decke	DE05_Decke Wohnung gegen Wohnung	OSB	0.02	1415.7	28.314
Decke	DE05_Decke Wohnung gegen Wohnung	Wooden construction incl. thermal insulation	0.022	1415.7	31.145
Decke	DE05_Decke Wohnung gegen Wohnung	OSB	0.245	1415.7	346.847
Decke	DE05_Decke Wohnung gegen Wohnung	Impact sound insulation	0.015	1415.7	21.236
Decke	DE05_Decke Wohnung gegen Wohnung	CLT	0.06	1415.7	84.942
Decke	DE05_Decke Wohnung gegen Wohnung	Soft mineral wool	0.1	1415.7	141.570
Decke	DE05_Decke Wohnung gegen Wohnung	GKF	0.05	1415.7	70.785
Decke	DE05_Decke Wohnung gegen Wohnung	GKF	0.015	1415.7	21.236
Decke	DE05_Decke Wohnung gegen Wohnung	Ceramic tiles	0.015	1415.7	21.236
Decke	DE05a_Decke Wohnung gegen Naßzelle	Screed	0.01	163.2	1.632
Decke	DE05a_Decke Wohnung gegen Naßzelle	Impact sound insulation	0.05	163.2	8.160
Decke	DE05a_Decke Wohnung gegen Naßzelle	OSB	0.02	163.2	3.264
Decke	DE05a_Decke Wohnung gegen Naßzelle	Wooden construction incl. Thermal insulation	0.022	163.2	3.590
Decke	DE05a_Decke Wohnung gegen Naßzelle	OSB	0.245	163.2	39.984
Decke	DE05a_Decke Wohnung gegen Naßzelle	Impact sound insulation	0.015	163.2	2.448

Description	Building element	Building material	Thickness [m]	Area [m²]	Volume [m³]
Decke	DE05a_Decke Wohnung gegen Naßzelle	CLT	0.06	163.2	9.792
Decke	DE05a_Decke Wohnung gegen Naßzelle	Soft mineral wool	0.1	163.2	16.320
Decke	DE05a_Decke Wohnung gegen Naßzelle	GKF	0.05	163.2	8.160
Decke	DE05a_Decke Wohnung gegen Naßzelle	GKF	0.015	163.2	2.448
Decke	DE05a_Decke Wohnung gegen Naßzelle	Parquet	0.015	163.2	2.448
Decke	DE05b_Decke Wohnung 1OG	Gypsum fiber screed elements	0.02	288.4	5.768
Decke	DE05b_Decke Wohnung 1OG	Impact sound insulation	0.03	288.4	8.652
Decke	DE05b_Decke Wohnung 1OG	OSB	0.02	288.4	5.768
Decke	DE05b_Decke Wohnung 1OG	Wood construction incl. thermal insulation	0.022	288.4	6.345
Decke	DE05b_Decke Wohnung 1OG	OSB	0.245	288.4	70.658
Decke	DE05b_Decke Wohnung 1OG	Impact sound insulation	0.015	288.4	4.326
Decke	DE05b_Decke Wohnung 1OG	Reinforced concrete	0.06	288.4	17.304
Decke	DE05b_Decke Wohnung 1OG	Filter layer	0.5	288.4	144.200
Dach	DE06_Extensives Gründach mit reduziertem Aufbau	Drainage layer	0.04	243.9	9.756
Dach	DE06_Extensives Gründach mit reduziertem Aufbau	Roof seal	0.04	243.9	9.756
Dach	DE06_Extensives Gründach mit reduziertem Aufbau	EPDM seal	0.001	243.9	0.244
Dach	DE06_Extensives Gründach mit reduziertem Aufbau	Slope insulation	0.001	243.9	0.244
Dach	DE06_Extensives Gründach mit reduziertem Aufbau	Impact sound insulation TDPT 30	0.27	243.9	65.853
Dach	DE06_Extensives Gründach mit reduziertem Aufbau	CLT	0.03	243.9	7.317
Dach	DE06_Extensives Gründach mit reduziertem Aufbau	Soft mineral wool	0.12	243.9	29.268
Dach	DE06_Extensives Gründach mit reduziertem Aufbau	GKF	0.05	243.9	12.195
Dach	DE06_Extensives Gründach mit reduziertem Aufbau	GKF	0.015	243.9	3.659
Dach	DE06_Extensives Gründach mit reduziertem Aufbau	Wood covering on substructure	0.015	243.9	3.659
Decke	DE07_Decke unter Freibereich	Rubber granulate mat Regupol	0.03	468.9	14.067
Decke	DE07_Decke unter Freibereich	EPDM seal	0.015	468.9	7.034

Description	Building element	Building material	Thickness [m]	Area [m²]	Volume [m³]
Decke	DE07_Decke unter Freibereich	Slope insulation	0.002	468.9	0.938
Decke	DE07_Decke unter Freibereich	Impact sound insulation TDPT 30	0.27	468.9	126.603
Decke	DE07_Decke unter Freibereich	Bituminous moisture seal	0.03	468.9	14.067
Decke	DE07_Decke unter Freibereich	CLT	0.01	468.9	4.689
Decke	DE07_Decke unter Freibereich	Soft mineral wool	0.12	468.9	56.268
Decke	DE07_Decke unter Freibereich	GKF	0.05	468.9	23.445
Decke	DE07_Decke unter Freibereich	GKF	0.015	468.9	7.034
Decke	DE07_Decke unter Freibereich	Standing seam	0.015	468.9	7.034
Dach	DE08_Flachdach Blecheindeckung	Solid wood	0.005	7.5	0.038
Dach	DE08_Flachdach Blecheindeckung	Horizontal air layer	0.025	7.5	0.188
Dach	DE08_Flachdach Blecheindeckung	Hard mineral wool	0.08	7.5	0.600
Dach	DE08_Flachdach Blecheindeckung	Reinforced concrete	0.2	7.5	1.500
Dach	DE08_Flachdach Blecheindeckung	Screed	0.2	7.5	1.500
Decke	DE09_Decke Stiegenhaus	Impact sound insulation	0.05	194.3	9.715
Decke	DE09_Decke Stiegenhaus	Reinforced concrete	0.03	194.3	5.829
Decke	DE09_Decke Stiegenhaus	Gravel	0.25	194.3	48.575
Dach	DE10_Flachdach Stiegenhaus	EPDM sealing	0.05	38.2	1.910
Dach	DE10_Flachdach Stiegenhaus	Gradient screed i.M.	0.002	38.2	0.076
Dach	DE10_Flachdach Stiegenhaus	Reinforced concrete	0.11	38.2	4.202
Dach	DE10_Flachdach Stiegenhaus	Reinforced concrete	0.2	38.2	7.640
Außenwand	AW01_ Kelleraußenwand 30STB+17WD	XPS	0.3	312.6	93.780
Außenwand	AW01_ Kelleraußenwand 30STB+17WD	XPS	0.17	312.6	53.142
Außenwand	AW01_ Kelleraußenwand 25STB+12WD	Reinforced concrete	0.12	41.3	4.956
Außenwand	AW01_ Kelleraußenwand 25STB+12WD	Hard mineral wool	0.25	41.3	10.325
Außenwand	AW02_ Außenwand 25STB+12WD	Reinforced concrete	0.12	188.6	22.632
Außenwand	AW02_ Außenwand 25STB+12WD	Wooden cladding	0.25	188.6	47.150

Description	Building element	Building material	Thickness [m]	Area [m²]	Volume [m³]
Außenwand	AW03_ Außenraum gegen beheizt	Fiber cement board	0.036	1471	52.956
Außenwand	AW03_ Außenraum gegen beheizt	UK battens 2.8x7.0cm c/c 60cm	0.015	1471	22.065
Außenwand	AW03_ Außenraum gegen beheizt	UK battens 2.8x7.0cm c/c 40cm	0.03		
Außenwand	AW03_ Außenraum gegen beheizt	Vapour diffusion open wind brake	0.03		
Außenwand	AW03_ Außenraum gegen beheizt	Wooden construction incl. thermal insulation	0.001	1471	1.471
Außenwand	AW03_ Außenraum gegen beheizt	CLT	0.195	1471	286.845
Außenwand	AW03_ Außenraum gegen beheizt	Vapour barrier	0.1	1471	147.100
Außenwand	AW03_ Außenraum gegen beheizt	GKF	0	1377.3	0.000
Außenwand	AW03_ Außenraum gegen beheizt	GKF	0.015	1377.3	20.660
Außenwand	AW03_ Außenraum gegen beheizt	Reinforced concrete	0.015	1377.3	20.660
Außenwand	AW05_ Stgh gegen Beheizt OG2-OG6	Hard mineral wool	0.25	143.2	35.800
Außenwand	AW05_ Stgh gegen Beheizt OG2-OG7	CLT	0.13	133.8	17.394
Außenwand	AW05_ Stgh gegen Beheizt OG2-OG8	GKF	0.1	133.8	13.380
Außenwand	AW05_ Stgh gegen Beheizt OG2-OG9	Vapour barrier	0.015	133.8	2.007
Außenwand	AW05_ Stgh gegen Beheizt OG2-OG10	GKF	0	133.8	0.000
Außenwand	AW05_ Stgh gegen Beheizt OG2-OG11	Reinforced concrete	0.015	133.8	2.007
Außenwand	AW05a_ Stgh gegen Naßzelle OG2-OG6	Hard mineral wool	0.25	27	6.750
Außenwand	AW05a_ Stgh gegen Naßzelle OG2-OG7	CLT	0.13	24.5	3.185
Außenwand	AW05a_ Stgh gegen Naßzelle OG2-OG8	Vapour barrier	0.1	24.5	2.450
Außenwand	AW05a_ Stgh gegen Naßzelle OG2-OG9	CW profile dzw MW-W	0	24.5	0.000
Außenwand	AW05a_ Stgh gegen Naßzelle OG2-OG10	GKF	0.085	24.5	2.083
Außenwand	AW05a_ Stgh gegen Naßzelle OG2-OG11	Ceramic tiles	0.015	24.5	0.368
Außenwand	AW05a_ Stgh gegen Naßzelle OG2-OG12	Final coating	0.01	24.5	0.245
Außenwand	AW05b_ Stgh gegen Beheizt OG1	Thermal insulation	0.005	28.3	0.142

Description	Building element	Building material	Thickness [m]	Area [m²]	Volume [m³]
Außenwand	AW05b_ Stgh gegen Beheizt OG2	Adhesive filler	0.12	28.3	3.396
Außenwand	AW05b_ Stgh gegen Beheizt OG3	Reinforced concrete	0.005	28.3	0.142
Außenwand	AW05b_ Stgh gegen Beheizt OG4	Mineral wool soft	0.25	28.3	7.075
Außenwand	AW05b_ Stgh gegen Beheizt OG5	CLT	0.13	28.3	3.679
Außenwand	AW05b_ Stgh gegen Beheizt OG6	GKF	0.1	28.3	2.830
Außenwand	AW05b_ Stgh gegen Beheizt OG7	vapor barrier	0.015	28.3	0.425
Außenwand	AW05b_ Stgh gegen Beheizt OG8	GKF	0	28.3	0.000
Außenwand	AW05b_ Stgh gegen Beheizt OG9	Final coating	0.015	28.3	0.425
Außenwand	AW05c_ Stgh gegen Unbeheizt	Thermal insulation	0.005	19.4	0.097
Außenwand	AW05c_ Stgh gegen Unbeheizt	Adhesive filler	0.12	19.4	2.328
Außenwand	AW05c_ Stgh gegen Unbeheizt	Reinforced concrete	0.005	19.4	0.097
Außenwand	AW05c_ Stgh gegen Unbeheizt	Wooden construction in between thermal insulation	0.25	19.4	4.850
Außenwand	AW05c_ Stgh gegen Unbeheizt	Vapor permeable wind barrier	0.16	19.4	3.104
Außenwand	AW05c_ Stgh gegen Unbeheizt	UK battens 2.8x7.0cm c/c 40cm	0.001	19.4	0.019
Außenwand	AW05c_ Stgh gegen Unbeheizt	UK battens 2.8x7.0cm c/c 60cm	0.03	19.4	0.582
Außenwand	AW05c_ Stgh gegen Unbeheizt	fiber cement board	0.03	19.4	0.582
Außenwand	AW05c_ Stgh gegen Unbeheizt	wooden cladding	0.015	19.4	0.291
Außenwand	AW05c_ Stgh gegen Unbeheizt	reinforced concrete	0.036	19.4	0.698
Außenwand	AW05d_ Stgh gegen Unbeheizt OG2-OG6	wooden construction in between thermal insulation	0.25	51	12.750
Außenwand	AW05d_ Stgh gegen Unbeheizt OG2-OG7	vapor permeable wind barrier	0.29	51	14.790
Außenwand	AW05d_ Stgh gegen Unbeheizt OG2-OG8	UK battens 2.8x7.0cm c/c 40cm	0.001	51	0.051
Außenwand	AW05d_ Stgh gegen Unbeheizt OG2-OG9	UK battens 2.8x7.0cm c/c 60cm	0.03	51	1.530

Description	Building element	Building material	Thickness [m]	Area [m²]	Volume [m³]
Außenwand	AW05d_ Stgh gegen Unbeheizt OG2-OG10	fiber cement board	0.03	51	1.530
Außenwand	AW05d_ Stgh gegen Unbeheizt OG2-OG11	wooden cladding	0.015	51	0.765
Außenwand	AW05d_ Stgh gegen Unbeheizt OG2-OG12	GKF	0.036	51	1.836
Innenwand	IW01_ Wohnung gegen Wohnung	GKF	0.015	328.7	4.931
Innenwand	IW01_ Wohnung gegen Wohnung	CLT	0.015	328.7	4.931
Innenwand	IW01_ Wohnung gegen Wohnung	Heralan-TW	0.1	328.7	32.870
Innenwand	IW01_ Wohnung gegen Wohnung	CLT	0.06	328.7	19.722
Innenwand	IW01_ Wohnung gegen Wohnung	GKF	0.1	328.7	32.870
Innenwand	IW01_ Wohnung gegen Wohnung	GKF	0.015	328.7	4.931
Innenwand	IW01_ Wohnung gegen Wohnung	CLT	0.015	328.7	4.931
Innenwand	IW02_ Modultrennwand	Heralan-TW	0.08	580.9	46.472
Innenwand	IW02_ Modultrennwand	CLT	0.04	580.9	23.236
Innenwand	IW02_ Modultrennwand	GKF	0.08	580.9	46.472
Innenwand	IW02a_ Modultrennwand einseitig	roof insulation soft	0.015	143	2.145
Innenwand	IW02a_ Modultrennwand einseitig	CLT	0.025	143	3.575
Innenwand	IW02a_ Modultrennwand einseitig	GKF	0.08	143	11.440
Innenwand	IW03_ Gang gegen Wohnung	GKF	0.015	345.3	5.180
Innenwand	IW03_ Gang gegen Wohnung	Partition wall clamping felt	0.015	345.3	5.180
Innenwand	IW03_ Gang gegen Wohnung	CLT	0.05	345.3	17.265
Innenwand	IW03_ Gang gegen Wohnung	Partition wall clamping felt	0.1	345.3	34.530
Innenwand	IW03_ Gang gegen Wohnung	GKF	0.05	345.3	17.265
Innenwand	IW03_ Gang gegen Wohnung	GKF	0.015	345.3	5.180
Innenwand	IW03_ Gang gegen Wohnung	GKF	0.015	345.3	5.180
Innenwand	IW04_LB 10cm einfach Metallständerwand	Mineral wool soft	0.015	1140.4	17.106
Innenwand	IW04_LB 10cm einfach Metallständerwand	GKF	0.07	1140.4	79.828
Innenwand	IW04_LB 10cm einfach Metallständerwand	Mineral wool soft	0.015	1140.4	17.106
Vorsatzschale	IW04a_LB 6,25cm einfach Vorsatzschale	GKF	0.05	108.8	5.440

Description	Building element	Building material	Thickness [m]	Area [m²]	Volume [m³]
Vorsatzschale	IW04a_LB 6,25cm einfach Vorsatzschale	Mineral wool soft	0.0125	108.8	1.360
Vorsatzschale	IW04b_LB 7,5cm einfach Vorsatzschale	GKF	0.05	100.8	5.040
Vorsatzschale	IW04b_LB 7,5cm einfach Vorsatzschale	Mineral wool soft	0.0125	100.8	1.260
Vorsatzschale	IW04b_LB 7,5cm einfach Vorsatzschale	GKF	0.0125	100.8	1.260
Außenwand	STB01_ Außenwand 20STB (Stigenhaus)	GKF	0.2	289	57.800
Außenwand	STB02_ Außenwand 25STB (KG)	Reinforced concrete	0.2	199.4	39.880
Außenwand	STB02_ Außenwand 25STB (EG/OG)	Reinforced concrete	0.2	160.9	32.180
Innenwand	STB03_ Außenwand 50STB	Reinforced concrete	0.5	44	22.000
Unterzug	35x28cm	Reinforced concrete			1.600
Unterzug	36x36cm	Construction timber			38.600
Stütze	alle Typen	Reinforced concrete			35.275
Stütze	alle Typen	Construction timber			59.996
Modelierung	Geländer auf Lodgien	Railing material		429.1	
Fassade	Glasfassade	Glass and aluminum		534.7	
Absturzsicherung	Geländer für Treppen	Railing material		99.14	
Wand	Wand Forum, Dicke 5 cm	Unknown material		71.94	
Treppe	Treppe	Reinforced concrete			13.369
Wand	Gitter Wände im EG	Metal grid		156.7	

Attachment C – Results – OneClick LCA for 50 years, Scenario 1

Main > Forum am Seebogen H7A > Forum am Seebogen H7A (50 years) > Level(s) life-cycle assessment (EN15804 +A1)

Forum am Seebogen H7A (50 years) - Level(s) life-cycle assessment (EN15804 +A1) Level(s)

Project basic information

Result report: Forum am Seebogen H7A (50 years)

Project	Forum am Seebogen H7A - Forum am Seebogen H7A (50 years)
User	Margarita Fedorova - 16.09.2024
Tool	Level(s) life-cycle assessment (EN15804 +A1)
Details	Life-cycle assessment for Level(s) - overarching assessment tool 7: Cradle to cradle Life Cycle Assessment (LCA)
General information	
Type	Apartment buildings
Country	Austria
Address	null
Gross Floor Area (m²)	3577.3
Number of above ground floors	7
Frame type	timber
Project number / code	
Investor / final client	
Year of construction (if refurbishment, original build year)	
Building function(s) distribution	
Technical, functional and qualitative properties	

1 112 Tonnes CO_2e — 6.21 kg CO_2e / m^2 / year — 55 579 € Social cost of carbon

› Carbon Heroes Benchmark

⌄ Results

Life-Cycle Assessment for Level(s) in compliancy with EN 15978

Download Results Summary

	Result category	Global warming kg CO2e	Biogenic carbon storage kg CO2e bio	Ozone Depletion kg CFC11e	Acidification kg SO2e	Eutrophication kg PO4e	Formation of ozone of lower atmosphere kg Ethenee	Abiotic depletion potential (ADP-elements) for non fossil resources kg Sbe	Abiotic depletion potential (ADP-fossil fuels) for fossil
A1-A3	Construction Materials	789 456,13	737 624,56	0,05	4 595,94	952,36	374,22	28,94	7 908 002,07

How can we help?

	Result category	Global warming kg CO2e	Biogenic carbon storage kg CO2e bio	Ozone Depletion kg CFC11e	Acidification kg SO2e	Eutrophication kg PO4e	Formation of ozone of lower atmosphere kg Ethenee	Abiotic depletion potential (ADP-elements) for non fossil resources kg Sbe	Abiotic depletion potential (ADP-fossil fuels) for fossil resources MJ	
A4	Transportation to site	25 462,17		0	62,13	13,18	3,08	57,56	457 106,26	Details
A5	Construction/installation process	70 992,25		0,01	432,52	95,71	37,26	16,96	829 302,66	Details
B1	Use phase									Hide empty
B3	Repair	0		0	0	0	0	0	0	Details
B4-B5	Material replacement and refurbishment	114 767,73		0,01	493,91	211,22	40,93	14,2	860 882,88	Details
B6	Energy consumption	63 041,63		0	280,96	60,52	12,05	0,39	858 399,33	Details
B7	Water use									Hide empty
C1-C4	End of life	47 855,08		0	144,66	36,48	4,1	109,51	547 625,43	Details
C1	Deconstruction/demolition									Details
C2	Waste transport	15 093,25		0	69,02	15,02	0,91	109,3	432 119,3	Details
C3	Waste processing	32 334,55		0	72,5	20,79	3,11	0,21	109 396,92	Details
C4	Waste disposal	427,28		0	3,14	0,67	0,09	0	6 109,21	Details
D	External impacts (not included in totals)	−298 603,31		−0,02	−1 801,85	−314,32	−102,8	−5,99	−2 725 531,18	Details
	Total	**1 111 574,99**	**737 624,56**	**0,08**	**6 010,12**	**1 369,47**	**471,65**	**227,56**	**11 461 318,63**	
	Results per denominator									
	Per gross internal floor area m2 / year	6,21	4,12	0	0,03	0,01	0	0	64,08	
	Per gross internal floor area m2	310,73	206,2	0	1,68	0,38	0,13	0,06	3 203,9	

Indicators describing the usage of primary energy and water

	Result category	Use of renewable primary energy resources as raw materials MJ	Total use of primary energy ex. raw materials MJ	Total use of renewable primary energy MJ	Total use of non renewable primary energy MJ	Use of net fresh water m3	
A1-A3	Construction Materials	7 631 156,95	12 119 145,76	9 660 434,97	11 079 240,14	194 641,34	Details
A4	Transport to the building site	0	493 010,27	17 886,29	475 123,98	12,18	Details
A5	Construction/installation process	1 292 084,19	1 250 868,26	1 558 012,31	1 071 051,71	8 968,52	Details
B1	Use phase						Hide empty
B3	Repair	0	0	0	0	0	Details
B4-B5	Material replacement and refurbishment	893 991,23	2 481 584,05	1 536 966,49	2 160 514,54	1 110,03	Details
B6	Energy consumption	0	1 866 139,89	1 007 740,55	858 399,33	86,81	Details
B7	Water use						Hide empty
C1-C4	End of life	0	568 446,89	8 477,7	559 969,19	858,49	Details
D	External impacts (not included in totals)	0	−3 031 336,9	−193 464,78	−2 837 872,12	−1 015,5	Details
	Total	**9 817 232,37**	**18 779 195,13**	**13 789 518,3**	**16 204 298,89**	**205 677,37**	
	Results per denominator						
	Per gross internal floor area m2 / year	54,89	104,99	77,09	90,6	1,15	
	Per gross internal floor area m2	2 744,31	5 249,54	3 854,73	4 529,76	57,5	

Can also be used for VERDE credits *B 01 Uso de energía no renovable en los materiales de construcción & C 20 Impacto de los materiales de construcción distintos del consumo de energía* you need to consider roof, framework, slabs, façade, interior partitions, wall finishes, flooring, and foundation walls. Structural elements are only to be considered when it´s possible to prove that they perform better than the average.

Site impacts (energy, water, transportation monitoring)

	Result category	Global warming kg CO2e	Energy kWh	Water consumption m3	Distance traveled km	Fuel consumption litres	
A5a1	Construction site energy use						Hide empty
A5a2	Construction site water use						Hide empty
A5b3	Construction waste transportation						Hide empty
A4c1	Transportation of construction materials	25 462,17			13 183,75	8 115,93	Details
A4c2	Additional transportation						Hide empty

› Completeness (%) and plausibility checker (-)

⌄ Most contributing materials (Global warming)

Compare data (3)

No.	Resource	Cradle to gate impacts (A1-A3)	Of cradle to gate (A1-A3)	Sustainable alternatives	
1.	Ready-mix concrete, normal strength, generic, C25/30 (3600/4400 PSI), with CEM I, 0% recycled binders (280 kg/m3; 17.5 lbs/ft3 total cement) ?	238 tonnes CO_2e	30.1 %	Show sustainable alternatives	Add to compare
2.	Stone wool (mineral wool) insulation, unfaced, L = 0.0325 W/mK, R = 1 m2K/W, 32.5mm, 5.04 kg/m2, 155 kg/m3, (Range: 113-200kg/m3), 22% slag content, high pressure suitable ?	178 tonnes CO_2e	22.5 %	Show sustainable alternatives	Add to compare
3.	Cross-laminated timber (CLT), 480 kg/m3 ?	120 tonnes CO_2e	15.2 %	Show sustainable alternatives	Add to compare
4.	Aluminium foil, ?	59 tonnes CO_2e	7.4 %	Show sustainable alternatives	Add to compare
5.	Reinforcement for concrete (rebar), diameter: 6-40 mm, 7850 kg/m3 ?	26 tonnes CO_2e	3.3 %	Show sustainable alternatives	Add to compare
6.	Gypsum plasterboard, standard, biogenic CO2 not subtracted, 15 mm, 12 kg/m2, 800 kg/m3 ?	23 tonnes CO_2e	2.9 %	Show sustainable alternatives	Add to compare
7.	Fibre cement boards, 1300 kg/m3 (81.16 lbs/ft3) ?	23 tonnes CO_2e	2.9 %	Show sustainable alternatives	Add to compare
8.	EPS insulation panels, graphite, L= 0.033 W/mK, R= 3.03 m2K/W, 100 mm, 3 kg/m2, 30 kg/m3, compressive strength 220 kPa, 10% recycled polystyrene, Lambda=0.033 W/(m.K) ?	21 tonnes CO_2e	2.7 %	Show sustainable alternatives	Add to compare
9.	Glass wool insulation panels, ?	14 tonnes CO_2e	1.7 %	Show sustainable alternatives	Add to compare
10.	Parquet, multilayered, biogenic CO2 not substracted, 7 kg/m2 ?	11 tonnes CO_2e	1.4 %	Show sustainable alternatives	Add to compare
11.	Oriented Strand Board (OSB), 6 - 40 x 590 - 1250 x 1840 - 6250 mm, 600 kg/m3 ?	9,5 tonnes CO_2e	1.2 %	Show sustainable alternatives	Add to compare
12.	Stone wool (mineral wool) insulation, unfaced, L = 0.0315 W/mK, R = 1 m2K/W, 31.5mm, 1.26 kg/m2, 40 kg/m3, (Range: 36-50kg/m3), 22% slag content ?	9,2 tonnes CO_2e	1.2 %	Show sustainable alternatives	Add to compare
13.	Floor screed mortar, cement screed, 1500 kg/m3, EPD coverage: > 1500 kg/m3 ?	7,1 tonnes CO_2e	0.9 %	Show sustainable alternatives	Add to compare
14.	Gypsum plasterboard, 12.5 x 2000/2500 x 1250 mm, 12.8 kg/m2 ?	6,7 tonnes CO_2e	0.8 %	Show sustainable alternatives	Add to compare
15.	EPDM waterproofing membrane, 1.5 mm, 1.95 kg/m2 ?	6,2 tonnes CO_2e	0.8 %	Show sustainable alternatives	Add to compare
16.	Rubber floor covering with foam coating, 3.82 kg/m2, EN15804+A1, ref. year 2018 ?	5,8 tonnes CO_2e	0.7 %	Show sustainable alternatives	Add to compare
17.	XPS-G 30 > 180 mm (32 kg/m³), More than 180 mm ?	4,9 tonnes CO_2e	0.6 %	Show sustainable alternatives	Add to compare
18.	XPS insulation with flame retardant, L = 0.032 W/mK, 20-200 x 1265 x 600 mm, 28-50 kg/m3, Lambda=0.032 W/(m.K) ?	4,2 tonnes CO_2e	0.5 %	Show sustainable alternatives	Add to compare
19.	Bitumen-polymer waterproofing membrane, ?	3,7 tonnes CO_2e	0.5 %	Show sustainable alternatives	Add to compare
20.	Insulation, EPS 100, 0.035 W/mK, 18-22 kg/m3 (100 kPa), without flame retardant ?	3 tonnes CO_2e	0.4 %	Show sustainable alternatives	Add to compare

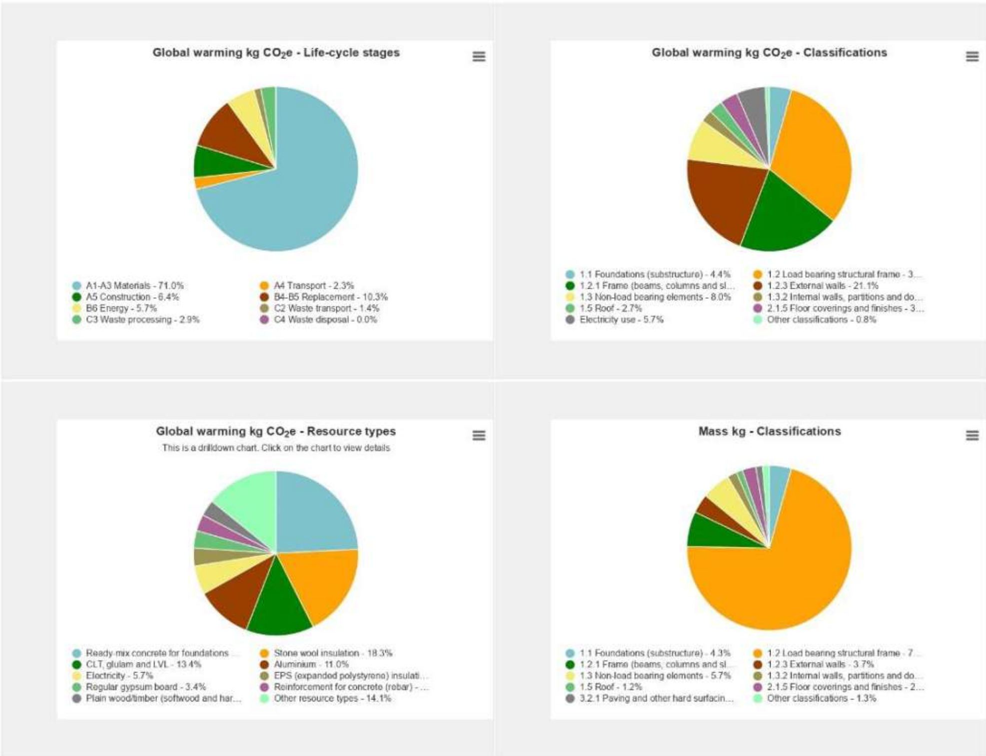
No.	Resource	Cradle to gate impacts (A1-A3)	Of cradle to gate (A1-A3)	Sustainable alternatives	
21.	Sawn timber, pine or spruce, 460 kg/m3, 15-140 mm, 10-20% moisture content ?	2,6 tonnes CO_2e	0.3 %	Show sustainable alternatives	Add to compare
22.	Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3) ?	2 tonnes CO_2e	0.2 %	Show sustainable alternatives	Add to compare
23.	Solidwood flooring, multiple species, thickness range: 8 - 22mm, 4.38kg/m2, 548 kg/m3 oven-dry, moisture content < 13% ?	1,7 tonnes CO_2e	0.2 %	Show sustainable alternatives	Add to compare
24.	Fresh sawn timber, biogenic CO2 not substracted, wood moisture at delivery 70 %, 740 kg/m3 ?	1,7 tonnes CO_2e	0.2 %	Show sustainable alternatives	Add to compare
25.	Ceramic tiles and slabs, 17.97 kg/m2 ?	1,4 tonnes CO_2e	0.2 %	Show sustainable alternatives	Add to compare

Graphs

Overview | Bubble | Sankey | Treemap | Life-cycle stages | Annual | Spidergram | Stages - stacked | Materials - stacked | Classifications | All graphs

Life-cycle overview of Global warming

Pie | Bar | Column | Treemap



Show data table: ☑ Global warming kg CO_2e - Life-cycle stages ☐ Global warming kg CO_2e - Classifications ☐ Global warming kg CO_2e - Resource types ☐ Mass kg - Classifications

Global warming kg CO_2e - Life-cycle stages

Item	Value	Unit	Percentage %
A1-A3 Materials	790 000	kg CO_2e	71.02 %
A4 Transport	25 000	kg CO_2e	2.29 %
A5 Construction	71 000	kg CO_2e	6.39 %
B4-B5 Replacement	110 000	kg CO_2e	10.32 %
B6 Energy	63 000	kg CO_2e	5.67 %
C2 Waste transport	15 000	kg CO_2e	1.36 %
C3 Waste processing	32 000	kg CO_2e	2.91 %
C4 Waste disposal	430	kg CO_2e	0.04 %

Global warming kg CO_2e - Classifications

Item	Value	Unit	Percentage %
1.1 Foundations (substructure)	49 000	kg CO_2e	4.4 %
1.2 Load bearing structural frame	350 000	kg CO_2e	31.43 %
1.2.1 Frame (beams, columns and slabs)	220 000	kg CO_2e	19.98 %
1.2.3 External walls	230 000	kg CO_2e	21.14 %

1.3 Non-load bearing elements	89 000	kg CO_2e	8.04 %
1.3.2 Internal walls, partitions and doors	26 000	kg CO_2e	2.36 %
1.5 Roof	30 000	kg CO_2e	2.72 %
2.1.5 Floor coverings and finishes	39 000	kg CO_2e	3.46 %
Electricity use	63 000	kg CO_2e	5.67 %
Other classifications	9 000	kg CO_2e	0.81 %

Global warming kg CO_2e - Resource types

Item	Value	Unit	Percentage %
Ready-mix concrete for foundations and internal walls	270 000	kg CO_2e	24.23 %
Stone wool insulation	200 000	kg CO_2e	18.32 %
CLT, glulam and LVL	150 000	kg CO_2e	13.37 %
Aluminium	120 000	kg CO_2e	10.96 %
Electricity	63 000	kg CO_2e	5.67 %
EPS (expanded polystyrene) insulation	39 000	kg CO_2e	3.51 %
Regular gypsum board	38 000	kg CO_2e	3.39 %
Reinforcement for concrete (rebar)	36 000	kg CO_2e	3.24 %
Plain wood/timber (softwood and hardwood)	35 000	kg CO_2e	3.18 %
Other resource types	160 000	kg CO_2e	14.14 %

Mass kg - Classifications

Item	Value	Unit	Percentage %
1.1 Foundations (substructure)	160 000	kg	4.31 %
1.2 Load bearing structural frame	2 600 000	kg	71.0 %
1.2.1 Frame (beams, columns and slabs)	250 000	kg	6.9 %
1.2.3 External walls	140 000	kg	3.73 %
1.3 Non-load bearing elements	210 000	kg	5.67 %
1.3.2 Internal walls, partitions and doors	68 000	kg	1.85 %
1.5 Roof	45 000	kg	1.23 %
2.1.5 Floor coverings and finishes	99 000	kg	2.68 %
3.2.1 Paving and other hard surfacing	49 000	kg	1.32 %
Other classifications	49 000	kg	1.32 %

Data sources

Sources

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
Aggregate (crushed gravel), generic, dry bulk density	1600 kg/m3			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL
Aluminium foil		Würth Dampfsperre Wütop DS Alu	Würth Handelsges.m.b.H.	baubook	9352 am	BAUBOOK	EN15804+A1	Internally verified	2018	austria

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
Aluminium pipes	STD, DN 6 mm, (1/8 in), 0.61 kg/m, wall thickness: 1.73 mm		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Armchair with steel legs	H: 790 mm, D: 890 mm, W: 880 mm, 30 kg/unit		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Bike path (light-vehicle, cycle way) with concrete block paver , per m2, excl. sub-grade layer (3 materials)	Total thickness 33 cm (13 in)			One Click LCA						LOCAL
Bitumen-polymer waterproofing membrane		Soprema E-4-SK	Soprema GmbH	baubook	9510 ad	BAUBOOK	EN15804+A1	Internally verified	2015	austria
Ceramic glazed tile	20 kg/m2		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Ceramic tiles and slabs	17.97 kg/m2		Bundesverband Keramische Fliesen	IBU	EPD-BKF-20220183-ICG1-DE	EPD Keramische Fliesen und Platten Bundesverband Keramische Fliesen e.V	EN15804+A1	Third-party verified (as per ISO 14025)	2022	germany
Ceramic toilet bowl	23 kg/unit, 600 × 360 × 430 mm		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Concrete stone pavement	stone thickness 50 mm (2 in)			One Click LCA		Adjusted data based on the specifications of the Swedish Transport Administration (Trafikverket).				LOCAL
Cross-laminated timber (CLT)	480 kg/m3		KLH Massivholz	IBU	EPD-KLH-20190027-ICA1-EN	EPD KLH cross-laminated timber panels	EN15804+A1	Third-party verified (as per ISO 14025)	2019	austria
Drainage pipe for culvert applications, Flush joint pipe, reinforced concrete, per m (ft)	300 mm (12 in) nominal diameter			One Click LCA						LOCAL
EPDM waterproofing membrane	1.5 mm, 1.95 kg/m2		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
EPS insulation boards		EPS W25	AUSTROTHERM	baubook	3332 al	BAUBOOK	EN15804+A1	Internally verified	2018	austria
EPS insulation panels, graphite	L= 0.037 W/mK, R= 2.7 m2K/W, 100 mm, 1.5 kg/m2, 15 kg/m3, compressive strength 85kPa, 10% recycled polystyrene, Lambda=0.037 W/(m.K)		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
EPS insulation panels, graphite	L= 0.037 W/mK, R= 2.7 m2K/W, 100 mm, 1.5 kg/m2, 15 kg/m3, compressive strength 85kPa, 100% virgin polystyrene, Lambda=0.037 W/(m.K)		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
EPS insulation panels, graphite	L= 0.033 W/mK, R= 3.03 m2K/W, 100 mm, 3 kg/m2, 30 kg/m3, compressive strength 220 kPa, 10% recycled polystyrene, Lambda=0.033 W/(m.K)		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Electricity, Austria				One Click LCA		LCA study for country specific electricity mixes based on IEA, OneClickLCA 2024		Internally verified	2022	austria
Extensive green roof system	40mm, 23.34 kg/m2	Urbanspace	Knauf	IBU	EPD-KNI-20160071-CBA1-EN	EPD URBANSCAPE Extensive Green Roof System	EN15804+A1	Third-party verified (as per ISO 14025)	2016	germany
Fibre cement boards	1300 kg/m3 (81.16 lbs/ft3)			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2019	LOCAL
Floor screed mortar, cement screed	1500 kg/m3, EPD coverage: > 1500 kg/m3		quickmix Gruppe GmbH & Co. KG	IBU	EPD-QMX-20160208-IBC1-DE	Oekobau.dat 2017-I, EPD Mineralische Werkmörtel: Estrichmörtel - Zementestrich quickmix Gruppe GmbH & Co. KG	EN15804+A1	Third-party verified (as per ISO 14025)	2014	germany
Fresh sawn timber	biogenic CO2 not substracted, wood moisture at delivery 70 %, 740 kg/m3		Fritz EGGER	IBU	EPD-EGG-20140246-IBA2-DE	Oekobau.dat 2017-I, EPD EGGER Schnittholz frisch EGGER Sägewerk Brilon GmbH	EN15804+A1	Third-party verified (as per ISO 14025)	2016	germany
Galvanized steel T-shape piece for	d1-d2: 200-200 mm, (8-8 in), 1.3 kg/unit		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
ventilation ducts, circular										
Glass wool insulation panels		ISOVER MERINO	Saint-Gobain Isover Austria GmbH	baubook	2273 bs	BAUBOOK	EN15804+A1	Internally verified	2018	austria
Glass wool insulation panels		ISOVER ULTIMATE UNTERSPARREN KLEMMFILZ 035 TWIN	Saint-Gobain Isover Austria GmbH	baubook	2273 cw	BAUBOOK	EN15804+A1	Internally verified	2018	austria
Glass wool insulation panels		ISOVER TRITTSCHALL-DÄMMPLATTE S (Feb.2016)	Saint-Gobain Isover Austria GmbH	baubook	2273 bu	BAUBOOK	EN15804+A1	Internally verified	2018	austria
Gravel, dry bulk density	1680 kg/m3			One Click LCA	-	LCA inventory for gravel production	ISO14040	Internally verified	2016	LOCAL
Gypsum plasterboard	12.5 x 2000/2500 x 1250 mm, 12.8 kg/m2	Diamant GKFI	KNAUF	IBU	EPD-KNA-20150104-IBD1-EN	EPD Plasterboard Knauf Diamant GKFI Knauf Gips KG	EN15804+A1	Third-party verified (as per ISO 14025)	2016	germany, croatia, netherlands, austria, turkey
Gypsum plasterboard, standard	biogenic CO2 not subtracted, 15 mm, 12 kg/m2, 800 kg/m3	RB	Rigips	BauEPD	EPD-RIGIPS-2014-1-GaBi	EPD Gipsplatten (RIGIPS RB, RIGIPS RF, RIGIPS RBI, RIGIPS RFI, RIGIPS DL, RIGIPS DLI und RIGIPS Riduro)	EN15804+A1	Third-party verified (as per ISO 14025)	2014	austria
Hot dip galvanized steel	0.73 mm, 5.72 kg/m2, EN15804+A1, ref. year 2018			OKOBAUDAT	50c9e674-afd9-456c-9440-6506bec6d55b	ÖKOBAUDAT 2021-II (25.06.2021)	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany
Hot-dip galvanized structural steel	7850 kg/m3		bauforumstahl / Industrieverband Feuerverzinken	IBU	EPD-BFS-20130173-IBG1-DE	Oekobau.dat 2017-I, EPD Feuerverzinkte Baustähle: Offene Walzprofile und Grobbleche bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.	EN15804+A1	Third-party verified (as per ISO 14025)	2013	europe
Insulation, EPS 100	0.035 W/mK, 18-22 kg/m3 (100 kPa), without flame retardant		EUMEPS	IBU	EPD-EPS-20130077-CBG1-EN	Expanded Polystyrene (EPS) Foam Insulation (without flame retardant, density 20 kg/m³), EPS 100, EUMEPS (region Scandinavia)	EN15804+A1	Third-party verified (as per ISO 14025)	2013	finland, sweden, denmark
LED office lighting	5.95 kg/unit, EN15804+A1, ref. year 2018			OKOBAUDAT	43991578-721b-4f93-8467-a7683060a26b	ÖKOBAUDAT 2021-II (25.06.2021)	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany
Mineral glue for leveling compounds		Universal-Spachtelmasse USP 32 S	PCI Augsburg GmbH	baubook	2038 aw	BAUBOOK	EN15804+A1	Internally verified	2019	austria

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
Mineral wool (floor insulation)	L = 0.040 W/mK, 85 kg/m3, EN15804+A1, ref. year 2018			OKOBAUDAT	2691d6e4-a41e-40d7-92ca-680f8785fc1d	ÖKOBAUDAT 2021-II (25.06.2021)	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany
Modular and scalable fibre communication system	Single-mode fibre, LC connectors, 1Gbps, 92 kg/unit		Backbone	BRE	BREG EN EPD000468, issue 02	EPD Backbone Connected Building	EN15804+A1	Third-party verified (as per ISO 14025)	2022	unitedKingdom
Oriented Strand Board (OSB)	6 - 40 x 590 - 1250 x 1840 - 6250 mm, 600 kg/m3	AGEPAN	Sonae Indústria	IBU	EPD-SON-20150246-IBA1-EN	EPD	EN15804+A1	Third-party verified (as per ISO 14025)	2016	germany, portugal, southAfrica, spain, canada
Parquet, multilayered	biogenic CO2 not substracted, 7 kg/m2		Scheucher	IBU	EPD-SCP-20150324-IBC1-DE	Oekobau.dat 2017-I, EPD Scheucher Parkett Mehrschichtparkett Scheucher Holzindustrie GmbH	EN15804+A1	Third-party verified (as per ISO 14025)	2016	austria
Polyethylene vapour barrier membrane	0.15 mm, 0.14 kg/m2		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Precast concrete pavers/blocks, Danish average	10 cm, 225 kg/m2		Belægningsgruppen	EPD Danmark	MD-20022-DA	EPD Belægningsgruppen	EN15804+A1	Third-party verified (as per ISO 14025)	2020	denmark
Precast concrete slab, wall	12cm, 291.3 kg/m2, 2427.5 kg/m3, EN15804+A1, ref. year 2018			OKOBAUDAT	b342696e-2ebb-4fe1-a71d-f3520db0cee9	ÖKOBAUDAT 2021-II (25.06.2021)	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany
Ready-mix concrete, normal strength, generic	C25/30 (3600/4400 PSI), with CEM I, 0% recycled binders (280 kg/m3; 17.5 lbs/ft3 total cement)			One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2020	LOCAL
Ready-mix concrete, normal-strength, generic	C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3)			One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2018	LOCAL
Recycled asphalt pavement (RAP), generic	2100 kg/m3 (131 lbs/ft3) uncompacted densisty			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL
Reinforcement for concrete (rebar)	diameter: 6-40 mm, 7850 kg/m3		Badische Stahlwerke	ift Rosenheim	EPD-BS-10.2	EPD Betonbewehrung Betonstahl	EN15804+A1	Third-party verified (as per ISO 14025)	2018	germany
Reinforcement steel (rebar), generic	97% recycled content (typical), A615			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
Rubber floor covering with foam coating	3.82 kg/m2, EN15804+A1, ref. year 2018			OKOBAUDAT	7d8cb95b-99c2-4824-97a0-55d2fca5cedd	ÖKOBAUDAT 2021-II (25.06.2021)	EN15804+A1	Third-party verified (as per ISO 14025)	2020	europe
Sand, compacted dry density	1682 kg/m3			One Click LCA	-	LCA inventory for sand quarry operation	EN15804+A1	Internally verified	2020	LOCAL
Sawn timber, pine or spruce	460 kg/m3, 15-140 mm, 10-20% moisture content	Classic Sawn	Stora Enso	International EPD System	S-P-02150	EPD Classic Sawn by Stora Enso	EN15804+A1, EN15804+A2	Third-party verified (as per ISO 14025)	2020	austria, sweden, estonia, finland, czechRepublic, latvia, lithuania, poland, russia
Screed mortar, cement screed		Estriche	Baumit GmbH	baubook	8843 am	BAUBOOK	EN15804+A1	Internally verified	2017	austria
Solar thermal collector	18.19 kg/unit, 400 Wp	VirtuHOT, A100142	Naked Energy Ltd	EPD Hub	HUB-0433	EPD VirtuHOT Naked Energy Ltd	EN15804+A1, EN15804+A2	Third-party verified (as per ISO 14025)	2023	italy, OCLEPD
Solidwood flooring, multiple species	thickness range: 8 - 22mm, 4.38kg/m2, 548 kg/m3 oven-dry, moisture content < 13%		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Stone wool (mineral wool) insulation, unfaced	L = 0.0315 W/mK, R = 1 m2K/W, 31.5mm, 1.26 kg/m2, 40 kg/m3, (Range: 36-50kg/m3), 22% slag content		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Stone wool (mineral wool) insulation, unfaced	L = 0.0325 W/mK, R = 1 m2K/W, 32.5mm, 5.04 kg/m2, 155 kg/m3, (Range: 113-200kg/m3), 22% slag content, high pressure suitable		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Waterproofing membrane for green roof systems	2 mm, 2 kg/m2	Sarnafil® TG 66	Sika Deutschland	IBU	EPD-SIK-20190169-IBA1-EN	EPD Sarnafil® TG 66 Sika Deutschland GmbH	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany
Wildlife fence, galvanized steel mesh, steel posts				One Click LCA		Adjusted data based on the specifications of the Swedish Transport Administration (Trafikverket).				LOCAL

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
XPS insulation with flame retardant	L = 0.032 W/mK, 20-200 x 1265 x 600 mm, 28-50 kg/m3, Lambda=0.032 W/(m.K)	Styrodur	BASF	IBU	EPD-BAS-20190113-IBA1-DE	EPD Styrodur® BASF SE	EN15804+A1	Third-party verified (as per ISO 14025)	2019	germany
XPS-G 30 > 180 mm (32 kg/m³)	More than 180 mm	ROOFMATE SL-AP (81-120mm)	Ravago Building Solutions Germany GmbH	baubook	3158 ak	BAUBOOK	EN15804+A1	Internally verified	2016	austria

Attachment D – Results – OneClick LCA for 100 years, Scenario 1

Main > Forum am Seebogen H7A > Forum am Seebogen H7A > Level(s) life-cycle assessment (EN15804 +A1)

Forum am Seebogen H7A - Level(s) life-cycle assessment (EN15804 +A1) Level(s) Project basic information

Result report: Forum am Seebogen H7A

Project	Forum am Seebogen H7A - Forum am Seebogen H7A
User	Margarita Fedorova - 15.09.2024
Tool	Level(s) life-cycle assessment (EN15804 +A1)
Details	Life-cycle assessment for Level(s) - overarching assessment tool 7: Cradle to cradle Life Cycle Assessment (LCA)
General information	
Type	Apartment buildings
Country	Austria
Address	null
Gross Floor Area (m²)	3577.3
Number of above ground floors	7
Frame type	timber
Project number / code	
Investor / final client	
Year of construction (if refurbishment, original build year)	
Building function(s) distribution	
Technical, functional and qualitative properties	

1 372 Tonnes CO_2e — **3.83 kg CO_2e / m^2 / year** — **68 580 € Social cost of carbon**

› Carbon Heroes Benchmark

⌄ Results

Life-Cycle Assessment for Level(s) in compliancy with EN 15978

Download Results Summary

	Result category	Global warming kg CO2e	Biogenic carbon storage kg CO2e bio	Ozone Depletion kg CFC11e	Acidification kg SO2e	Eutrophication kg PO4e	Formation of ozone of lower atmosphere kg Ethenee	Abiotic depletion potential (ADP-elements) for non fossil resources kg Sbe	Abiotic depletion potential (ADP-fossil fuels) for fossil resources
A1-A3	Construction Materials	789 456,13	737 624,56	0,05	4 595,94	952,36	374,22	28,94	7 908 002,07
A4	Transportation to site	25 462,17		0	62,13	13,18	3,08	57,56	457 106,26

How can we help?

	Result category	Global warming kg CO2e	Biogenic carbon storage kg CO2e bio	Ozone Depletion kg CFC11e	Acidification kg SO2e	Eutrophication kg PO4e	Formation of ozone of lower atmosphere kg Ethenee	Abiotic depletion potential (ADP-elements) for non fossil resources kg Sbe	Abiotic depletion potential (ADP-fossil fuels) for fossil resources MJ	
A5	Construction/installation process	70 992,25		0,01	432,52	95,71	37,26	16,96	829 302,66	Details
B1	Use phase									Hide empty
B3	Repair	0		0	0	0	0	0	0	Details
B4-B5	Material replacement and refurbishment	311 755,34		0,02	1 272,47	509,27	106,94	64,48	2 842 516,93	Details
B6	Energy consumption	126 083,27		0,01	561,91	121,03	24,11	0,78	1 716 798,67	Details
B7	Water use									Hide empty
C1-C4	End of life	47 855,08		0	144,66	36,48	4,1	109,51	547 625,43	Details
D	External impacts (not included in totals)	−359 505,62		−0,02	−2 199,9	−379,06	−127,17	−11,48	−3 349 018,38	Details
	Total	**1 371 604,23**	**737 624,56**	**0,09**	**7 069,63**	**1 728,04**	**549,71**	**278,22**	**14 301 352,01**	
	Results per denominator									
	Per gross internal floor area m2 / year	3,83	2,06	0	0,02	0	0	0	39,98	
	Per gross internal floor area m2	383,42	206,2	0	1,98	0,48	0,15	0,08	3 997,81	

Indicators describing the usage of primary energy and water

	Result category	Use of renewable primary energy resources as raw materials MJ	Total use of primary energy ex. raw materials MJ	Total use of renewable primary energy MJ	Total use of non renewable primary energy MJ	Use of net fresh water m3	
A1-A3	Construction Materials	7 631 156,95	12 119 145,76	9 660 434,97	11 079 240,14	194 641,34	Details
A4	Transport to the building site	0	493 010,27	17 886,29	475 123,98	12,18	Details
A5	Construction/installation process	1 292 084,19	1 250 868,26	1 558 012,31	1 071 051,71	8 968,52	Details
B1	Use phase						Hide empty
B3	Repair	0	0	0	0	0	Details
B4-B5	Material replacement and refurbishment	2 744 276,08	6 777 287,28	4 461 071,05	5 862 565,79	3 184,8	Details
B6	Energy consumption	0	3 732 279,78	2 015 481,11	1 716 798,67	173,62	Details
B7	Water use						Hide empty
C1-C4	End of life	0	568 446,89	8 477,7	559 969,19	858,49	Details
D	External impacts (not included in totals)	0	−3 806 900,24	−275 882,49	−3 531 017,75	−1 685,95	Details
	Total	**11 667 517,22**	**24 941 038,24**	**17 721 363,42**	**20 764 749,48**	**207 838,95**	
	Results per denominator						
	Per gross internal floor area m2 / year	32,62	69,72	49,54	58,05	0,58	
	Per gross internal floor area m2	3 261,54	6 972,03	4 953,84	5 804,59	58,1	

Can also be used for VERDE credits *B 01 Uso de energía no renovable en los materiales de construcción & C 20 Impacto de los materiales de construcción distintos del consumo de energía* you need to consider roof, framework, slabs, façade, interior partitions, wall finishes, flooring, and foundation walls. Structural elements are only to be considered when it´s possible to prove that they perform better than the average.

Site impacts (energy, water, transportation monitoring)

	Result category	Global warming kg CO2e	Energy kWh	Water consumption m3	Distance traveled km	Fuel consumption litres	
A5a1	Construction site energy use						Hide empty
A5a2	Construction site water use						Hide empty
A5b3	Construction waste transportation						Hide empty
A4c1	Transportation of construction materials	25 462,17			13 183,75	8 115,93	Details

	Result category	Global warming kg CO2e	Energy kWh	Water consumption m3	Distance traveled km	Fuel consumption litres	
A4c2	Additional transportation						Hide empty

› Completeness (%) and plausibility checker (-)

⌄ Most contributing materials (Global warming)

Compare data (3)

No.	Resource	Cradle to gate impacts (A1-A3)	Of cradle to gate (A1-A3)	Sustainable alternatives	
1.	Ready-mix concrete, normal strength, generic, C25/30 (3600/4400 PSI), with CEM I, 0% recycled binders (280 kg/m3; 17.5 lbs/ft3 total cement) ?	238 tonnes CO_2e	30.1 %	Show sustainable alternatives	Add to compare
2.	Stone wool (mineral wool) insulation, unfaced, L = 0.0325 W/mK, R = 1 m2K/W, 32.5mm, 5.04 kg/m2, 155 kg/m3, (Range: 113-200kg/m3), 22% slag content, high pressure suitable ?	178 tonnes CO_2e	22.5 %	Show sustainable alternatives	Add to compare
3.	Cross-laminated timber (CLT), 480 kg/m3 ?	120 tonnes CO_2e	15.2 %	Show sustainable alternatives	Add to compare
4.	Aluminium foil, ?	59 tonnes CO_2e	7.4 %	Show sustainable alternatives	Add to compare
5.	Reinforcement for concrete (rebar), diameter: 6-40 mm, 7850 kg/m3 ?	26 tonnes CO_2e	3.3 %	Show sustainable alternatives	Add to compare
6.	Gypsum plasterboard, standard, biogenic CO2 not subtracted, 15 mm, 12 kg/m2, 800 kg/m3 ?	23 tonnes CO_2e	2.9 %	Show sustainable alternatives	Add to compare
7.	Fibre cement boards, 1300 kg/m3 (81.16 lbs/ft3) ?	23 tonnes CO_2e	2.9 %	Show sustainable alternatives	Add to compare
8.	EPS insulation panels, graphite, L= 0.033 W/mK, R= 3.03 m2K/W, 100 mm, 3 kg/m2, 30 kg/m3, compressive strength 220 kPa, 10% recycled polystyrene, Lambda=0.033 W/(m.K) ?	21 tonnes CO_2e	2.7 %	Show sustainable alternatives	Add to compare
9.	Glass wool insulation panels, ?	14 tonnes CO_2e	1.7 %	Show sustainable alternatives	Add to compare
10.	Parquet, multilayered, biogenic CO2 not substracted, 7 kg/m2 ?	11 tonnes CO_2e	1.4 %	Show sustainable alternatives	Add to compare
11.	Oriented Strand Board (OSB), 6 - 40 x 590 - 1250 x 1840 - 6250 mm, 600 kg/m3 ?	9,5 tonnes CO_2e	1.2 %	Show sustainable alternatives	Add to compare
12.	Stone wool (mineral wool) insulation, unfaced, L = 0.0315 W/mK, R = 1 m2K/W, 31.5mm, 1.26 kg/m2, 40 kg/m3, (Range: 36-50kg/m3), 22% slag content ?	9,2 tonnes CO_2e	1.2 %	Show sustainable alternatives	Add to compare
13.	Floor screed mortar, cement screed, 1500 kg/m3, EPD coverage: > 1500 kg/m3 ?	7,1 tonnes CO_2e	0.9 %	Show sustainable alternatives	Add to compare
14.	Gypsum plasterboard, 12.5 x 2000/2500 x 1250 mm, 12.8 kg/m2 ?	6,7 tonnes CO_2e	0.8 %	Show sustainable alternatives	Add to compare
15.	EPDM waterproofing membrane, 1.5 mm, 1.95 kg/m2 ?	6,2 tonnes CO_2e	0.8 %	Show sustainable alternatives	Add to compare
16.	Rubber floor covering with foam coating, 3.82 kg/m2, EN15804+A1, ref. year 2018 ?	5,8 tonnes CO_2e	0.7 %	Show sustainable alternatives	Add to compare
17.	XPS-G 30 > 180 mm (32 kg/m³), More than 180 mm ?	4,9 tonnes CO_2e	0.6 %	Show sustainable alternatives	Add to compare
18.	XPS insulation with flame retardant, L = 0.032 W/mK, 20-200 x 1265 x 600 mm, 28-50 kg/m3, Lambda=0.032 W/(m.K) ?	4,2 tonnes CO_2e	0.5 %	Show sustainable alternatives	Add to compare
19.	Bitumen-polymer waterproofing membrane, ?	3,7 tonnes CO_2e	0.5 %	Show sustainable alternatives	Add to compare
20.	Insulation, EPS 100, 0.035 W/mK, 18-22 kg/m3 (100 kPa), without flame retardant ?	3 tonnes CO_2e	0.4 %	Show sustainable alternatives	Add to compare
21.	Sawn timber, pine or spruce, 460 kg/m3, 15-140 mm, 10-20% moisture content ?	2,6 tonnes CO_2e	0.3 %	Show sustainable alternatives	Add to compare
22.	Ready-mix concrete, normal-strength, generic, C30/37 (4400/5400 PSI), 10% (typical) recycled binders in cement (300 kg/m3 / 18.72 lbs/ft3) ?	2 tonnes CO_2e	0.2 %	Show sustainable alternatives	Add to compare

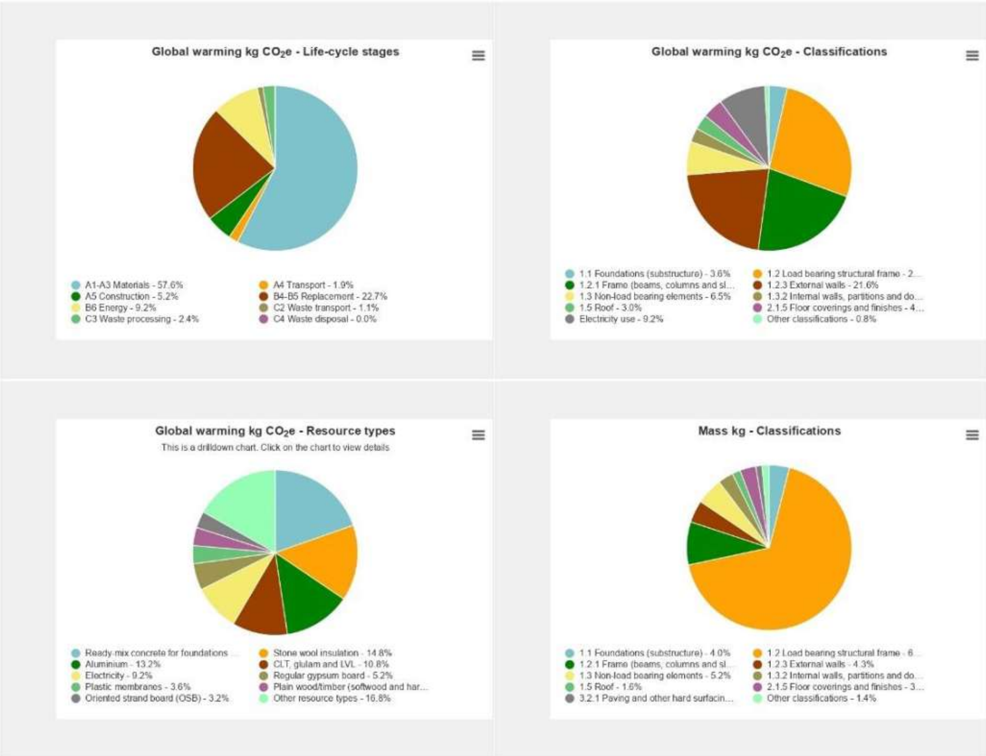
No.	Resource	Cradle to gate impacts (A1-A3)	Of cradle to gate (A1-A3)	Sustainable alternatives	
23.	Solidwood flooring, multiple species, thickness range: 8 - 22mm, 4.38kg/m2, 548 kg/m3 oven-dry, moisture content < 13% ?	1,7 tonnes CO_2e	0.2 %	Show sustainable alternatives	Add to compare
24.	Fresh sawn timber, biogenic CO2 not substracted, wood moisture at delivery 70 %, 740 kg/m3 ?	1,7 tonnes CO_2e	0.2 %	Show sustainable alternatives	Add to compare
25.	Ceramic tiles and slabs, 17.97 kg/m2 ?	1,4 tonnes CO_2e	0.2 %	Show sustainable alternatives	Add to compare

Graphs

Overview | Bubble | Sankey | Treemap | Life-cycle stages | Annual | Spidergram | Stages - stacked | Materials - stacked | Classifications | All graphs

Life-cycle overview of Global warming

Pie | Bar | Column | Treemap



Show data table: ☑ Global warming kg CO_2e - Life-cycle stages ☐ Global warming kg CO_2e - Classifications ☐ Global warming kg CO_2e - Resource types ☐ Mass kg - Classifications

Global warming kg CO_2e - Life-cycle stages

Item	Value	Unit	Percentage %
A1-A3 Materials	790 000	kg CO_2e	57.56 %
A4 Transport	25 000	kg CO_2e	1.86 %
A5 Construction	71 000	kg CO_2e	5.18 %
B4-B5 Replacement	310 000	kg CO_2e	22.73 %
B6 Energy	130 000	kg CO_2e	9.19 %
C2 Waste transport	15 000	kg CO_2e	1.1 %
C3 Waste processing	32 000	kg CO_2e	2.36 %
C4 Waste disposal	430	kg CO_2e	0.03 %

Global warming kg CO_2e - Classifications

Item	Value	Unit	Percentage %
1.1 Foundations (substructure)	49 000	kg CO_2e	3.56 %
1.2 Load bearing structural frame	370 000	kg CO_2e	27.03 %
1.2.1 Frame (beams, columns and slabs)	300 000	kg CO_2e	21.54 %
1.2.3 External walls	300 000	kg CO_2e	21.6 %

1.3 Non-load bearing elements	89 000	kg CO_2e	6.51 %
1.3.2 Internal walls, partitions and doors	38 000	kg CO_2e	2.77 %
1.5 Roof	41 000	kg CO_2e	2.97 %
2.1.5 Floor coverings and finishes	55 000	kg CO_2e	3.99 %
Electricity use	130 000	kg CO_2e	9.19 %
Other classifications	12 000	kg CO_2e	0.85 %

Global warming kg CO_2e - Resource types

Item	Value	Unit	Percentage %
Ready-mix concrete for foundations and internal walls	270 000	kg CO_2e	19.64 %
Stone wool insulation	200 000	kg CO_2e	14.84 %
Aluminium	180 000	kg CO_2e	13.16 %
CLT, glulam and LVL	150 000	kg CO_2e	10.83 %
Electricity	130 000	kg CO_2e	9.19 %
Regular gypsum board	71 000	kg CO_2e	5.18 %
Plastic membranes	49 000	kg CO_2e	3.55 %
Plain wood/timber (softwood and hardwood)	49 000	kg CO_2e	3.54 %
Oriented strand board (OSB)	45 000	kg CO_2e	3.25 %
Other resource types	230 000	kg CO_2e	16.81 %

Mass kg - Classifications

Item	Value	Unit	Percentage %
1.1 Foundations (substructure)	160 000	kg	3.98 %
1.2 Load bearing structural frame	2 700 000	kg	67.69 %
1.2.1 Frame (beams, columns and slabs)	340 000	kg	8.41 %
1.2.3 External walls	170 000	kg	4.34 %
1.3 Non-load bearing elements	210 000	kg	5.24 %
1.3.2 Internal walls, partitions and doors	120 000	kg	3.01 %
1.5 Roof	64 000	kg	1.6 %
2.1.5 Floor coverings and finishes	120 000	kg	3.12 %
3.2.1 Paving and other hard surfacing	49 000	kg	1.22 %
Other classifications	55 000	kg	1.39 %

Data sources

Sources

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
Aggregate (crushed gravel), generic, dry bulk density	1600 kg/m3			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL
Aluminium foil		Würth Dampfsperre Wütop DS Alu	Würth Handelsges.m.b.H.	baubook	9352 am	BAUBOOK	EN15804+A1	Internally verified	2018	austria

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
Aluminium pipes	STD, DN 6 mm, (1/8 in), 0.61 kg/m, wall thickness: 1.73 mm		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Armchair with steel legs	H: 790 mm, D: 890 mm, W: 880 mm, 30 kg/unit		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Bike path (light-vehicle, cycle way) with concrete block paver , per m2, excl. sub-grade layer (3 materials)	Total thickness 33 cm (13 in)			One Click LCA						LOCAL
Bitumen-polymer waterproofing membrane		Soprema E-4-SK	Soprema GmbH	baubook	9510 ad	BAUBOOK	EN15804+A1	Internally verified	2015	austria
Ceramic glazed tile	20 kg/m2		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Ceramic tiles and slabs	17.97 kg/m2		Bundesverband Keramische Fliesen	IBU	EPD-BKF-20220183-ICG1-DE	EPD Keramische Fliesen und Platten Bundesverband Keramische Fliesen e.V	EN15804+A1	Third-party verified (as per ISO 14025)	2022	germany
Ceramic toilet bowl	23 kg/unit, 600 × 360 × 430 mm		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Concrete stone pavement	stone thickness 50 mm (2 in)			One Click LCA		Adjusted data based on the specifications of the Swedish Transport Administration (Trafikverket).				LOCAL
Cross-laminated timber (CLT)	480 kg/m3		KLH Massivholz	IBU	EPD-KLH-20190027-ICA1-EN	EPD KLH cross-laminated timber panels	EN15804+A1	Third-party verified (as per ISO 14025)	2019	austria
Drainage pipe for culvert applications, Flush joint pipe, reinforced concrete, per m (ft)	300 mm (12 in) nominal diameter			One Click LCA						LOCAL
EPDM waterproofing membrane	1.5 mm, 1.95 kg/m2		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
EPS insulation boards		EPS W25	AUSTROTHERM	baubook	3332 al	BAUBOOK	EN15804+A1	Internally verified	2018	austria
EPS insulation panels, graphite	L= 0.037 W/mK, R= 2.7 m2K/W, 100 mm, 1.5 kg/m2, 15 kg/m3, compressive strength 85kPa, 10% recycled polystyrene, Lambda=0.037 W/(m.K)		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
EPS insulation panels, graphite	L= 0.037 W/mK, R= 2.7 m2K/W, 100 mm, 1.5 kg/m2, 15 kg/m3, compressive strength 85kPa, 100% virgin polystyrene, Lambda=0.037 W/(m.K)		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
EPS insulation panels, graphite	L= 0.033 W/mK, R= 3.03 m2K/W, 100 mm, 3 kg/m2, 30 kg/m3, compressive strength 220 kPa, 10% recycled polystyrene, Lambda=0.033 W/(m.K)		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Electricity, Austria				One Click LCA		LCA study for country specific electricity mixes based on IEA, OneClickLCA 2024		Internally verified	2022	austria
Extensive green roof system	40mm, 23.34 kg/m2	Urbanspace	Knauf	IBU	EPD-KNI-20160071-CBA1-EN	EPD URBANSCAPE Extensive Green Roof System	EN15804+A1	Third-party verified (as per ISO 14025)	2016	germany
Fibre cement boards	1300 kg/m3 (81.16 lbs/ft3)			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2019	LOCAL
Floor screed mortar, cement screed	1500 kg/m3, EPD coverage: > 1500 kg/m3		quickmix Gruppe GmbH & Co. KG	IBU	EPD-QMX-20160208-IBC1-DE	Oekobau.dat 2017-I, EPD Mineralische Werkmörtel: Estrichmörtel - Zementestrich quickmix Gruppe GmbH & Co. KG	EN15804+A1	Third-party verified (as per ISO 14025)	2014	germany

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
Fresh sawn timber	biogenic CO2 not substracted, wood moisture at delivery 70 %, 740 kg/m3		Fritz EGGER	IBU	EPD-EGG-20140246-IBA2-DE	Oekobau.dat 2017-I, EPD EGGER Schnittholz frisch EGGER Sägewerk Brilon GmbH	EN15804+A1	Third-party verified (as per ISO 14025)	2016	germany
Galvanized steel T-shape piece for ventilation ducts, circular	d1-d2: 200-200 mm, (8-8 in), 1.3 kg/unit		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Glass wool insulation panels		ISOVER MERINO	Saint-Gobain Isover Austria GmbH	baubook	2273 bs	BAUBOOK	EN15804+A1	Internally verified	2018	austria
Glass wool insulation panels		ISOVER ULTIMATE UNTERSPARREN KLEMMFILZ 035 TWIN	Saint-Gobain Isover Austria GmbH	baubook	2273 cw	BAUBOOK	EN15804+A1	Internally verified	2018	austria
Glass wool insulation panels		ISOVER TRITTSCHALL-DÄMPLATTE S (Feb.2016)	Saint-Gobain Isover Austria GmbH	baubook	2273 bu	BAUBOOK	EN15804+A1	Internally verified	2018	austria
Gravel, dry bulk density	1680 kg/m3			One Click LCA	-	LCA inventory for gravel production	ISO14040	Internally verified	2016	LOCAL
Gypsum plasterboard	12.5 x 2000/2500 x 1250 mm, 12.8 kg/m2	Diamant GKFI	KNAUF	IBU	EPD-KNA-20150104-IBD1-EN	EPD Plasterboard Knauf Diamant GKFI Knauf Gips KG	EN15804+A1	Third-party verified (as per ISO 14025)	2016	germany, croatia, netherlands, austria, turkey
Gypsum plasterboard, standard	biogenic CO2 not subtracted, 15 mm, 12 kg/m2, 800 kg/m3	RB	Rigips	BauEPD	EPD-RIGIPS-2014-1-GaBi	EPD Gipsplatten (RIGIPS RB, RIGIPS RF, RIGIPS RBI, RIGIPS RFI, RIGIPS DL, RIGIPS DLI und RIGIPS Riduro)	EN15804+A1	Third-party verified (as per ISO 14025)	2014	austria
Hot dip galvanized steel	0.73 mm, 5.72 kg/m2, EN15804+A1, ref. year 2018			OKOBAUDAT	50c9e674-afd9-456c-9440-6506bec6d55b	ÖKOBAUDAT 2021-II (25.06.2021)	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany
Hot-dip galvanized structural steel	7850 kg/m3		bauforumstahl / Industrieverband Feuerverzinken	IBU	EPD-BFS-20130173-IBG1-DE	Oekobau.dat 2017-I, EPD Feuerverzinkte Baustähle: Offene Walzprofile und Grobbleche bauforumstahl e.V. & Industrieverband Feuerverzinken e.V.	EN15804+A1	Third-party verified (as per ISO 14025)	2013	europe
Insulation, EPS 100	0.035 W/mK, 18-22 kg/m3 (100 kPa), without flame retardant		EUMEPS	IBU	EPD-EPS-20130077-CBG1-EN	Expanded Polystyrene (EPS) Foam Insulation (without flame retardant, density 20 kg/m³), EPS 100, EUMEPS	EN15804+A1	Third-party verified (as per ISO 14025)	2013	finland, sweden, denmark

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
						(region Scandinavia)				
LED office lighting	5.95 kg/unit, EN15804+A1, ref. year 2018			OKOBAUDAT	43991578-721b-4f93-8467-a7683060a26b	ÖKOBAUDAT 2021-II (25.06.2021)	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany
Mineral glue for leveling compounds		Universal-Spachtelmasse USP 32 S	PCI Augsburg GmbH	baubook	2038 aw	BAUBOOK	EN15804+A1	Internally verified	2019	austria
Mineral wool (floor insulation)	L = 0.040 W/mK, 85 kg/m3, EN15804+A1, ref. year 2018			OKOBAUDAT	2691d6e4-a41e-40d7-92ca-680f8785fc1d	ÖKOBAUDAT 2021-II (25.06.2021)	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany
Modular and scalable fibre communication system	Single-mode fibre, LC connectors, 1Gbps, 92 kg/unit		Backbone	BRE	BREG EN EPD000468, issue 02	EPD Backbone Connected Building	EN15804+A1	Third-party verified (as per ISO 14025)	2022	unitedKingdom
Oriented Strand Board (OSB)	6 - 40 x 590 - 1250 x 1840 - 6250 mm, 600 kg/m3	AGEPAN	Sonae Indústria	IBU	EPD-SON-20150246-IBA1-EN	EPD	EN15804+A1	Third-party verified (as per ISO 14025)	2016	germany, portugal, southAfrica, spain, canada
Parquet, multilayered	biogenic CO2 not substracted, 7 kg/m2		Scheucher	IBU	EPD-SCP-20150324-IBC1-DE	Oekobau.dat 2017-I, EPD Scheucher Parkett Mehrschichtparkett Scheucher Holzindustrie GmbH	EN15804+A1	Third-party verified (as per ISO 14025)	2016	austria
Polyethylene vapour barrier membrane	0.15 mm, 0.14 kg/m2		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Precast concrete pavers/blocks, Danish average	10 cm, 225 kg/m2		Belægningsgruppen	EPD Danmark	MD-20022-DA	EPD Belægningsgruppen	EN15804+A1	Third-party verified (as per ISO 14025)	2020	denmark
Precast concrete slab, wall	12cm, 291.3 kg/m2, 2427.5 kg/m3, EN15804+A1, ref. year 2018			OKOBAUDAT	b342696e-2ebb-4fe1-a71d-f3520db0cee9	ÖKOBAUDAT 2021-II (25.06.2021)	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany
Ready-mix concrete, normal strength, generic	C25/30 (3600/4400 PSI), with CEM I, 0% recycled binders (280 kg/m3; 17.5 lbs/ft3 total cement)			One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2020	LOCAL
Ready-mix concrete, normal-strength, generic	C30/37 (4400/5400 PSI), 10% (typical) recycled binders in			One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2018	LOCAL

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
	cement (300 kg/m3 / 18.72 lbs/ft3)									
Recycled asphalt pavement (RAP), generic	2100 kg/m3 (131 lbs/ft3) uncompacted density			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL
Reinforcement for concrete (rebar)	diameter: 6-40 mm, 7850 kg/m3		Badische Stahlwerke	ift Rosenheim	EPD-BS-10.2	EPD Betonbewehrung Betonstahl	EN15804+A1	Third-party verified (as per ISO 14025)	2018	germany
Reinforcement steel (rebar), generic	97% recycled content (typical), A615			One Click LCA	-	One Click LCA	EN15804+A1	Internally verified	2018	LOCAL
Rubber floor covering with foam coating	3.82 kg/m2, EN15804+A1, ref. year 2018			OKOBAUDAT	7d8cb95b-99c2-4824-97a0-55d2fca5cedd	ÖKOBAUDAT 2021-II (25.06.2021)	EN15804+A1	Third-party verified (as per ISO 14025)	2020	europe
Sand, compacted dry density	1682 kg/m3			One Click LCA	-	LCA inventory for sand quarry operation	EN15804+A1	Internally verified	2020	LOCAL
Sawn timber, pine or spruce	460 kg/m3, 15-140 mm, 10-20% moisture content	Classic Sawn	Stora Enso	International EPD System	S-P-02150	EPD Classic Sawn by Stora Enso	EN15804+A1, EN15804+A2	Third-party verified (as per ISO 14025)	2020	austria, sweden, estonia, finland, czechRepublic, latvia, lithuania, poland, russia
Screed mortar, cement screed		Estriche	Baumit GmbH	baubook	8843 am	BAUBOOK	EN15804+A1	Internally verified	2017	austria
Solar thermal collector	18.19 kg/unit, 400 Wp	VirtuHOT, A100142	Naked Energy Ltd	EPD Hub	HUB-0433	EPD VirtuHOT Naked Energy Ltd	EN15804+A1, EN15804+A2	Third-party verified (as per ISO 14025)	2023	italy, OCLEPD
Solidwood flooring, multiple species	thickness range: 8 - 22mm, 4.38kg/m2, 548 kg/m3 oven-dry, moisture content < 13%		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Stone wool (mineral wool) insulation, unfaced	L = 0.0315 W/mK, R = 1 m2K/W, 31.5mm, 1.26 kg/m2, 40 kg/m3, (Range: 36-50kg/m3), 22% slag content		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL
Stone wool (mineral wool) insulation, unfaced	L = 0.0325 W/mK, R = 1 m2K/W, 32.5mm, 5.04 kg/m2, 155 kg/m3,		One Click LCA	One Click LCA	-	One Click LCA	EN15804+A1, EN15804+A2	Internally verified	2023	LOCAL

Resource name	Technical specification	Product	Manufacturer	EPD program	EPD number	Environment Data Source	Standard	Verification	Year	Country
	(Range: 113-200kg/m3), 22% slag content, high pressure suitable									
Waterproofing membrane for green roof systems	2 mm, 2 kg/m2	Sarnafil® TG 66	Sika Deutschland	IBU	EPD-SIK-20190169-IBA1-EN	EPD Sarnafil® TG 66 Sika Deutschland GmbH	EN15804+A1	Third-party verified (as per ISO 14025)	2020	germany
Wildlife fence, galvanized steel mesh, steel posts				One Click LCA		Adjusted data based on the specifications of the Swedish Transport Administration (Trafikverket).				LOCAL
XPS insulation with flame retardant	L = 0.032 W/mK, 20-200 x 1265 x 600 mm, 28-50 kg/m3, Lambda=0.032 W/(m.K)	Styrodur	BASF	IBU	EPD-BAS-20190113-IBA1-DE	EPD Styrodur® BASF SE	EN15804+A1	Third-party verified (as per ISO 14025)	2019	germany
XPS-G 30 > 180 mm (32 kg/m³)	More than 180 mm	ROOFMATE SL-AP (81-120mm)	Ravago Building Solutions Germany GmbH	baubook	3158 ak	BAUBOOK	EN15804+A1	Internally verified	2016	austria

Attachment E – Results – OI3-Index for 50 years

Project name: **Case Study 50 years**

building overall

PENRT:	4.020 MJ / m² ref. area	GWP-total:	280 kg CO_2 equ. / m² ref. area	GFA:	3.577,3 m²
PENRE:	3.532 MJ / m² ref. area	GWP-fossil:	287 kg CO_2 equ. / m² ref. area	ref. area:	3.577,3 m²
PENRM:	488 MJ / m² ref. area	GWP-biogenic:	-6,77 kg CO_2 equ. / m² ref. area	reference limit:	BG3 ref. Area
PERT:	2.928 MJ / m² ref. area	AP:	1,26 kg SO_2 equ. / m² ref. area	catalog of LCA indicators:	IBO benchmarks 2020
PERE:	755 MJ / m² ref. area	EP:	0,498 kg PO_4^{3-} / m² ref. area	useful life considered:	yes, with integer replacements rates (according to EN 15804 standard)
PERM:	2.173 MJ / m² ref. area	POCP:	0,328 kg C_2H_4 / m² ref. area	study period:	50 years
		ODP:	$1{,}89 \cdot 10^{-5}$ kg CFC-11 / m² ref. area	service life catalog:	2018
				calculation for:	new building

A1-A3: Bauteile

quantity	building element	PENRT MJ	PENRE MJ	PENRM MJ	PERT MJ	PERE MJ	PERM MJ	GWP-total kg CO_2 equ.	GWP-fossil kg CO_2 equ.	GWP-biogenic kg CO_2 equ.	AP kg SO_2 equ.	EP kg PO_4^{3-}	POCP kg C_2H_4	ODP kg CFC-11
		per m² ref. area												
41,30 m²	AW01_ Kelleraußenwand 25STB+12WD	9	7	2	0	0	0	0,8	1	0	0,00	0,001	0,001	$0{,}00 \cdot 10^{-5}$
312,60 m²	AW01_ Kelleraußenwand 30STB+17WD	90	72	17	3	3	0	8,0	8	0	0,02	0,009	0,006	$0{,}02 \cdot 10^{-5}$
192,20 m²	AW02_ Außenwand 25STB+12WD	38	38	0	2	2	0	4,4	4	0	0,01	0,006	0,004	$0{,}01 \cdot 10^{-5}$
1.471,00 m²	AW03_ Außenraum gegen beheizt	610	578	32	718	176	542	-13,9	40	-54	0,21	0,079	0,069	$0{,}25 \cdot 10^{-5}$
143,20 m²	AW05_ Stgh gegen Beheizt OG2-OG6	52	50	2	43	11	32	1,4	5	-3	0,02	0,007	0,005	$0{,}02 \cdot 10^{-5}$
27,00 m²	AW05a_ Stgh gegen Naßzelle OG2-OG6	12	12	0	8	2	6	0,4	1	-1	0,00	0,002	0,001	$0{,}01 \cdot 10^{-5}$
28,30 m²	AW05b_ Stgh gegen Beheizt OG1	11	10	1	8	2	6	0,2	1	-1	0,00	0,001	0,001	$0{,}00 \cdot 10^{-5}$
19,10 m²	AW05c_ Stgh gegen Unbeheizt	9	8	1	4	1	3	0,5	1	-0	0,00	0,001	0,001	$0{,}00 \cdot 10^{-5}$
51,00 m²	AW05d_ Stgh gegen Unbeheizt	23	23	0	11	3	7	1,4	2	-1	0,01	0,003	0,003	$0{,}01 \cdot 10^{-5}$
60,00 m³	Bauholz Stütze	29	29	0	162	25	137	-11,5	2	-13	0,01	0,005	0,004	$0{,}01 \cdot 10^{-5}$
38,60 m³	Bauholz Unterzug	18	18	0	104	16	88	-7,4	1	-8	0,01	0,003	0,003	$0{,}01 \cdot 10^{-5}$
291,40 m²	DE01_Fußboden Außenraum gegen beheizt	120	95	26	4	4	0	10,1	10	-0	0,02	0,011	0,007	$0{,}03 \cdot 10^{-5}$
32,40 m²	DE02_Müllraum gegen beheizt	12	10	2	1	1	0	1,1	1	-0	0,00	0,001	0,001	$0{,}00 \cdot 10^{-5}$
487,00 m²	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	313	270	43	14	14	0	32,2	32	-0	0,07	0,038	0,015	$0{,}09 \cdot 10^{-5}$
149,60 m²	DE04_Forum	40	35	5	2	2	0	4,2	4	-0	0,01	0,005	0,002	$0{,}01 \cdot 10^{-5}$
1.415,70 m²	DE05_Decke Wohnung gegen Wohnung	702	671	31	793	232	561	-13,0	45	-58	0,33	0,105	0,077	$0{,}34 \cdot 10^{-5}$
163,20 m²	DE05a_Decke Wohnung gegen Naßzelle	80	76	3	72	16	56	-0,4	5	-6	0,03	0,011	0,009	$0{,}04 \cdot 10^{-5}$
288,40 m²	DE05b_Decke Wohnung 1OG	164	160	3	82	33	49	10,4	16	-5	0,06	0,025	0,015	$0{,}06 \cdot 10^{-5}$
243,90 m²	DE06_Extensives Gründach mit reduziertem Aufbau	125	89	36	85	19	66	-0,8	6	-6	0,03	0,010	0,009	$0{,}05 \cdot 10^{-5}$
468,90 m²	DE07_Decke unter Freibereich	316	208	108	199	40	159	-2,2	13	-15	0,07	0,024	0,019	$0{,}11 \cdot 10^{-5}$
328,70 m²	IW01_ Wohnung gegen Wohnung	115	111	4	190	43	147	-7,7	7	-15	0,04	0,015	0,011	$0{,}06 \cdot 10^{-5}$
580,90 m²	IW02_ Modultrennwand	114	109	5	260	51	208	-13,6	7	-20	0,04	0,016	0,012	$0{,}06 \cdot 10^{-5}$
143,00 m²	IW02a_ Modultrennwand einseitig	16	15	1	33	7	26	-1,6	1	-3	0,00	0,002	0,001	$0{,}01 \cdot 10^{-5}$
345,30 m²	IW03_ Gang gegen Wohnung	68	66	2	103	25	77	-3,8	4	-8	0,02	0,008	0,005	$0{,}04 \cdot 10^{-5}$
1.139,60 m²	IW04_LB 10cm einfach Metallständerwand	53	51	1	12	11	1	3,3	4	-0	0,01	0,005	0,001	$0{,}04 \cdot 10^{-5}$
108,80 m²	IW04a_LB 6,25cm einfach Vorsatzschale	3	3	0	1	1	0	0,2	0	-0	0,00	0,000	0,000	$0{,}00 \cdot 10^{-5}$
100,80 m²	IW04b_LB 7,5cm Vorsatzschale	4	4	0	1	1	0	0,2	0	-0	0,00	0,000	0,000	$0{,}00 \cdot 10^{-5}$
35,28 m³	STB Stütze	18	18	0	1	1	0	2,3	2	0	0,00	0,003	0,001	$0{,}01 \cdot 10^{-5}$
1,60 m³	STB Unterzug	1	1	0	0	0	0	0,1	0	0	0,00	0,000	0,000	$0{,}00 \cdot 10^{-5}$
199,40 m²	STB Wand 25 cm KG	25	25	0	1	1	0	3,3	3	0	0,01	0,004	0,001	$0{,}01 \cdot 10^{-5}$
44,00 m²	STB Wand 50 cm KG	11	11	0	1	1	0	1,5	1	0	0,00	0,002	0,000	$0{,}00 \cdot 10^{-5}$
8.816,70 m²	**sum**	**3.200**	**2.874**	**326**	**2.916**	**743**	**2.173**	**10,0**	**228**	**-218**	**1,04**	**0,401**	**0,282**	$1{,}32 \cdot 10^{-5}$

B4: Bauteile

quantity	building element	PENRT MJ	PENRE MJ	PENRM MJ	PERT MJ	PERE MJ	PERM MJ	GWP-total kg CO_2 equ.	GWP-fossil kg CO_2 equ.	GWP-biogenic kg CO_2 equ.	AP kg SO_2 equ.	EP kg PO_4^{3-}	POCP kg C_2H_4	ODP kg CFC-11
		per m² ref. area												
41,30 m²	AW01_ Kelleraußenwand 25STB+12WD	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0{,}00 \cdot 10^{-6}$
312,60 m²	AW01_ Kelleraußenwand 30STB+17WD	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0{,}00 \cdot 10^{-6}$
192,20 m²	AW02_ Außenwand 25STB+12WD	14	14	0	0,53	0,53	0,000	1,2	1,2	0,00	0,0080	0,0021	0,0034	$0{,}05 \cdot 10^{-6}$
1.471,00 m²	AW03_ Außenraum gegen beheizt	24	12	12	0,36	0,36	0,000	0,8	0,8	0,00	0,0023	0,0004	0,0007	$0{,}01 \cdot 10^{-6}$
143,20 m²	AW05_ Stgh gegen Beheizt OG2-OG6	2	1	1	0,04	0,04	0,000	0,1	0,1	0,00	0,0002	0,0000	0,0001	$0{,}00 \cdot 10^{-6}$
27,00 m²	AW05a_ Stgh gegen Naßzelle OG2-OG6	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0{,}00 \cdot 10^{-6}$
28,30 m²	AW05b_ Stgh gegen Beheizt OG1	3	2	1	0,10	0,10	0,000	0,1	0,1	0,00	0,0006	0,0002	0,0001	$0{,}01 \cdot 10^{-6}$
19,10 m²	AW05c_ Stgh gegen Unbeheizt	2	1	0	0,06	0,06	0,000	0,1	0,1	0,00	0,0004	0,0002	0,0001	$0{,}01 \cdot 10^{-6}$
51,00 m²	AW05d_ Stgh gegen Unbeheizt	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0{,}00 \cdot 10^{-6}$
60,00 m³	Bauholz Stütze	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0{,}00 \cdot 10^{-6}$
38,60 m³	Bauholz Unterzug	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0{,}00 \cdot 10^{-6}$
291,40 m²	DE01_Fußboden Außenraum gegen beheizt	12	7	5	0,28	0,28	0,000	0,4	0,4	0,00	0,0016	0,0005	0,0003	$0{,}09 \cdot 10^{-6}$
32,40 m²	DE02_Müllraum gegen beheizt	2	1	1	0,05	0,05	0,000	0,0	0,0	0,00	0,0002	0,0001	0,0000	$0{,}01 \cdot 10^{-6}$
487,00 m²	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	8	4	4	0,12	0,12	0,000	0,3	0,3	0,00	0,0008	0,0001	0,0002	$0{,}00 \cdot 10^{-6}$
149,60 m²	DE04_Forum	1	1	0	0,11	0,11	0,000	0,1	0,1	0,00	0,0001	0,0001	0,0000	$0{,}00 \cdot 10^{-6}$
1.415,70 m²	DE05_Decke Wohnung gegen Wohnung	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0{,}00 \cdot 10^{-6}$
163,20 m²	DE05a_Decke Wohnung gegen Naßzelle	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0{,}00 \cdot 10^{-6}$
288,40 m²	DE05b_Decke Wohnung 1OG	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0{,}00 \cdot 10^{-6}$
243,90 m²	DE06_Extensives Gründach mit reduziertem Aufbau	83	49	34	1,28	1,08	0,193	3,2	3,2	0,00	0,0175	0,0042	0,0057	$0{,}26 \cdot 10^{-6}$
468,90 m²	DE07_Decke unter Freibereich	219	115	104	3,82	3,44	0,371	7,5	7,5	0,00	0,0395	0,0112	0,0115	$0{,}56 \cdot 10^{-6}$
328,70 m²	IW01_ Wohnung gegen Wohnung	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0{,}00 \cdot 10^{-6}$
580,90 m²	IW02_ Modultrennwand	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0{,}00 \cdot 10^{-6}$

143,00 m²	IW02a_ Modultrennwand einseitig	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0,00 \cdot 10^{-6}$
345,30 m²	IW03_ Gang gegen Wohnung	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0,00 \cdot 10^{-6}$
1.139,60 m²	IW04_LB 10cm einfach Metallständerwand	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0,00 \cdot 10^{-6}$
108,80 m²	IW04a_LB 6,25cm einfach Vorsatzschale	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0,00 \cdot 10^{-6}$
100,80 m²	IW04b_LB 7,5cm Vorsatzschale	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0,00 \cdot 10^{-6}$
35,28 m³	STB Stütze	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0,00 \cdot 10^{-6}$
1,60 m³	STB Unterzug	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0,00 \cdot 10^{-6}$
199,40 m²	STB Wand 25 cm KG	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0,00 \cdot 10^{-6}$
44,00 m²	STB Wand 50 cm KG	0	0	0	0,00	0,00	0,000	0,0	0,0	0,00	0,0000	0,0000	0,0000	$0,00 \cdot 10^{-6}$
8.816,70 m²	**sum**	**370**	**208**	**162**	**6,74**	**6,17**	**0,564**	**13,8**	**13,8**	**0,00**	**0,0712**	**0,0193**	**0,0222**	**$1,01 \cdot 10^{-6}$**

A1-A3 + B4: Bauteile

quantity	building element	PENRT MJ	PENRE MJ	PENRM MJ	PERT MJ	PERE MJ	PERM MJ	GWP-total kg CO_2 equ.	GWP-fossil kg CO_2 equ.	GWP-biogenic kg CO_2 equ.	AP kg SO_2 equ.	EP kg PO_4^{3-}	POCP kg C_2H_4	ODP kg CFC-11
		per m² ref. area												
41,30 m²	AW01_ Kelleraußenwand 25STB+12WD	9	7	2	0	0	0	0,8	1	0	0,00	0,001	0,001	$0,00 \cdot 10^{-5}$
312,60 m²	AW01_ Kelleraußenwand 30STB+17WD	90	72	17	3	3	0	8,0	8	0	0,02	0,009	0,006	$0,02 \cdot 10^{-5}$
192,20 m²	AW02_ Außenwand 25STB+12WD	53	53	0	2	2	0	5,5	6	0	0,02	0,008	0,008	$0,02 \cdot 10^{-5}$
1.471,00 m²	AW03_ Außenraum gegen beheizt	634	590	44	718	177	542	-13,1	41	-54	0,21	0,079	0,069	$0,25 \cdot 10^{-5}$
143,20 m²	AW05_ Stgh gegen Beheizt OG2-OG6	55	52	3	43	11	32	1,4	5	-3	0,02	0,007	0,005	$0,02 \cdot 10^{-5}$
27,00 m²	AW05a_ Stgh gegen Naßzelle OG2-OG6	12	12	0	8	2	6	0,4	1	-1	0,00	0,002	0,001	$0,01 \cdot 10^{-5}$
28,30 m²	AW05b_ Stgh gegen Beheizt OG1	14	12	2	9	2	6	0,4	1	-1	0,00	0,002	0,001	$0,01 \cdot 10^{-5}$
19,10 m²	AW05c_ Stgh gegen Unbeheizt	11	10	1	4	1	3	0,6	1	-0	0,00	0,001	0,001	$0,00 \cdot 10^{-5}$
51,00 m²	AW05d_ Stgh gegen Unbeheizt	23	23	0	11	3	7	1,4	2	-1	0,01	0,003	0,003	$0,01 \cdot 10^{-5}$
60,00 m³	Bauholz Stütze	29	29	0	162	25	137	-11,5	2	-13	0,01	0,005	0,004	$0,01 \cdot 10^{-5}$
38,60 m³	Bauholz Unterzug	18	18	0	104	16	88	-7,4	1	-8	0,01	0,003	0,003	$0,01 \cdot 10^{-5}$
291,40 m²	DE01_Fußboden Außenraum gegen beheizt	133	102	31	4	4	0	10,5	10	-0	0,02	0,012	0,007	$0,04 \cdot 10^{-5}$
32,40 m²	DE02_Müllraum gegen beheizt	14	11	3	1	1	0	1,2	1	-0	0,00	0,001	0,001	$0,01 \cdot 10^{-5}$
487,00 m²	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	321	274	47	14	14	0	32,5	33	-0	0,07	0,038	0,015	$0,09 \cdot 10^{-5}$
149,60 m²	DE04_Forum	40	35	5	2	2	0	4,2	4	-0	0,01	0,005	0,002	$0,01 \cdot 10^{-5}$
1.415,70 m²	DE05_Decke Wohnung gegen Wohnung	702	671	31	793	232	561	-13,0	45	-58	0,33	0,105	0,077	$0,34 \cdot 10^{-5}$
163,20 m²	DE05a_Decke Wohnung gegen Naßzelle	80	76	3	72	16	56	-0,4	5	-6	0,03	0,011	0,009	$0,04 \cdot 10^{-5}$
288,40 m²	DE05b_Decke Wohnung 1OG	164	160	3	82	33	49	10,4	16	-5	0,06	0,025	0,015	$0,06 \cdot 10^{-5}$
243,90 m²	DE06_Extensives Gründach mit reduziertem Aufbau	208	138	70	87	20	66	2,4	9	-6	0,05	0,014	0,014	$0,08 \cdot 10^{-5}$
468,90 m²	DE07_Decke unter Freibereich	535	323	212	203	43	159	5,3	21	-15	0,11	0,035	0,031	$0,17 \cdot 10^{-5}$
328,70 m²	IW01_ Wohnung gegen Wohnung	115	111	4	190	43	147	-7,7	7	-15	0,04	0,015	0,011	$0,06 \cdot 10^{-5}$
580,90 m²	IW02_ Modultrennwand	114	109	5	260	51	208	-13,6	7	-20	0,04	0,016	0,012	$0,06 \cdot 10^{-5}$
143,00 m²	IW02a_ Modultrennwand einseitig	16	15	1	33	7	26	-1,6	1	-3	0,00	0,002	0,001	$0,01 \cdot 10^{-5}$
345,30 m²	IW03_ Gang gegen Wohnung	68	66	2	103	25	77	-3,8	4	-8	0,02	0,008	0,005	$0,04 \cdot 10^{-5}$
1.139,60 m²	IW04_LB 10cm einfach Metallständerwand	53	51	1	12	11	1	3,3	4	-0	0,01	0,005	0,001	$0,04 \cdot 10^{-5}$
108,80 m²	IW04a_LB 6,25cm einfach Vorsatzschale	3	3	0	1	1	0	0,2	0	-0	0,00	0,000	0,000	$0,00 \cdot 10^{-5}$
100,80 m²	IW04b_LB 7,5cm Vorsatzschale	4	4	0	1	1	0	0,2	0	-0	0,00	0,000	0,000	$0,00 \cdot 10^{-5}$
35,28 m³	STB Stütze	18	18	0	1	1	0	2,3	2	0	0,00	0,003	0,001	$0,01 \cdot 10^{-5}$
1,60 m³	STB Unterzug	1	1	0	0	0	0	0,1	0	0	0,00	0,000	0,000	$0,00 \cdot 10^{-5}$
199,40 m²	STB Wand 25 cm KG	25	25	0	1	1	0	3,3	3	0	0,01	0,004	0,001	$0,01 \cdot 10^{-5}$
44,00 m²	STB Wand 50 cm KG	11	11	0	1	1	0	1,5	1	0	0,00	0,002	0,000	$0,00 \cdot 10^{-5}$
8.816,70 m²	**sum**	**3.569**	**3.081**	**488**	**2.923**	**750**	**2.173**	**23,8**	**242**	**-218**	**1,11**	**0,420**	**0,304**	**$1,42 \cdot 10^{-5}$**

A4: transportation

	PENRT MJ	PENRE MJ	PENRM MJ	PERT MJ	PERE MJ	PERM MJ	GWP-total kg CO_2 equ.	GWP-fossil kg CO_2 equ.	GWP-biogenic kg CO_2 equ.	AP kg SO_2 equ.	EP kg PO_4^{3-}	POCP kg C_2H_4	ODP kg CFC-11
	per m² ref. area												
sum (100,0% of all components with known mass included)	174	174	0,00	2,47	2,47	0,00	11,2	11,2	0,00	0,0435	0,0117	0,00616	$1,76 \cdot 10^{-6}$

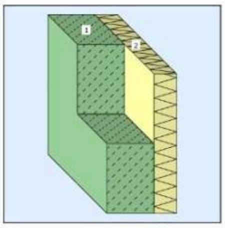
C1-C4: end of life

	PENRT MJ	PENRE MJ	PENRM MJ	PERT MJ	PERE MJ	PERM MJ	GWP-total kg CO_2 equ.	GWP-fossil kg CO_2 equ.	GWP-biogenic kg CO_2 equ.	AP kg SO_2 equ.	EP kg PO_4^{3-}	POCP kg C_2H_4	ODP kg CFC-11
	per m² ref. area												
sum (100,0% of all components with known mass included)	277	277	0,00	2,90	2,90	0,00	245	33,8	212	0,108	0,0660	0,0171	$2,90 \cdot 10^{-6}$

graphic details of solid and transparent building elements

Project name: **Case Study 50 years**

AW01_ Kelleraußenwand 25STB+12WD (30359)



Fläche: 41,3 m²
mass: 603,3 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 773 MJ/m²
PENRE: 641 MJ/m²
PENRM: 132 MJ/m²
PERT: 27,0 MJ/m²
PERE: 27,0 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 73,1 kg CO_2 equ./m²
GWP-fossil: 73,1 kg CO_2 equ./m²
GWP-biogenic: 0,00 kg CO_2 equ./m²
AP: 0,156 kg SO_2 equ./m²
EP: 0,0795 kg PO_4^{3-}/m²
POCP: 0,0472 kg C_2H_4/m²
ODP: $1{,}81 \cdot 10^{-6}$ kg CFC-11/m²

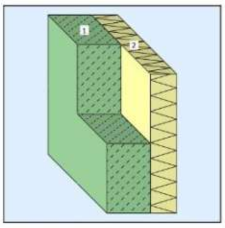
no.	**layer** (from inside to outside)	d cm	**Useful life >b**
1	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
2	EPS W 30 plus *(AUSTROTHERM EPS W30 PLUS)*	12,00	[1]100
	building element	**37,00**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

AW01_ Kelleraußenwand 30STB+17WD (30359)



Fläche: 312,6 m²
mass: 725,0 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 1.025 MJ/m²
PENRE: 827 MJ/m²
PENRM: 198 MJ/m²
PERT: 33,3 MJ/m²
PERE: 33,3 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 91,9 kg CO_2 equ./m²
GWP-fossil: 91,9 kg CO_2 equ./m²
GWP-biogenic: 0,00 kg CO_2 equ./m²
AP: 0,202 kg SO_2 equ./m²
EP: 0,0980 kg PO_4^{3-}/m²
POCP: 0,0657 kg C_2H_4/m²
ODP: $2{,}30 \cdot 10^{-6}$ kg CFC-11/m²

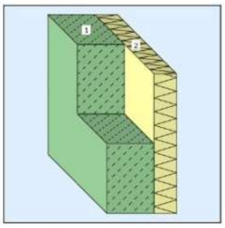
no.	**layer** (from inside to outside)	d cm	**Useful life >b**
1	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	30,00	100
2	EPS W 30 plus *(AUSTROTHERM EPS W30 PLUS)*	18,00	[1]100
	building element	**48,00**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

AW02_ Außenwand 25STB+12WD (30358)



Fläche: 192,2 m²
mass: 612,6 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 984 MJ/m²
PENRE: 984 MJ/m²
PENRM: 0,00 MJ/m²
PERT: 43,6 MJ/m²
PERE: 43,6 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 103 kg CO_2 equ./m²
GWP-fossil: 103 kg CO_2 equ./m²
GWP-biogenic: 0,00 kg CO_2 equ./m²
AP: 0,405 kg SO_2 equ./m²
EP: 0,149 kg PO_4^{3-}/m²
POCP: 0,145 kg C_2H_4/m²
ODP: $3{,}14 \cdot 10^{-6}$ kg CFC-11/m²

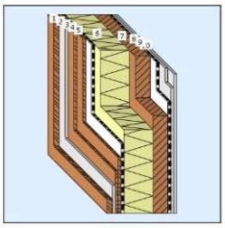
no.	**layer** (from inside to outside)	d cm	**Useful life >b**
1	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
2	Mineralwolle hart, Dämmung hart, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	12,00	35
	building element	**37,00**	

[1] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

AW03_ Außenraum gegen beheizt (30358)



Fläche: 1471 m²
mass: 152,3 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 1.542 MJ/m²
PENRE: 1.435 MJ/m²
PENRM: 106 MJ/m²
PERT: 1.747 MJ/m²
PERE: 429 MJ/m²
PERM: 1.318 MJ/m²
GWP-total: -31,9 kg CO_2 equ./m²
GWP-fossil: 100 kg CO_2 equ./m²
GWP-biogenic: -132 kg CO_2 equ./m²
AP: 0,507 kg SO_2 equ./m²
EP: 0,192 kg PO_4^{3-}/m²
POCP: 0,169 kg C_2H_4/m²
ODP: 6,09·10⁻⁶ kg CFC-11/m²

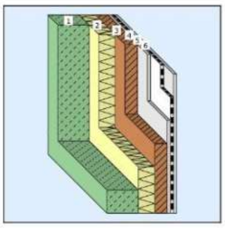
no.	layer (from inside to outside)	d cm	Useful life >b
1	Verkleidung Holz, Vollholz SN21, 700.0 kg/m³ *(Timber (675 kg/m³ - e.g. oak) - planed, technically dried)*	3,60	50
2	Faserzementplatte, Leer, 2,300.0 kg/m³ *(Fibre cement panels (2000 kg/m³))*	1,25	50
3	Timber slats *(Konstruktionsvollholz (KVH))*	0,70	[1]100
4	Timber slats *(Konstruktionsvollholz (KVH))*	0,70	[1]100
5	Dampfdiffusionsoffene Windbremse, Folie, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	[1]100
6	Wooden construction including thermal insulation, hard insulation, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	19,50	[1]100
7	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
8	Dampfbremse, Folie, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	25
9	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
10	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**38,87**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

AW05_ Stgh gegen Beheizt OG2-OG6 (30358)



Fläche: 143,2 m²
mass: 688,8 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 1.367 MJ/m²
PENRE: 1.289 MJ/m²
PENRM: 77,9 MJ/m²
PERT: 1.066 MJ/m²
PERE: 264 MJ/m²
PERM: 802 MJ/m²
GWP-total: 35,9 kg CO_2 equ./m²
GWP-fossil: 115 kg CO_2 equ./m²
GWP-biogenic: -79,5 kg CO_2 equ./m²
AP: 0,421 kg SO_2 equ./m²
EP: 0,179 kg PO_4^{3-}/m²
POCP: 0,125 kg C_2H_4/m²
ODP: 5,34·10⁻⁶ kg CFC-11/m²

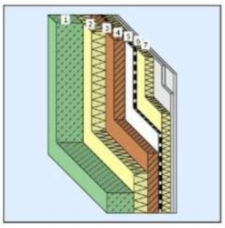
no.	layer (from inside to outside)	d cm	Useful life >b
1	Concrete reinforced, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
2	Hard mineral wool, hard insulation, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	13,00	[1]100
3	CLT, solid wood SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
4	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
5	Vapor barrier, foil, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	25
6	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**51,06**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

AW05a_ Stgh gegen Naßzelle OG2-OG6 (30358)



Fläche: 27 m²
mass: 701,8 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 1.584 MJ/m²
PENRE: 1.530 MJ/m²
PENRM: 53,6 MJ/m²
PERT: 1.070 MJ/m²
PERE: 265 MJ/m²
PERM: 805 MJ/m²
GWP-total: 53,2 kg CO_2 equ./m²
GWP-fossil: 132 kg CO_2 equ./m²
GWP-biogenic: -79,0 kg CO_2 equ./m²
AP: 0,494 kg SO_2 equ./m²
EP: 0,208 kg PO_4^{3-}/m²
POCP: 0,130 kg C_2H_4/m²
ODP: 7,24·10⁻⁶ kg CFC-11/m²

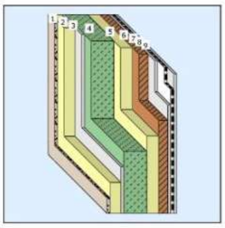
no.	layer (from inside to outside)	d cm	Useful life >b
1	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
2	Mineralwolle hart, Dämmung hart, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	13,00	[1]100
3	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
4	Dampfbremse, Folie, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	[1]50
5	CW-Profil *(ROCKWOOL Termarock 40)*	8,00	50
6	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
7	White tiles, empty, 1,750.0 kg/m³ *(Ceramic tiles (2300 kg/m³))*	1,00	50
	building element	**58,56**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

AW05b_ Stgh gegen Beheizt OG1 (30358)



Fläche: 28,3 m²
mass: 698,9 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

0,132 W/m²K — U value [2]

PENRT: 1.800 MJ/m²
PENRE: 1.564 MJ/m²
PENRM: 236 MJ/m²
PERT: 1.085 MJ/m²
PERE: 280 MJ/m²
PERM: 805 MJ/m²
GWP-total: 48,1 kg CO_2 equ./m²
GWP-fossil: 128 kg CO_2 equ./m²
GWP-biogenic: -79,6 kg CO_2 equ./m²
AP: 0,422 kg SO_2 equ./m²
EP: 0,200 kg PO_4^{3-}/m²
POCP: 0,0815 kg C_2H_4/m²
ODP: $7{,}49 \cdot 10^{-6}$ kg CFC-11/m²

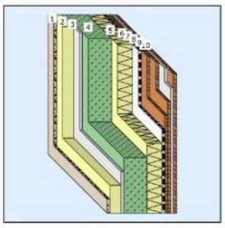
no.	layer (from inside to outside)	d cm	Useful life >b
1	Endbeschichtung, Leer, 1,800.0 kg/m³ *(CR lime cement finish plaster (1800 kg/m³))*	0,50	35
2	Wärmedämmung, Dämmung hart, 15.0 kg/m³ *(Glass wool MW(GW)-W (15 kg/m³))*	12,00	[1]35
3	Klebespachtel, Leer, 1,800.0 kg/m³ *(Synthesa Capatect Klebespachtel 160)*	0,50	35
4	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
5	Mineralwolle weich, Dämmstoff SN55, 40.0 kg/m³ *(ROCKWOOL Steelrock 040)*	13,00	[1]100
6	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
7	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
8	Dampfbremse, Folie, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	25
9	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**64,06**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

AW05c_ Stgh gegen Unbeheizt (30358)



Fläche: 19,1 m²
mass: 698,5 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

0,126 W/m²K — U value [2]

PENRT: 2.035 MJ/m²
PENRE: 1.852 MJ/m²
PENRM: 183 MJ/m²
PERT: 768 MJ/m²
PERE: 252 MJ/m²
PERM: 516 MJ/m²
GWP-total: 104 kg CO_2 equ./m²
GWP-fossil: 158 kg CO_2 equ./m²
GWP-biogenic: -53,2 kg CO_2 equ./m²
AP: 0,570 kg SO_2 equ./m²
EP: 0,252 kg PO_4^{3-}/m²
POCP: 0,154 kg C_2H_4/m²
ODP: $7{,}28 \cdot 10^{-6}$ kg CFC-11/m²

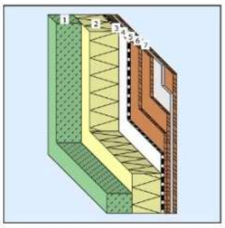
no.	layer (from inside to outside)	d cm	Useful life >b
1	Final coating, empty, 1,800.0 kg/m³ *(CR lime cement finish plaster (1800 kg/m³))*	0,50	35
2	Thermal insulation *(Glass wool MW(GW)-W (15 kg/m³))*	12,00	[1]35
3	Adhesive putty, empty, 1,800.0 kg/m³ *(Synthesa Capatect Klebespachtel 160)*	0,50	35
4	Concrete reinforced, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
5	Wooden construction including thermal insulation, hard insulation, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	16,00	[1]50
6	Vapor diffusion-open wind brake, foil, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	[1]50
7	Timber slats *(Konstruktionsvollholz (KVH))*	0,70	[1]100
8	Timber slats *(Konstruktionsvollholz (KVH))*	0,70	[1]100
9	Fiber cement board, empty, 2,300.0 kg/m³ *(Fibre cement panels (2000 kg/m³))*	1,50	50
10	Wood cladding, solid wood SN21, 700.0 kg/m³ *(Timber (675 kg/m³ - e.g. oak) - planed, technically dried)*	3,60	50
	building element	**60,56**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

AW05d_ Stgh gegen Unbeheizt (30358)



Fläche: 51 m²
mass: 692,1 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

0,119 W/m²K — U value [2]

PENRT: 1.638 MJ/m²
PENRE: 1.609 MJ/m²
PENRM: 28,6 MJ/m²
PERT: 755 MJ/m²
PERE: 239 MJ/m²
PERM: 516 MJ/m²
GWP-total: 96,5 kg CO_2 equ./m²
GWP-fossil: 150 kg CO_2 equ./m²
GWP-biogenic: -53,2 kg CO_2 equ./m²
AP: 0,594 kg SO_2 equ./m²
EP: 0,238 kg PO_4^{3-}/m²
POCP: 0,200 kg C_2H_4/m²
ODP: $5{,}38 \cdot 10^{-6}$ kg CFC-11/m²

no.	layer (from inside to outside)	d cm	Useful life >b
1	Concrete reinforced, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
2	Wooden construction including thermal insulation, hard insulation, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	29,00	[1]50
3	Vapor diffusion-open wind brake, foil, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	[1]50
4	Timber slats *(Konstruktionsvollholz (KVH))*	0,70	[1]100
5	Timber slats *(Konstruktionsvollholz (KVH))*	0,70	[1]100
6	Fiber cement board, empty, 2,300.0 kg/m³ *(Fibre cement panels (2000 kg/m³))*	1,50	50
7	Wood cladding, solid wood SN21, 700.0 kg/m³ *(Timber (675 kg/m³ - e.g. oak) - planed, technically dried)*	3,60	50
	building element	**60,56**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

Bauholz Stütze (30358)

quantity: 59,996 m³
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 28,6 MJ/m²GFA
PENRE: 28,6 MJ/m²GFA
PENRM: 0,00 MJ/m²GFA
PERT: 162 MJ/m²GFA
PERE: 24,6 MJ/m²GFA
PERM: 137 MJ/m²GFA
GWP-total: -11,5 kg CO_2 equ./m²GFA
GWP-fossil: 1,68 kg CO_2 equ./m²GFA
GWP-biogenic: -13,2 kg CO_2 equ./m²GFA
AP: 0,0102 kg SO_2 equ./m²GFA
EP: 0,00464 kg PO_4^{3-}/m²GFA
POCP: 0,00405 kg C_2H_4/m²GFA
ODP: $1{,}45 \cdot 10^{-7}$ kg CFC-11/m²GFA

components (without component structure) (quantity per m³ building elen	**Useful life >b**
475 kg Konstruktionsvollholz (KVH)	100

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

Bauholz Unterzug (30358)

quantity: 38,6 m³
service life: yes, with integer replacements rates (according to EN 15804 standard)

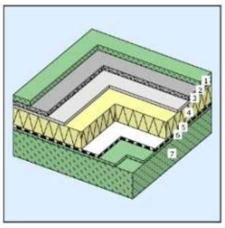
PENRT: 18,4 MJ/m²GFA
PENRE: 18,4 MJ/m²GFA
PENRM: 0,00 MJ/m²GFA
PERT: 104 MJ/m²GFA
PERE: 15,8 MJ/m²GFA
PERM: 88,4 MJ/m²GFA
GWP-total: -7,39 kg CO_2 equ./m²GFA
GWP-fossil: 1,08 kg CO_2 equ./m²GFA
GWP-biogenic: -8,47 kg CO_2 equ./m²GFA
AP: 0,00657 kg SO_2 equ./m²GFA
EP: 0,00299 kg PO_4^{3-}/m²GFA
POCP: 0,00261 kg C_2H_4/m²GFA
ODP: $9{,}30 \cdot 10^{-8}$ kg CFC-11/m²GFA

components (without component structure) (quantity per m³ building elen	**Useful life >b**
475 kg Konstruktionsvollholz (KVH)	100

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

DE01_Fußboden Außenraum gegen beheizt (30358)



Fläche: 291,4 m²
mass: 1022,0 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 1.630 MJ/m²
PENRE: 1.252 MJ/m²
PENRM: 378 MJ/m²
PERT: 54,6 MJ/m²
PERE: 54,6 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 129 kg CO_2 equ./m²
GWP-fossil: 129 kg CO_2 equ./m²
GWP-biogenic: -0,0969 kg CO_2 equ./m²
AP: 0,302 kg SO_2 equ./m²
EP: 0,143 kg PO_4^{3-}/m²
POCP: 0,0875 kg C_2H_4/m²
ODP: $5{,}39 \cdot 10^{-6}$ kg CFC-11/m²

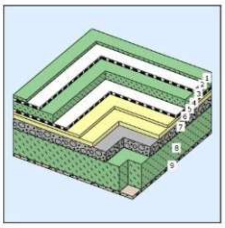
no.	layer	d cm	Useful life >b
1	Concrete plates *(Concrete slabs)*	6,00	50
2	Gravel *(Fillings made of sand, gravel, grit (1800 kg/m³))*	5,00	¹100
3	EDPM-seal *(COVERiT NOVOtan ® EPDM DA-K Rollenware 1,3/1,5 mm)*	0,15	25
4	EPS W 30 plus *(AUSTROTHERM EPS W30 PLUS)*	20,00	¹100
5	Vapor barrier, foil, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	¹100
6	Sloping screed *(Quarzolith Zementestrich E400)*	3,00	¹100
7	Concrete reinforced, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	30,00	100
	building element	**64,21**	

¹ deviating from service life catalogue ² U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

DE02_Müllraum gegen beheizt (30358)



Fläche: 32,4 m²
mass: 1227,8 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

U value [2]

PENRT: 1.507 MJ/m²
PENRE: 1.178 MJ/m²
PENRM: 328 MJ/m²
PERT: 71,1 MJ/m²
PERE: 71,1 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 129 kg CO_2 equ./m²
GWP-fossil: 129 kg CO_2 equ./m²
GWP-biogenic: -0,0174 kg CO_2 equ./m²
AP: 0,302 kg SO_2 equ./m²
EP: 0,162 kg PO_4^{3-}/m²
POCP: 0,0618 kg C_2H_4/m²
ODP: $5{,}95 \cdot 10^{-6}$ kg CFC-11/m²

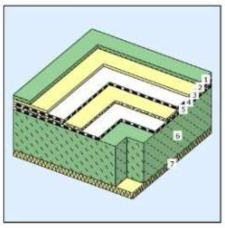
no.	layer	d cm	Useful life >b
1	Concrete plates *(Concrete slabs)*	3,00	50
2	Bituminous moisture sealing ALGV, sealant SN59, 1,100.0 kg/m³ *(BITALBIT E-ALGV-4K)*	0,38	35
3	Screed *(Quarzolith Zementestrich E400)*	10,00	[1]100
4	Polyethylene films, sealant SN59, 1,100.0 kg/m³ *(Polyethylene (PE) sealing sheeting)*	0,15	[1]100
5	EPS system board W T, hard insulation, 15.0 kg/m³ *(Bachl EPS W-15)*	3,00	[1]100
6	EPS W 25 *(Bachl EPS W-25)*	5,00	[1]100
7	Kies *(Fillings made of sand, gravel, grit (1800 kg/m³))*	12,20	[1]100
8	Concrete reinforced, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	30,00	100
9	Filling *(CR lime cement finish plaster (1800 kg/m³))*	0,50	35
	building element	**64,23**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

DE03_Fußboden Keller beheizt (>1.5m unter Erdreich) (30358)



Fläche: 487 m²
mass: 2071,8 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

U value [2]

PENRT: 2.357 MJ/m²
PENRE: 2.011 MJ/m²
PENRM: 346 MJ/m²
PERT: 103 MJ/m²
PERE: 103 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 239 kg CO_2 equ./m²
GWP-fossil: 239 kg CO_2 equ./m²
GWP-biogenic: -0,0225 kg CO_2 equ./m²
AP: 0,495 kg SO_2 equ./m²
EP: 0,278 kg PO_4^{3-}/m²
POCP: 0,109 kg C_2H_4/m²
ODP: $6{,}83 \cdot 10^{-6}$ kg CFC-11/m²

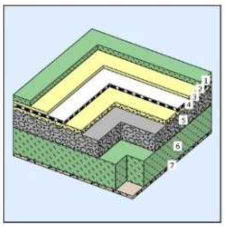
no.	layer	d cm	Useful life >b
1	Estrichbeton, Beton bewehrt SN46, 2,300.0 kg/m³ *(Quarzolith Zementestrich E400)*	7,00	50
2	EPS Systemplatte W T, Dämmung hart, 15.0 kg/m³ *(Bachl EPS W-15)*	3,00	50
3	Dampfbremse, Folie, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	25
4	EPS-Granulat, Füllstoff SN56, 15.0 kg/m³ *(Cement-bonded EPS granulate (99 kg/m³))*	3,00	[1]50
5	Bituminous moisture sealing ALGV, sealant SN59, 1,100.0 kg/m³ *(BITALBIT E-ALGV-4K)*	0,38	[1]50
6	Stahlbeton Decke, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	80,00	100
7	XPS, Dämmung hart, 28.0 kg/m³ *(AUSTROTHERM XPS PLUS 30 SF)*	12,00	[1]100
	building element	**105,44**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

DE04_Forum (30358)



Fläche: 149,6 m²
mass: 1245,2 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

U value [2]

PENRT: 967 MJ/m²
PENRE: 844 MJ/m²
PENRM: 124 MJ/m²
PERT: 44,2 MJ/m²
PERE: 44,2 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 101 kg CO_2 equ./m²
GWP-fossil: 101 kg CO_2 equ./m²
GWP-biogenic: -0,00900 kg CO_2 equ./m²
AP: 0,214 kg SO_2 equ./m²
EP: 0,118 kg PO_4^{3-}/m²
POCP: 0,0457 kg C_2H_4/m²
ODP: $2{,}63 \cdot 10^{-6}$ kg CFC-11/m²

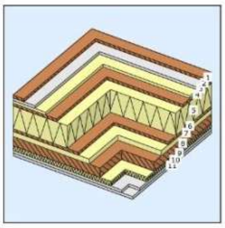
no.	layer	d cm	Useful life >b
1	Betonplatten, Massiv 25 %, 1,400.0 kg/m³ *(Concrete slabs)*	6,00	50
2	EPS system board W T, hard insulation, 15.0 kg/m³ *(Bachl EPS W-15)*	3,00	[1]100
3	Polyethylen Folien, Dichtstoff SN59, 1,100.0 kg/m³ *(Polyethylene (PE) sealing sheeting)*	0,15	[1]100
4	EPS-Granulat, Füllstoff SN56, 15.0 kg/m³ *(Cement-bonded EPS granulate (99 kg/m³))*	5,00	[1]100
5	Gravel *(Fillings made of sand, gravel, grit (1800 kg/m³))*	20,30	[1]100
6	Stahlbeton Decke, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	30,00	100
7	Spachtelung, Leer, 1,800.0 kg/m³ *(CR lime cement finish plaster (1800 kg/m³))*	0,50	35
	building element	**64,95**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

DE05_Decke Wohnung gegen Wohnung (30358)



Fläche: 1415,7 m²
mass: 173,5 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 1.773 MJ/m²
PENRE: 1.695 MJ/m²
PENRM: 78,1 MJ/m²
PERT: 2.004 MJ/m²
PERE: 587 MJ/m²
PERM: 1.416 MJ/m²
GWP-total: -32,9 kg CO_2 equ./m²
GWP-fossil: 115 kg CO_2 equ./m²
GWP-biogenic: -148 kg CO_2 equ./m²
AP: 0,827 kg SO_2 equ./m²
EP: 0,265 kg PO_4^{3-}/m²
POCP: 0,195 kg C_2H_4/m²
ODP: $8{,}58 \cdot 10^{-6}$ kg CFC-11/m²

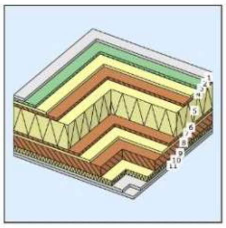
no.	layer	d cm	Useful life >b
1	Parkett, Vollholz SN21, 700.0 kg/m³ *(Solid parquet)*	2,00	50
2	Gipsfaser Estrich-Elemente, Beton bewehrt SN46, 2,300.0 kg/m³ *(FERMACELL Gipsfaser Estrich-Elemente)*	2,50	50
3	Trittschalldämmung, Dämmung hart, 64.0 kg/m³ *(ISOVER Trittschall-Dämmplatte S TDPS)*	2,00	50
4	OSB, Holzwerkstoff SN23, 610.0 kg/m³ *(SterlingOSB/3-Zero)*	2,20	50
5	Holzkonstruktion inzw. Wärmedämmung, Dämmung hart, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	24,50	[1]50
6	OSB, Holzwerkstoff SN23, 610.0 kg/m³ *(SterlingOSB/3-Zero)*	1,50	50
7	Trittschalldämmung, Dämmung hart, 64.0 kg/m³ *(ISOVER Trittschall-Dämmplatte S TDPS)*	5,50	50
8	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
9	Mineralwolle weich, Dämmstoff SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	5,00	50
10	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
11	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**58,20**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

DE05a_Decke Wohnung gegen Naßzelle (30358)



Fläche: 163,2 m²
mass: 164,7 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 1.744 MJ/m²
PENRE: 1.674 MJ/m²
PENRM: 70,1 MJ/m²
PERT: 1.589 MJ/m²
PERE: 352 MJ/m²
PERM: 1.237 MJ/m²
GWP-total: -8,36 kg CO_2 equ./m²
GWP-fossil: 113 kg CO_2 equ./m²
GWP-biogenic: -121 kg CO_2 equ./m²
AP: 0,703 kg SO_2 equ./m²
EP: 0,233 kg PO_4^{3-}/m²
POCP: 0,190 kg C_2H_4/m²
ODP: $8{,}63 \cdot 10^{-6}$ kg CFC-11/m²

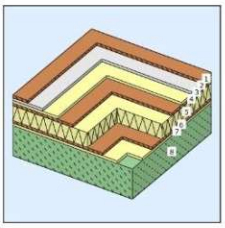
no.	layer	d cm	Useful life >b
1	White tiles, empty, 1,750.0 kg/m³ *(Ceramic tiles (2300 kg/m³))*	1,00	50
2	Screed *(Quarzolith Zementestrich E400)*	0,50	50
3	Impact sound insulation *(ISOVER Trittschall-Dämmplatte S TDPS)*	2,00	50
4	OSB, wood material SN23, 610.0 kg/m³ *(SterlingOSB/3-Zero)*	2,20	50
5	Wooden construction including thermal insulation, hard insulation, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	24,50	[1]50
6	OSB, wood material SN23, 610.0 kg/m³ *(SterlingOSB/3-Zero)*	2,20	50
7	Impact sound insulation *(ISOVER Trittschall-Dämmplatte S TDPS)*	2,00	50
8	CLT, solid wood SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
9	Soft mineral wool, insulation material SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	5,00	50
10	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
11	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**52,40**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

DE05b_Decke Wohnung 1OG (30358)



Fläche: 288,4 m²
mass: 1294,3 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 2.029 MJ/m²
PENRE: 1.987 MJ/m²
PENRM: 41,7 MJ/m²
PERT: 1.013 MJ/m²
PERE: 404 MJ/m²
PERM: 609 MJ/m²
GWP-total: 129 kg CO_2 equ./m²
GWP-fossil: 197 kg CO_2 equ./m²
GWP-biogenic: -68,1 kg CO_2 equ./m²
AP: 0,779 kg SO_2 equ./m²
EP: 0,309 kg PO_4^{3-}/m²
POCP: 0,188 kg C_2H_4/m²
ODP: $7{,}67 \cdot 10^{-6}$ kg CFC-11/m²

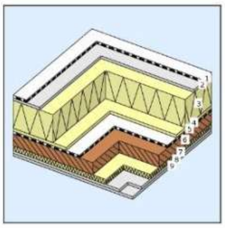
no.	layer	d cm	Useful life >b
1	Parquet, solid wood SN21, 700.0 kg/m³ *(Solid parquet)*	2,00	50
2	Gypsum fiber screed elements, concrete reinforced SN46, 2,300.0 kg/m³ *(FERMACELL Gipsfaser Estrich-Elemente)*	2,50	50
3	Impact sound insulation *(ISOVER Trittschall-Dämmplatte S TDPS)*	2,00	50
4	OSB, wood material SN23, 610.0 kg/m³ *(SterlingOSB/3-Zero)*	2,20	50
5	Wooden construction including thermal insulation, hard insulation, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	24,50	[1]50
6	OSB, wood material SN23, 610.0 kg/m³ *(SterlingOSB/3-Zero)*	1,50	50
7	Impact sound insulation *(ISOVER Trittschall-Dämmplatte S TDPS)*	2,00	50
8	Concrete reinforced, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	50,00	100
	building element	**86,70**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

DE06_Extensives Gründach mit reduziertem Aufbau (30358)



Fläche: 243,9 m²
mass: 103,1 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 3.048 MJ/m²
PENRE: 2.023 MJ/m²
PENRM: 1.024 MJ/m²
PERT: 1.270 MJ/m²
PERE: 300 MJ/m²
PERM: 970 MJ/m²
GWP-total: 35,3 kg CO_2 equ./m²
GWP-fossil: 131 kg CO_2 equ./m²
GWP-biogenic: -95,3 kg CO_2 equ./m²
AP: 0,695 kg SO_2 equ./m²
EP: 0,202 kg PO_4^{3-}/m²
POCP: 0,212 kg C_2H_4/m²
ODP: $1{,}12 \cdot 10^{-5}$ kg CFC-11/m²

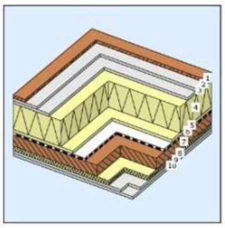
no.	layer	d cm	Useful life >b
1	Dachdichtung, Folie, 1,200.0 kg/m³ *(Enkolan Abdichtung 1K LF)*	0,10	[1]25
2	EPDM-Abdichtung, Dichtstoff SN59, 1,100.0 kg/m³ *(COVERiT NOVOtan ® EPDM DA-K Rollenware 1,3/1,5 mm)*	0,13	25
3	Gefälledämmung, Dämmung hart, 15.0 kg/m³ *(AUSTROTHERM EPS W30)*	28,00	[1]25
4	Trittschalldämmung TDPT 30, Dämmung hart, 64.0 kg/m³ *(ISOVER Trittschall-Dämmplatte S TDPS)*	3,00	[1]25
5	Bituminous moisture sealing ALGV, sealant SN59, 1,100.0 kg/m³ *(BITALBIT E-ALGV-4K)*	0,38	[1]25
6	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	12,00	100
7	Mineralwolle weich, Dämmstoff SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	5,00	50
8	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
9	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**51,61**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

DE07_Decke unter Freibereich (30358)



Fläche: 468,9 m²
mass: 126,0 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

0,083 W/m²K — U value [2]

PENRT: 4.080 MJ/m²
PENRE: 2.465 MJ/m²
PENRM: 1.615 MJ/m²
PERT: 1.546 MJ/m²
PERE: 330 MJ/m²
PERM: 1.215 MJ/m²
GWP-total: 40,6 kg CO_2 equ./m²
GWP-fossil: 158 kg CO_2 equ./m²
GWP-biogenic: -117 kg CO_2 equ./m²
AP: 0,826 kg SO_2 equ./m²
EP: 0,270 kg PO_4^{3-}/m²
POCP: 0,234 kg C_2H_4/m²
ODP: $1{,}27 \cdot 10^{-5}$ kg CFC-11/m²

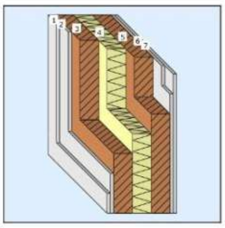
no.	layer	d cm	Useful life >b
1	Wooden covering on substructure *(Rema 3-Schicht Massivholzplatte nord. Fichte)*	3,20	50
2	Rubber granulate mat *(Rubber granulate mat)*	1,50	25
3	EPDM sealing *(COVERiT NOVOtan ® EPDM DA-K Rollenware 1,3/1,5 mm)*	0,15	25
4	Sloped insulation, hard insulation, 15.0 kg/m³ *(AUSTROTHERM EPS W30)*	28,00	[1]25
5	Impact sound insulation TDPT 30, hard insulation, 64.0 kg/m³ *(ISOVER Trittschall-Dämmplatte S TDPS)*	3,00	[1]25
6	Bituminous moisture sealing ALGV, sealant SN59, 1,100.0 kg/m³ *(BITALBIT E-ALGV-4K)*	0,38	[1]25
7	CLT, solid wood SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	12,00	100
8	Soft mineral wool, insulation material SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	5,00	50
9	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
10	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**56,23**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

IW01_ Wohnung gegen Wohnung (30360)



Fläche: 328,7 m²
mass: 159,5 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 1.250 MJ/m²
PENRE: 1.209 MJ/m²
PENRM: 41,5 MJ/m²
PERT: 2.068 MJ/m²
PERE: 464 MJ/m²
PERM: 1.604 MJ/m²
GWP-total: -83,5 kg CO_2 equ./m²
GWP-fossil: 75,4 kg CO_2 equ./m²
GWP-biogenic: -159 kg CO_2 equ./m²
AP: 0,407 kg SO_2 equ./m²
EP: 0,159 kg PO_4^{3-}/m²
POCP: 0,125 kg C_2H_4/m²
ODP: $6{,}66 \cdot 10^{-6}$ kg CFC-11/m²

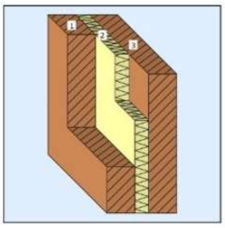
no.	layer (from inside to outside)	d cm	Useful life >b
1	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
2	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
3	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
4	Heralan-TW, Dämmung hart, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	10,00	[1]100
5	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
6	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
7	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**36,00**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

IW02_ Modultrennwand (30360)



Fläche: 580,9 m²
mass: 80,2 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 703 MJ/m²
PENRE: 670 MJ/m²
PENRM: 33,2 MJ/m²
PERT: 1.599 MJ/m²
PERE: 316 MJ/m²
PERM: 1.283 MJ/m²
GWP-total: -83,9 kg CO_2 equ./m²
GWP-fossil: 41,6 kg CO_2 equ./m²
GWP-biogenic: -125 kg CO_2 equ./m²
AP: 0,245 kg SO_2 equ./m²
EP: 0,100 kg PO_4^{3-}/m²
POCP: 0,0752 kg C_2H_4/m²
ODP: $3{,}66 \cdot 10^{-6}$ kg CFC-11/m²

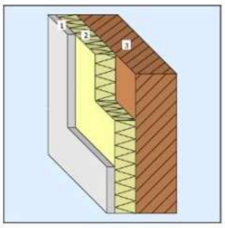
no.	layer (from inside to outside)	d cm	Useful life >b
1	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	8,00	100
2	Heralan-TW, Dämmung hart, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	4,00	[1]100
3	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	8,00	100
	building element	**20,00**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

IW02a_ Modultrennwand einseitig (30360)



Fläche: 143 m²
mass: 53,3 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

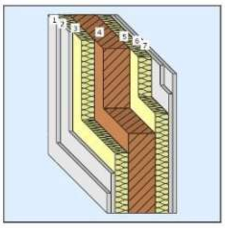
PENRT: 389 MJ/m²
PENRE: 371 MJ/m²
PENRM: 18,7 MJ/m²
PERT: 817 MJ/m²
PERE: 174 MJ/m²
PERM: 643 MJ/m²
GWP-total: -40,4 kg CO_2 equ./m²
GWP-fossil: 22,9 kg CO_2 equ./m²
GWP-biogenic: -63,3 kg CO_2 equ./m²
AP: 0,120 kg SO_2 equ./m²
EP: 0,0515 kg PO_4^{3-}/m²
POCP: 0,0289 kg C_2H_4/m²
ODP: 2,23·10⁻⁶ kg CFC-11/m²

no.	layer (from inside to outside)	d cm	Useful life >b
1	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
2	Dachdämmung weich *(ROCKWOOL Termarock 40)*	4,00	50
3	CLT, solid wood SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	8,00	100
	building element	**13,50**	

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

IW03_ Gang gegen Wohnung (30360)



Fläche: 345,3 m²
mass: 104,5 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

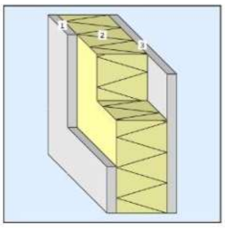
PENRT: 707 MJ/m²
PENRE: 686 MJ/m²
PENRM: 20,7 MJ/m²
PERT: 1.065 MJ/m²
PERE: 263 MJ/m²
PERM: 802 MJ/m²
GWP-total: -39,6 kg CO_2 equ./m²
GWP-fossil: 40,9 kg CO_2 equ./m²
GWP-biogenic: -80,5 kg CO_2 equ./m²
AP: 0,196 kg SO_2 equ./m²
EP: 0,0814 kg PO_4^{3-}/m²
POCP: 0,0534 kg C_2H_4/m²
ODP: 4,03·10⁻⁶ kg CFC-11/m²

no.	layer (from inside to outside)	d cm	Useful life >b
1	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
2	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
3	Trennwand Klemmfilz, Dämmstoff SN55, 40.0 kg/m³ *(KI Klemmplatte KP, KP-HB (ab Juni 2016))*	5,00	50
4	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
5	Trennwand Klemmfilz, Dämmstoff SN55, 40.0 kg/m³ *(KI Klemmplatte KP, KP-HB (ab Juni 2016))*	5,00	50
6	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
7	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**26,00**	

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

IW04_LB 10cm einfach Metallständerwand (30360)



Fläche: 1139,6 m²
mass: 30,5 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

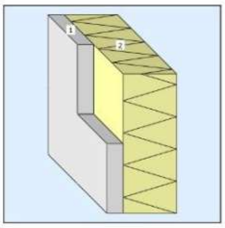
PENRT: 165 MJ/m²
PENRE: 161 MJ/m²
PENRM: 4,27 MJ/m²
PERT: 37,8 MJ/m²
PERE: 35,2 MJ/m²
PERM: 2,64 MJ/m²
GWP-total: 10,4 kg CO_2 equ./m²
GWP-fossil: 11,5 kg CO_2 equ./m²
GWP-biogenic: -1,09 kg CO_2 equ./m²
AP: 0,0439 kg SO_2 equ./m²
EP: 0,0159 kg PO_4^{3-}/m²
POCP: 0,00393 kg C_2H_4/m²
ODP: 1,10·10⁻⁶ kg CFC-11/m²

no.	layer (from inside to outside)	d cm	Useful life >b
1	Gipskarton, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
2	Mineralwolle weich, Dämmstoff SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	8,00	50
3	Gipskarton, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**11,00**	

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

IW04a_LB 6,25cm einfach Vorsatzschale (30360)



Fläche: 108,8 m²
mass: 15,7 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

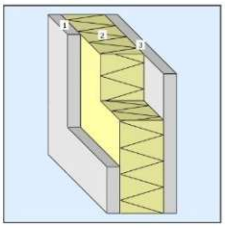
PENRT: 87,1 MJ/m²
PENRE: 84,4 MJ/m²
PENRM: 2,67 MJ/m²
PERT: 19,6 MJ/m²
PERE: 17,9 MJ/m²
PERM: 1,65 MJ/m²
GWP-total: 5,72 kg CO_2 equ./m²
GWP-fossil: 6,27 kg CO_2 equ./m²
GWP-biogenic: -0,550 kg CO_2 equ./m²
AP: 0,0250 kg SO_2 equ./m²
EP: 0,00882 kg PO_4^{3-}/m²
POCP: 0,00218 kg C_2H_4/m²
ODP: $5{,}82 \cdot 10^{-7}$ kg CFC-11/m²

no.	layer (from inside to outside)	d cm	Useful life >b
1	Gipskarton, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
2	Mineralwolle weich, Dämmstoff SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	5,00	50
	building element	**6,50**	

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

IW04b_LB 7,5cm Vorsatzschale (30360)



Fläche: 100,8 m²
mass: 29,2 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 152 MJ/m²
PENRE: 149 MJ/m²
PENRM: 2,67 MJ/m²
PERT: 35,8 MJ/m²
PERE: 34,2 MJ/m²
PERM: 1,65 MJ/m²
GWP-total: 8,77 kg CO_2 equ./m²
GWP-fossil: 9,83 kg CO_2 equ./m²
GWP-biogenic: -1,06 kg CO_2 equ./m²
AP: 0,0347 kg SO_2 equ./m²
EP: 0,0132 kg PO_4^{3-}/m²
POCP: 0,00329 kg C_2H_4/m²
ODP: $1{,}01 \cdot 10^{-6}$ kg CFC-11/m²

no.	layer (from inside to outside)	d cm	Useful life >b
1	Gipskarton, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
2	Mineralwolle weich, Dämmstoff SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	5,00	50
3	Gipskarton, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**8,00**	

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

STB Stütze (30358)

quantity: 35,275 m³
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 17,6 MJ/m²GFA
PENRE: 17,6 MJ/m²GFA
PENRM: 0,00 MJ/m²GFA
PERT: 0,940 MJ/m²GFA
PERE: 0,940 MJ/m²GFA
PERM: 0,00 MJ/m²GFA
GWP-total: 2,34 kg CO_2 equ./m²GFA
GWP-fossil: 2,34 kg CO_2 equ./m²GFA
GWP-biogenic: 0,00 kg CO_2 equ./m²GFA
AP: 0,00422 kg SO_2 equ./m²GFA
EP: 0,00280 kg PO_4^{3-}/m²GFA
POCP: 0,000672 kg C_2H_4/m²GFA
ODP: $5{,}42 \cdot 10^{-8}$ kg CFC-11/m²GFA

components (without component structure) (quantity per m³ building elen	Useful life >b
2400 kg ÖKOBETON C25/30 XC1	100

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

STB Unterzug (30358)

quantity: 1,6 m³
service life: yes, with integer replacements rates (according to EN 15804 standard)

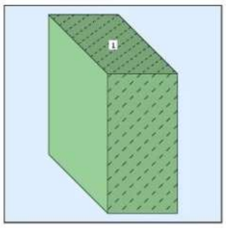
PENRT: 0,799 MJ/m²GFA
PENRE: 0,799 MJ/m²GFA
PENRM: 0,00 MJ/m²GFA
PERT: 0,0426 MJ/m²GFA
PERE: 0,0426 MJ/m²GFA
PERM: 0,00 MJ/m²GFA
GWP-total: 0,106 kg CO_2 equ./m²GFA
GWP-fossil: 0,106 kg CO_2 equ./m²GFA
GWP-biogenic: 0,00 kg CO_2 equ./m²GFA
AP: 0,000191 kg SO_2 equ./m²GFA
EP: 0,000127 kg PO_4^{3-}/m²GFA
POCP: $3,05 \cdot 10^{-5}$ kg C_2H_4/m²GFA
ODP: $2,46 \cdot 10^{-9}$ kg CFC-11/m²GFA

components (without component structure) (quantity per m³ building elem	**Useful life >b**
2400 kg ÖKOBETON C25/30 XC1	100

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

STB Wand 25 cm KG (30358)



Fläche: 199,4 m²
mass: 600,0 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

U value [1]: 3,922 W/m²K

PENRT: 447 MJ/m²
PENRE: 447 MJ/m²
PENRM: 0,00 MJ/m²
PERT: 23,8 MJ/m²
PERE: 23,8 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 59,2 kg CO_2 equ./m²
GWP-fossil: 59,2 kg CO_2 equ./m²
GWP-biogenic: 0,00 kg CO_2 equ./m²
AP: 0,107 kg SO_2 equ./m²
EP: 0,0709 kg PO_4^{3-}/m²
POCP: 0,0170 kg C_2H_4/m²
ODP: $1,37 \cdot 10^{-6}$ kg CFC-11/m²

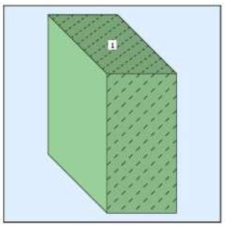
no.	**layer** (from inside to outside)	d cm	**Useful life >b**
1	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
	building element	**25,00**	

[1] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 50 years**

STB Wand 50 cm KG (30358)



Fläche: 44 m²
mass: 1200,0 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

U value [1]: 2,632 W/m²K

PENRT: 893 MJ/m²
PENRE: 893 MJ/m²
PENRM: 0,00 MJ/m²
PERT: 47,7 MJ/m²
PERE: 47,7 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 118 kg CO_2 equ./m²
GWP-fossil: 118 kg CO_2 equ./m²
GWP-biogenic: 0,00 kg CO_2 equ./m²
AP: 0,214 kg SO_2 equ./m²
EP: 0,142 kg PO_4^{3-}/m²
POCP: 0,0341 kg C_2H_4/m²
ODP: $2,75 \cdot 10^{-6}$ kg CFC-11/m²

no.	**layer** (from inside to outside)	d cm	**Useful life >b**
1	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	50,00	100
	building element	**50,00**	

[1] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

List of materials

material	mass kg	mass-percentage	cumulated percentage	Building material ID	Density kg/m³	λ-Value W/m²K	PENRT MJ/FU (functional unit)	PENRE MJ/FU (functional unit)	PENRM MJ/FU (functional unit)	PERT MJ/FU (functional unit)	PERE MJ/FU (functional unit)	PERM MJ/FU (functional unit)	GWP-total kg CO_2 equ./FU (functional unit)	GWP-fossil kg CO_2 equ./FU (functional unit)	GWP-biogenic kg CO_2 equ./FU (functional unit)	AP kg SO_2 equ./FU (functional unit)	EP kg PO_4^{3-}/FU (functional unit)	POCP kg C_2H_4/FU (functional unit)	ODP kg CFC-11/FU (functional unit)	FU (functional unit)
ÖKOBETON C25/30 XC1	2.409.240	68,2%	68,2%	P2142732948	2.400	2,000	0,744	0,744	0,00	0,0397	0,0397	0,00	0,0987	0,0987	0,00	0,000178	0,000118	$2{,}84 \cdot 10^{-5}$	$2{,}29 \cdot 10^{-9}$	kg
Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir)	292.139	8,3%	76,5%	R2142715634	475	0,120	8,07	7,64	0,436	21,0	4,11	16,9	-1,20	0,451	-1,65	0,00257	0,00115	0,000710	$4{,}42 \cdot 10^{-8}$	kg
Gypsum wallboards (900 kg/m³)	179.874	5,1%	81,6%	R2142714767	900	0,320	4,80	4,80	0,00	1,20	1,20	0,00	0,226	0,264	-0,0380	0,000719	0,000328	$8{,}23 \cdot 10^{-5}$	$3{,}18 \cdot 10^{-8}$	kg
Quarzolith Zementestrich E400	93.776	2,7%	84,2%	P2142721699	2.000	1,520	1,34	1,34	0,00	0,124	0,124	0,00	0,151	0,151	0,00	0,000315	0,000204	$4{,}82 \cdot 10^{-5}$	$4{,}85 \cdot 10^{-9}$	kg
Rock wool MW(SW)-PT 5 (105 kg/m³)	90.665	2,6%	86,8%	R2142714906	105	0,038	21,3	21,3	0,00	0,785	0,785	0,00	1,74	1,74	0,00	0,0118	0,00311	0,00506	$7{,}01 \cdot 10^{-8}$	kg
Fillings made of sand, gravel, grit (1800 kg/m³)	88.005	2,5%	89,3%	R2142715135	1.800	0,700	0,104	0,104	0,00	0,00262	0,00262	0,00	0,00708	0,00708	0,00	$4{,}83 \cdot 10^{-5}$	$1{,}46 \cdot 10^{-5}$	$5{,}24 \cdot 10^{-6}$	$7{,}53 \cdot 10^{-10}$	kg
Concrete slabs	65.837	1,9%	91,2%	R2142727922	2.400	2,000	0,702	0,702	0,00	0,0374	0,0374	0,00	0,0926	0,0926	0,00	0,000169	0,000111	$2{,}68 \cdot 10^{-5}$	$2{,}19 \cdot 10^{-9}$	kg
Konstruktionsvollholz (KVH)	57.081	1,6%	92,8%	P2142718934	475	0,120	3,59	3,59	0,00	20,3	3,08	17,2	-1,44	0,210	-1,65	0,00128	0,000583	0,000508	$1{,}81 \cdot 10^{-8}$	kg
FERMACELL Gipsfaser Estrich-Elemente	48.993	1,4%	94,2%	P2142704485	1.150	0,320	5,40	5,40	0,00	3,23	3,23	0,00	0,0845	0,376	-0,292	0,00157	0,000485	0,000132	$3{,}85 \cdot 10^{-8}$	kg
SterlingOSB/3-Zero	42.140	1,2%	95,3%	P2142703692	600	0,130	8,56	7,35	1,20	19,5	3,17	16,3	-1,15	0,418	-1,57	0,00210	0,000808	0,000452	$3{,}53 \cdot 10^{-8}$	kg
Fibre cement panels (2000 kg/m³)	38.878	1,1%	96,4%	R2142714823	2.000	1,500	13,2	13,2	0,00	1,56	1,56	0,00	0,947	1,01	-0,0650	0,00300	0,00189	0,000521	$4{,}71 \cdot 10^{-8}$	kg
Timber (675 kg/m³ - e.g. oak) - planed, technically dried	37.449	1,1%	97,5%	R2142715109	675	0,160	2,68	2,68	0,00	21,6	5,08	16,5	-1,50	0,154	-1,66	0,000947	0,000447	0,000322	$1{,}30 \cdot 10^{-8}$	kg
Solid parquet	25.221	0,7%	98,2%	R2142684313	740	0,160	8,49	8,49	0,00	28,1	11,6	16,5	-1,19	0,488	-1,68	0,00333	0,00145	0,000380	$4{,}10 \cdot 10^{-8}$	kg
ISOVER Trittschall-Dämmplatte S TDPS	10.339	0,3%	98,5%	P2142723365	71	0,032	40,9	35,6	5,25	1,88	0,550	1,33	2,12	2,12	0,00	0,0423	0,0121	0,00155	$2{,}20 \cdot 10^{-7}$	kg
ROCKWOOL Termarock 40	9.861	0,3%	98,8%	P2142717911	44	0,034	10,1	8,90	1,21	1,51	0,760	0,750	1,21	1,23	-0,0170	0,00696	0,00200	0,000486	$6{,}94 \cdot 10^{-8}$	kg
Rema 3-Schicht Massivholzplatte nord. Fichte	6.752	0,2%	99,0%	P2142704948	450	0,120	9,20	8,83	0,374	17,7	0,633	17,1	-1,01	0,510	-1,52	0,00288	0,00138	0,00104	$4{,}41 \cdot 10^{-8}$	kg
AUSTROTHERM EPS W30	5.489	0,2%	99,1%	P2142711067	28	0,035	98,9	58,9	40,0	0,959	0,959	0,00	4,21	4,21	0,00	0,0149	0,00261	0,00914	$1{,}32 \cdot 10^{-7}$	kg
BITALBIT E-ALGV-4K	5.151	0,1%	99,3%	P2142735114	1.100	0,230	41,6	17,2	24,4	0,664	0,664	0,00	0,822	0,824	-0,00200	0,00556	0,00182	0,00114	$3{,}16 \cdot 10^{-7}$	kg
Rubber granulate mat	4.501	0,1%	99,4%	R2142684398	640	0,170	51,5	19,7	31,8	1,20	1,20	0,00	1,29	1,29	0,00	0,00566	0,00266	0,000547	$3{,}31 \cdot 10^{-8}$	kg
Ceramic tiles (2300 kg/m³)	4.375	0,1%	99,5%	R2142715203	2.300	1,300	13,2	13,2	0,00	0,680	0,680	0,00	0,781	0,781	0,00	0,00277	0,00119	0,000237	$9{,}17 \cdot 10^{-8}$	kg
AUSTROTHERM EPS W30 PLUS	3.286	0,1%	99,6%	P2142686797	28	0,030	98,9	58,9	40,0	0,959	0,959	0,00	4,21	4,21	0,00	0,0149	0,00261	0,00914	$1{,}32 \cdot 10^{-7}$	kg
Würth Dampfbremse Wütop DB 2	2.684	0,1%	99,7%	P2142718757	1.160	0,330	86,0	43,5	42,5	1,30	1,30	0,00	2,84	2,86	-0,0210	0,00832	0,00161	0,00248	$3{,}91 \cdot 10^{-8}$	kg
Cement-bonded EPS granulate (99 kg/m³)	2.187	0,1%	99,8%	R2142715090	99	0,047	25,1	16,0	9,11	0,300	0,300	0,00	1,31	1,31	0,00	0,00394	0,000967	0,00219	$3{,}57 \cdot 10^{-8}$	kg
CR lime cement finish plaster (1800 kg/m³)	2.065	0,1%	99,8%	R2142714798	1.800	1,050	1,43	1,43	0,00	0,286	0,286	0,00	0,153	0,154	-0,00100	0,000348	0,000179	$4{,}87 \cdot 10^{-5}$	$6{,}49 \cdot 10^{-9}$	kg
AUSTROTHERM XPS PLUS 30 SF	1.753	0,0%	99,9%	P2142721407	30	0,032	93,6	53,6	40,0	0,879	0,879	0,00	4,24	4,24	0,00	0,0155	0,00257	0,00816	$6{,}13 \cdot 10^{-8}$	kg
COVERiT NOVOtan ® EPDM DA-K Rollenware 1,3/1,5 mm	1.749	0,0%	99,9%	P2142716922	1.200	0,170	83,8	47,9	35,9	1,89	1,89	0,00	2,60	2,65	-0,0460	0,0107	0,00370	0,00221	$6{,}42 \cdot 10^{-7}$	kg
KI Klemmplatte KP, KP-HB (ab Juni 2016)	1.036	0,0%	100,0%	P2142722586	30	0,038	21,3	21,3	0,00	0,785	0,785	0,00	1,74	1,74	0,00	0,0118	0,00311	0,00506	$7{,}01 \cdot 10^{-8}$	kg
Synthesa Capatect Klebespachtel 160	438	0,0%	100,0%	P2142731707	1.850	1,310	26,9	18,6	8,33	0,607	0,607	0,00	1,08	1,09	-0,00500	0,00414	0,00155	0,000896	$9{,}72 \cdot 10^{-8}$	kg
Enkolan Abdichtung 1K LF	317	0,0%	100,0%	P2142719726	1.300	0,500	49,9	33,3	16,5	1,25	1,25	0,00	2,33	2,33	0,00	0,00927	0,00211	0,00186	$1{,}95 \cdot 10^{-8}$	kg
Bachl EPS W-15	271	0,0%	100,0%	P2142705761	14	0,042	98,9	58,9	40,0	0,959	0,959	0,00	4,21	4,21	0,00	0,0149	0,00261	0,00914	$1{,}32 \cdot 10^{-7}$	kg
Polyethylene (PE) sealing sheeting	268	0,0%	100,0%	R2142712507	980	0,500	69,7	27,3	42,5	1,53	1,53	0,00	2,09	2,09	0,00	0,00788	0,00152	0,00274	$3{,}03 \cdot 10^{-8}$	kg
ROCKWOOL Steelrock 040	103	0,0%	100,0%	P2142717905	28	0,039	10,1	8,90	1,21	1,51	0,760	0,750	1,21	1,23	-0,0170	0,00696	0,00200	0,000486	$6{,}94 \cdot 10^{-8}$	kg
Glass wool MW(GW)-W (15 kg/m³)	85	0,0%	100,0%	R2142714916	15	0,040	45,7	45,7	0,00	2,11	2,11	0,00	2,42	2,42	-0,00500	0,0150	0,00686	0,00165	$2{,}61 \cdot 10^{-7}$	kg
Bachl EPS W-25	37	0,0%	100,0%	P2142705753	23	0,036	98,9	58,9	40,0	0,959	0,959	0,00	4,21	4,21	0,00	0,0149	0,00261	0,00914	$1{,}32 \cdot 10^{-7}$	kg

Attachment F – Results – OI3-Index for 100 years

Project name: **Case Study 100 years**

building overall

PENRT:	5.931 MJ / m² ref. area	GWP-total:	387 kg CO_2 equ. / m² ref. area	GFA:	3.577,3 m²
PENRE:	5.070 MJ / m² ref. area	GWP-fossil:	394 kg CO_2 equ. / m² ref. area	ref. area:	3.577,3 m²
PENRM:	861 MJ / m² ref. area	GWP-biogenic:	-6,77 kg CO_2 equ. / m² ref. area	reference limit:	BG3 ref. Area
PERT:	3.774 MJ / m² ref. area	AP:	1,86 kg SO_2 equ. / m² ref. area	catalog of LCA indicators:	IBO benchmarks 2020
PERE:	1.081 MJ / m² ref. area	EP:	0,693 kg PO_4^{3-} / m² ref. area	useful life considered:	yes, with integer replacements rates (according to EN 15804 standard)
PERM:	2.693 MJ / m² ref. area	POCP:	0,475 kg C_2H_4 / m² ref. area	study period:	100 years
		ODP:	$2{,}65 \cdot 10^{-5}$ kg CFC-11 / m² ref. area	service life catalog:	2018
				calculation for:	new building

A1-A3: Bauteile

quantity	building element	PENRT MJ	PENRE MJ	PENRM MJ	PERT MJ	PERE MJ	PERM MJ	GWP-total kg CO_2 equ.	GWP-fossil kg CO_2 equ.	GWP-biogenic kg CO_2 equ.	AP kg SO_2 equ.	EP kg PO_4^{3-}	POCP kg C_2H_4	ODP kg CFC-11
								per m² ref. area						
41,30 m²	AW01_ Kelleraußenwand 25STB+12WD	9	7	2	0	0	0	0,8	1	0	0,00	0,001	0,001	$0{,}00 \cdot 10^{-5}$
312,60 m²	AW01_ Kelleraußenwand 30STB+17WD	90	72	17	3	3	0	8,0	8	0	0,02	0,009	0,006	$0{,}02 \cdot 10^{-5}$
192,20 m²	AW02_ Außenwand 25STB+12WD	38	38	0	2	2	0	4,4	4	0	0,01	0,006	0,004	$0{,}01 \cdot 10^{-5}$
1.471,00 m²	AW03_ Außenraum gegen beheizt	610	578	32	718	176	542	-13,9	40	-54	0,21	0,079	0,069	$0{,}25 \cdot 10^{-5}$
143,20 m²	AW05_ Stgh gegen Beheizt OG2-OG6	52	50	2	43	11	32	1,4	5	-3	0,02	0,007	0,005	$0{,}02 \cdot 10^{-5}$
27,00 m²	AW05a_ Stgh gegen Naßzelle OG2-OG6	12	12	0	8	2	6	0,4	1	-1	0,00	0,002	0,001	$0{,}01 \cdot 10^{-5}$
28,30 m²	AW05b_ Stgh gegen Beheizt OG1	11	10	1	8	2	6	0,2	1	-1	0,00	0,001	0,001	$0{,}00 \cdot 10^{-5}$
19,10 m²	AW05c_ Stgh gegen Unbeheizt	9	8	1	4	1	3	0,5	1	-0	0,00	0,001	0,001	$0{,}00 \cdot 10^{-5}$
51,00 m²	AW05d_ Stgh gegen Unbeheizt	23	23	0	11	3	7	1,4	2	-1	0,01	0,003	0,003	$0{,}01 \cdot 10^{-5}$
60,00 m³	Bauholz Stütze	29	29	0	162	25	137	-11,5	2	-13	0,01	0,005	0,004	$0{,}01 \cdot 10^{-5}$
38,60 m³	Bauholz Unterzug	18	18	0	104	16	88	-7,4	1	-8	0,01	0,003	0,003	$0{,}01 \cdot 10^{-5}$
291,40 m²	DE01_Fußboden Außenraum gegen beheizt	120	95	26	4	4	0	10,1	10	-0	0,02	0,011	0,007	$0{,}03 \cdot 10^{-5}$
32,40 m²	DE02_Müllraum gegen beheizt	12	10	2	1	1	0	1,1	1	-0	0,00	0,001	0,001	$0{,}00 \cdot 10^{-5}$
487,00 m²	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	313	270	43	14	14	0	32,2	32	-0	0,07	0,038	0,015	$0{,}09 \cdot 10^{-5}$
149,60 m²	DE04_Forum	40	35	5	2	2	0	4,2	4	-0	0,01	0,005	0,002	$0{,}01 \cdot 10^{-5}$
1.415,70 m²	DE05_Decke Wohnung gegen Wohnung	702	671	31	793	232	561	-13,0	45	-58	0,33	0,105	0,077	$0{,}34 \cdot 10^{-5}$
163,20 m²	DE05a_Decke Wohnung gegen Naßzelle	80	76	3	72	16	56	-0,4	5	-6	0,03	0,011	0,009	$0{,}04 \cdot 10^{-5}$
288,40 m²	DE05b_Decke Wohnung 1OG	164	160	3	82	33	49	10,4	16	-5	0,06	0,025	0,015	$0{,}06 \cdot 10^{-5}$
243,90 m²	DE06_Extensives Gründach mit reduziertem Aufbau	125	89	36	85	19	66	-0,8	6	-6	0,03	0,010	0,009	$0{,}05 \cdot 10^{-5}$
468,90 m²	DE07_Decke unter Freibereich	316	208	108	199	40	159	-2,2	13	-15	0,07	0,024	0,019	$0{,}11 \cdot 10^{-5}$
328,70 m²	IW01_ Wohnung gegen Wohnung	115	111	4	190	43	147	-7,7	7	-15	0,04	0,015	0,011	$0{,}06 \cdot 10^{-5}$
580,90 m²	IW02_ Modultrennwand	114	109	5	260	51	208	-13,6	7	-20	0,04	0,016	0,012	$0{,}06 \cdot 10^{-5}$
143,00 m²	IW02a_ Modultrennwand einseitig	16	15	1	33	7	26	-1,6	1	-3	0,00	0,002	0,001	$0{,}01 \cdot 10^{-5}$
345,30 m²	IW03_ Gang gegen Wohnung	68	66	2	103	25	77	-3,8	4	-8	0,02	0,008	0,005	$0{,}04 \cdot 10^{-5}$
1.139,60 m²	IW04_LB 10cm einfach Metallständerwand	53	51	1	12	11	1	3,3	4	-0	0,01	0,005	0,001	$0{,}04 \cdot 10^{-5}$
108,80 m²	IW04a_LB 6,25cm einfach Vorsatzschale	3	3	0	1	1	0	0,2	0	-0	0,00	0,000	0,000	$0{,}00 \cdot 10^{-5}$
100,80 m²	IW04b_LB 7,5cm Vorsatzschale	4	4	0	1	1	0	0,2	0	-0	0,00	0,000	0,000	$0{,}00 \cdot 10^{-5}$
35,28 m³	STB Stütze	18	18	0	1	1	0	2,3	2	0	0,00	0,003	0,001	$0{,}01 \cdot 10^{-5}$
1,60 m³	STB Unterzug	1	1	0	0	0	0	0,1	0	0	0,00	0,000	0,000	$0{,}00 \cdot 10^{-5}$
199,40 m²	STB Wand 25 cm KG	25	25	0	1	1	0	3,3	3	0	0,01	0,004	0,001	$0{,}01 \cdot 10^{-5}$
44,00 m²	STB Wand 50 cm KG	11	11	0	1	1	0	1,5	1	0	0,00	0,002	0,000	$0{,}00 \cdot 10^{-5}$
8.816,70 m²	**sum**	**3.200**	**2.874**	**326**	**2.916**	**743**	**2.173**	**10,0**	**228**	**-218**	**1,04**	**0,401**	**0,282**	**$1{,}32 \cdot 10^{-5}$**

B4: Bauteile

quantity	building element	PENRT MJ	PENRE MJ	PENRM MJ	PERT MJ	PERE MJ	PERM MJ	GWP-total kg CO_2 equ.	GWP-fossil kg CO_2 equ.	GWP-biogenic kg CO_2 equ.	AP kg SO_2 equ.	EP kg PO_4^{3-}	POCP kg C_2H_4	ODP kg CFC-11
								per m² ref. area						
41,30 m²	AW01_ Kelleraußenwand 25STB+12WD	0	0	0	0	0	0	0	0	0,00	0,000	0,000	0,000	$0{,}00 \cdot 10^{-6}$
312,60 m²	AW01_ Kelleraußenwand 30STB+17WD	0	0	0	0	0	0	0	0	0,00	0,000	0,000	0,000	$0{,}00 \cdot 10^{-6}$
192,20 m²	AW02_ Außenwand 25STB+12WD	29	29	0	1	1	0	2	2	0,00	0,016	0,004	0,007	$0{,}09 \cdot 10^{-6}$
1.471,00 m²	AW03_ Außenraum gegen beheizt	287	252	35	246	81	165	17	17	0,00	0,055	0,029	0,012	$1{,}00 \cdot 10^{-6}$
143,20 m²	AW05_ Stgh gegen Beheizt OG2-OG6	12	9	3	1	1	0	1	1	0,00	0,001	0,000	0,000	$0{,}04 \cdot 10^{-6}$
27,00 m²	AW05a_ Stgh gegen Naßzelle OG2-OG6	3	3	0	0	0	0	0	0	0,00	0,001	0,000	0,000	$0{,}02 \cdot 10^{-6}$
28,30 m²	AW05b_ Stgh gegen Beheizt OG1	8	6	2	0	0	0	0	0	0,00	0,001	0,001	0,000	$0{,}03 \cdot 10^{-6}$
19,10 m²	AW05c_ Stgh gegen Unbeheizt	8	7	1	3	1	2	1	1	0,00	0,002	0,001	0,001	$0{,}03 \cdot 10^{-6}$
51,00 m²	AW05d_ Stgh gegen Unbeheizt	17	16	0	8	3	6	1	1	0,00	0,007	0,002	0,003	$0{,}06 \cdot 10^{-6}$
60,00 m³	Bauholz Stütze	0	0	0	0	0	0	0	0	0,00	0,000	0,000	0,000	$0{,}00 \cdot 10^{-6}$
38,60 m³	Bauholz Unterzug	0	0	0	0	0	0	0	0	0,00	0,000	0,000	0,000	$0{,}00 \cdot 10^{-6}$
291,40 m²	DE01_Fußboden Außenraum gegen beheizt	45	29	16	1	1	0	2	2	0,00	0,007	0,003	0,001	$0{,}31 \cdot 10^{-6}$
32,40 m²	DE02_Müllraum gegen beheizt	4	2	2	0	0	0	0	0	0,00	0,001	0,000	0,000	$0{,}03 \cdot 10^{-6}$
487,00 m²	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	88	57	31	3	3	0	5	5	0,00	0,014	0,006	0,004	$0{,}30 \cdot 10^{-6}$
149,60 m²	DE04_Forum	5	5	0	0	0	0	1	1	0,00	0,001	0,001	0,000	$0{,}02 \cdot 10^{-6}$
1.415,70 m²	DE05_Decke Wohnung gegen Wohnung	550	527	23	398	155	243	37	37	0,00	0,279	0,083	0,064	$2{,}57 \cdot 10^{-6}$
163,20 m²	DE05a_Decke Wohnung gegen Naßzelle	62	60	2	27	7	20	4	4	0,00	0,026	0,008	0,007	$0{,}30 \cdot 10^{-6}$
288,40 m²	DE05b_Decke Wohnung 1OG	92	88	3	78	29	49	6	6	0,00	0,046	0,014	0,012	$0{,}40 \cdot 10^{-6}$
243,90 m²	DE06_Extensives Gründach mit reduziertem Aufbau	259	157	102	6	6	1	10	10	0,00	0,055	0,014	0,017	$0{,}85 \cdot 10^{-6}$
468,90 m²	DE07_Decke unter Freibereich	693	381	312	50	16	34	25	25	0,00	0,129	0,038	0,037	$1{,}90 \cdot 10^{-6}$
328,70 m²	IW01_ Wohnung gegen Wohnung	24	24	0	6	6	0	1	1	0,00	0,004	0,002	0,000	$0{,}16 \cdot 10^{-6}$
580,90 m²	IW02_ Modultrennwand	0	0	0	0	0	0	0	0	0,00	0,000	0,000	0,000	$0{,}00 \cdot 10^{-6}$
143,00 m²	IW02a_ Modultrennwand einseitig	3	3	0	1	1	0	0	0	0,00	0,001	0,000	0,000	$0{,}00 \cdot 10^{-6}$

143,00 m²	IW02a_ Modultrennwand einseitig	3	3	0	1	1	0	0	0	0,00	0,001	0,000	0,000	$0,02 \cdot 10^{-6}$
345,30 m²	IW03_ Gang gegen Wohnung	31	31	0	6	6	0	2	2	0,00	0,007	0,003	0,002	$0,19 \cdot 10^{-6}$
1.139,60 m²	IW04_LB 10cm einfach Metallständerwand	53	51	1	12	11	1	4	4	0,00	0,014	0,005	0,001	$0,35 \cdot 10^{-6}$
108,80 m²	IW04a_LB 6,25cm einfach Vorsatzschale	3	3	0	1	1	0	0	0	0,00	0,001	0,000	0,000	$0,02 \cdot 10^{-6}$
100,80 m²	IW04b_LB 7,5cm Vorsatzschale	4	4	0	1	1	0	0	0	0,00	0,001	0,000	0,000	$0,03 \cdot 10^{-6}$
35,28 m³	STB Stütze	0	0	0	0	0	0	0	0	0,00	0,000	0,000	0,000	$0,00 \cdot 10^{-6}$
1,60 m³	STB Unterzug	0	0	0	0	0	0	0	0	0,00	0,000	0,000	0,000	$0,00 \cdot 10^{-6}$
199,40 m²	STB Wand 25 cm KG	0	0	0	0	0	0	0	0	0,00	0,000	0,000	0,000	$0,00 \cdot 10^{-6}$
44,00 m²	STB Wand 50 cm KG	0	0	0	0	0	0	0	0	0,00	0,000	0,000	0,000	$0,00 \cdot 10^{-6}$
8.816,70 m²	**sum**	**2.281**	**1.745**	**535**	**852**	**332**	**520**	**121**	**121**	**0,00**	**0,668**	**0,215**	**0,169**	**$8,70 \cdot 10^{-6}$**

A1-A3 + B4: Bauteile

quantity	building element	PENRT MJ	PENRE MJ	PENRM MJ	PERT MJ	PERE MJ	PERM MJ	GWP-total kg CO_2 equ.	GWP-fossil kg CO_2 equ.	GWP-biogenic kg CO_2 equ.	AP kg SO_2 equ.	EP kg PO_4^{3-}	POCP kg C_2H_4	ODP kg CFC-11
								per m² ref. area						
41,30 m²	AW01_ Kelleraußenwand 25STB+12WD	9	7	2	0	0	0	1	1	0	0,00	0,001	0,001	$0,00 \cdot 10^{-5}$
312,60 m²	AW01_ Kelleraußenwand 30STB+17WD	90	72	17	3	3	0	8	8	0	0,02	0,009	0,006	$0,02 \cdot 10^{-5}$
192,20 m²	AW02_ Außenwand 25STB+12WD	67	67	0	3	3	0	7	7	0	0,03	0,010	0,011	$0,02 \cdot 10^{-5}$
1.471,00 m²	AW03_ Außenraum gegen beheizt	897	830	67	964	257	707	3	58	-54	0,26	0,107	0,080	$0,35 \cdot 10^{-5}$
143,20 m²	AW05_ Stgh gegen Beheizt OG2-OG6	65	59	5	44	12	32	2	5	-3	0,02	0,008	0,005	$0,03 \cdot 10^{-5}$
27,00 m²	AW05a_ Stgh gegen Naßzelle OG2-OG6	15	15	1	8	2	6	1	1	-1	0,00	0,002	0,001	$0,01 \cdot 10^{-5}$
28,30 m²	AW05b_ Stgh gegen Beheizt OG1	19	16	3	9	3	6	1	1	-1	0,00	0,002	0,001	$0,01 \cdot 10^{-5}$
19,10 m²	AW05c_ Stgh gegen Unbeheizt	17	16	2	7	2	5	1	1	-0	0,01	0,002	0,001	$0,01 \cdot 10^{-5}$
51,00 m²	AW05d_ Stgh gegen Unbeheizt	40	39	1	19	6	13	3	3	-1	0,02	0,006	0,005	$0,01 \cdot 10^{-5}$
60,00 m³	Bauholz Stütze	29	29	0	162	25	137	-11	2	-13	0,01	0,005	0,004	$0,01 \cdot 10^{-5}$
38,60 m³	Bauholz Unterzug	18	18	0	104	16	88	-7	1	-8	0,01	0,003	0,003	$0,01 \cdot 10^{-5}$
291,40 m²	DE01_Fußboden Außenraum gegen beheizt	166	124	41	5	5	0	12	12	-0	0,03	0,014	0,008	$0,07 \cdot 10^{-5}$
32,40 m²	DE02_Müllraum gegen beheizt	16	12	4	1	1	0	1	1	-0	0,00	0,002	0,001	$0,01 \cdot 10^{-5}$
487,00 m²	DE03_Fußboden Keller beheizt (>1.5m unter Erdreich)	401	327	75	17	17	0	37	37	-0	0,08	0,044	0,018	$0,12 \cdot 10^{-5}$
149,60 m²	DE04_Forum	45	40	5	2	2	0	5	5	-0	0,01	0,006	0,002	$0,01 \cdot 10^{-5}$
1.415,70 m²	DE05_Decke Wohnung gegen Wohnung	1.251	1.198	54	1.191	387	804	24	82	-58	0,61	0,189	0,141	$0,60 \cdot 10^{-5}$
163,20 m²	DE05a_Decke Wohnung gegen Naßzelle	142	136	5	99	23	76	4	9	-6	0,06	0,019	0,016	$0,07 \cdot 10^{-5}$
288,40 m²	DE05b_Decke Wohnung 1OG	255	248	7	160	61	98	17	22	-5	0,11	0,038	0,028	$0,10 \cdot 10^{-5}$
243,90 m²	DE06_Extensives Gründach mit reduziertem Aufbau	384	246	138	92	25	67	10	16	-6	0,08	0,023	0,026	$0,14 \cdot 10^{-5}$
468,90 m²	DE07_Decke unter Freibereich	1.009	589	420	248	56	192	23	38	-15	0,20	0,062	0,056	$0,30 \cdot 10^{-5}$
328,70 m²	IW01_ Wohnung gegen Wohnung	139	135	4	196	49	147	-6	8	-15	0,04	0,016	0,012	$0,08 \cdot 10^{-5}$
580,90 m²	IW02_ Modultrennwand	114	109	5	260	51	208	-14	7	-20	0,04	0,016	0,012	$0,06 \cdot 10^{-5}$
143,00 m²	IW02a_ Modultrennwand einseitig	19	18	1	33	8	26	-1	1	-3	0,01	0,002	0,001	$0,01 \cdot 10^{-5}$
345,30 m²	IW03_ Gang gegen Wohnung	99	97	2	109	32	77	-2	6	-8	0,03	0,010	0,007	$0,06 \cdot 10^{-5}$
1.139,60 m²	IW04_LB 10cm einfach Metallständerwand	105	103	3	24	22	2	7	7	-0	0,03	0,010	0,003	$0,07 \cdot 10^{-5}$
108,80 m²	IW04a_LB 6,25cm einfach Vorsatzschale	5	5	0	1	1	0	0	0	-0	0,00	0,001	0,000	$0,00 \cdot 10^{-5}$
100,80 m²	IW04b_LB 7,5cm Vorsatzschale	9	8	0	2	2	0	1	1	-0	0,00	0,001	0,000	$0,01 \cdot 10^{-5}$
35,28 m³	STB Stütze	18	18	0	1	1	0	2	2	0	0,00	0,003	0,001	$0,01 \cdot 10^{-5}$
1,60 m³	STB Unterzug	1	1	0	0	0	0	0	0	0	0,00	0,000	0,000	$0,00 \cdot 10^{-5}$
199,40 m²	STB Wand 25 cm KG	25	25	0	1	1	0	3	3	0	0,01	0,004	0,001	$0,01 \cdot 10^{-5}$
44,00 m²	STB Wand 50 cm KG	11	11	0	1	1	0	1	1	0	0,00	0,002	0,000	$0,00 \cdot 10^{-5}$
8.816,70 m²	**sum**	**5.480**	**4.619**	**861**	**3.768**	**1.075**	**2.693**	**131**	**349**	**-218**	**1,71**	**0,615**	**0,451**	**$2,19 \cdot 10^{-5}$**

A4: transportation

	PENRT MJ	PENRE MJ	PENRM MJ	PERT MJ	PERE MJ	PERM MJ	GWP-total kg CO_2 equ.	GWP-fossil kg CO_2 equ.	GWP-biogenic kg CO_2 equ.	AP kg SO_2 equ.	EP kg PO_4^{3-}	POCP kg C_2H_4	ODP kg CFC-11
							per m² ref. area						
sum (100,0% of all components with known mass included)	174	174	0,00	2,47	2,47	0,00	11,2	11,2	0,00	0,0435	0,0117	0,00616	$1,76 \cdot 10^{-6}$

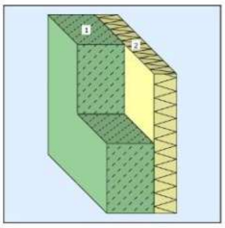
C1-C4: end of life

	PENRT MJ	PENRE MJ	PENRM MJ	PERT MJ	PERE MJ	PERM MJ	GWP-total kg CO_2 equ.	GWP-fossil kg CO_2 equ.	GWP-biogenic kg CO_2 equ.	AP kg SO_2 equ.	EP kg PO_4^{3-}	POCP kg C_2H_4	ODP kg CFC-11
							per m² ref. area						
sum (100,0% of all components with known mass included)	277	277	0,00	2,90	2,90	0,00	245	33,8	212	0,108	0,0660	0,0171	$2,90 \cdot 10^{-6}$

graphic details of solid and transparent building elements

Project name: **Case Study 100 years**

AW01_ Kelleraußenwand 25STB+12WD (30359)



Fläche: 41,3 m²
mass: 603,3 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 773 MJ/m²
PENRE: 641 MJ/m²
PENRM: 132 MJ/m²
PERT: 27,0 MJ/m²
PERE: 27,0 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 73,1 kg CO_2 equ./m²
GWP-fossil: 73,1 kg CO_2 equ./m²
GWP-biogenic: 0,00 kg CO_2 equ./m²
AP: 0,156 kg SO_2 equ./m²
EP: 0,0795 kg PO_4^{3-}/m²
POCP: 0,0472 kg C_2H_4/m²
ODP: $1{,}81\cdot10^{-6}$ kg CFC-11/m²

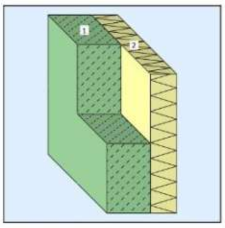
no.	layer (from inside to outside)	d cm	Useful life >b
1	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
2	EPS W 30 plus *(AUSTROTHERM EPS W30 PLUS)*	12,00	[1]100
	building element	**37,00**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

AW01_ Kelleraußenwand 30STB+17WD (30359)



Fläche: 312,6 m²
mass: 725,0 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 1.025 MJ/m²
PENRE: 827 MJ/m²
PENRM: 198 MJ/m²
PERT: 33,3 MJ/m²
PERE: 33,3 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 91,9 kg CO_2 equ./m²
GWP-fossil: 91,9 kg CO_2 equ./m²
GWP-biogenic: 0,00 kg CO_2 equ./m²
AP: 0,202 kg SO_2 equ./m²
EP: 0,0980 kg PO_4^{3-}/m²
POCP: 0,0657 kg C_2H_4/m²
ODP: $2{,}30\cdot10^{-6}$ kg CFC-11/m²

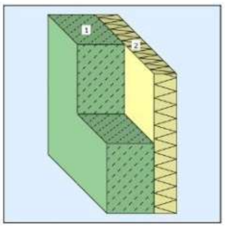
no.	layer (from inside to outside)	d cm	Useful life >b
1	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	30,00	100
2	EPS W 30 plus *(AUSTROTHERM EPS W30 PLUS)*	18,00	[1]100
	building element	**48,00**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

AW02_ Außenwand 25STB+12WD (30358)



Fläche: 192,2 m²
mass: 612,6 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 1.253 MJ/m²
PENRE: 1.253 MJ/m²
PENRM: 0,00 MJ/m²
PERT: 53,5 MJ/m²
PERE: 53,5 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 125 kg CO_2 equ./m²
GWP-fossil: 125 kg CO_2 equ./m²
GWP-biogenic: 0,00 kg CO_2 equ./m²
AP: 0,553 kg SO_2 equ./m²
EP: 0,188 kg PO_4^{3-}/m²
POCP: 0,208 kg C_2H_4/m²
ODP: $4{,}02\cdot10^{-6}$ kg CFC-11/m²

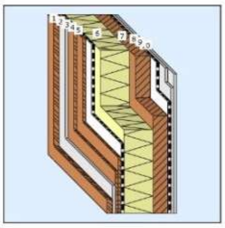
no.	layer (from inside to outside)	d cm	Useful life >b
1	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
2	Mineralwolle hart, Dämmung hart, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	12,00	35
	building element	**37,00**	

[1] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

AW03_ Außenraum gegen beheizt (30358)



Fläche: 1471 m²
mass: 152,3 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

0,150 W/m²K — U value [2]

PENRT: 2.181 MJ/m²
PENRE: 2.018 MJ/m²
PENRM: 164 MJ/m²
PERT: 2.344 MJ/m²
PERE: 626 MJ/m²
PERM: 1.719 MJ/m²
GWP-total: 8,11 kg CO_2 equ./m²
GWP-fossil: 140 kg CO_2 equ./m²
GWP-biogenic: -132 kg CO_2 equ./m²
AP: 0,636 kg SO_2 equ./m²
EP: 0,261 kg PO_4^{3-}/m²
POCP: 0,195 kg C_2H_4/m²
ODP: $8{,}49 \cdot 10^{-6}$ kg CFC-11/m²

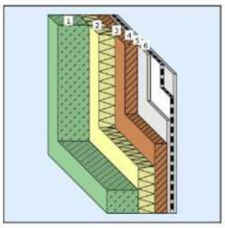
no.	layer (from inside to outside)	d cm	Useful life >b
1	Verkleidung Holz, Vollholz SN21, 700.0 kg/m³ *(Timber (675 kg/m³ - e.g. oak) - planed, technically dried)*	3,60	50
2	Faserzementplatte, Leer, 2,300.0 kg/m³ *(Fibre cement panels (2000 kg/m³))*	1,25	50
3	Timber slats *(Konstruktionsvollholz (KVH))*	0,70	[1]100
4	Timber slats *(Konstruktionsvollholz (KVH))*	0,70	[1]100
5	Dampfdiffusionsoffene Windbremse, Folie, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	[1]100
6	Wooden construction including thermal insulation, hard insulation, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	19,50	[1]100
7	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
8	Dampfbremse, Folie, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	25
9	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
10	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**38,87**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

AW05_ Stgh gegen Beheizt OG2-OG6 (30358)



Fläche: 143,2 m²
mass: 688,8 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

0,215 W/m²K — U value [2]

PENRT: 1.612 MJ/m²
PENRE: 1.477 MJ/m²
PENRM: 135 MJ/m²
PERT: 1.100 MJ/m²
PERE: 298 MJ/m²
PERM: 802 MJ/m²
GWP-total: 46,9 kg CO_2 equ./m²
GWP-fossil: 126 kg CO_2 equ./m²
GWP-biogenic: -79,5 kg CO_2 equ./m²
AP: 0,452 kg SO_2 equ./m²
EP: 0,190 kg PO_4^{3-}/m²
POCP: 0,131 kg C_2H_4/m²
ODP: $6{,}26 \cdot 10^{-6}$ kg CFC-11/m²

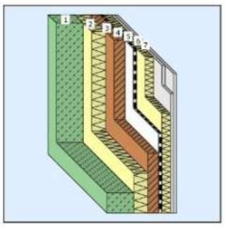
no.	layer (from inside to outside)	d cm	Useful life >b
1	Concrete reinforced, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
2	Hard mineral wool, hard insulation, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	13,00	[1]100
3	CLT, solid wood SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
4	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
5	Vapor barrier, foil, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	25
6	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**51,06**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

AW05a_ Stgh gegen Naßzelle OG2-OG6 (30358)



Fläche: 27 m²
mass: 701,8 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

0,144 W/m²K — U value [2]

PENRT: 2.046 MJ/m²
PENRE: 1.959 MJ/m²
PENRM: 86,4 MJ/m²
PERT: 1.108 MJ/m²
PERE: 301 MJ/m²
PERM: 807 MJ/m²
GWP-total: 80,9 kg CO_2 equ./m²
GWP-fossil: 160 kg CO_2 equ./m²
GWP-biogenic: -79,0 kg CO_2 equ./m²
AP: 0,597 kg SO_2 equ./m²
EP: 0,248 kg PO_4^{3-}/m²
POCP: 0,140 kg C_2H_4/m²
ODP: $1{,}00 \cdot 10^{-5}$ kg CFC-11/m²

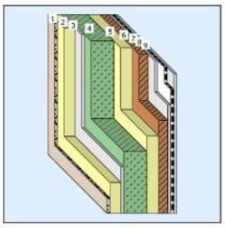
no.	layer (from inside to outside)	d cm	Useful life >b
1	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
2	Mineralwolle hart, Dämmung hart, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	13,00	[1]100
3	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
4	Dampfbremse, Folie, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	[1]50
5	CW-Profil *(ROCKWOOL Termarock 40)*	8,00	50
6	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
7	White tiles, empty, 1,750.0 kg/m³ *(Ceramic tiles (2300 kg/m³))*	1,00	50
	building element	**58,56**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

AW05b_ Stgh gegen Beheizt OG1 (30358)



Fläche: 28,3 m²
mass: 698,9 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

0,132 W/m²K — U value [2]

PENRT: 2.389 MJ/m²
PENRE: 2.019 MJ/m²
PENRM: 371 MJ/m²
PERT: 1.131 MJ/m²
PERE: 326 MJ/m²
PERM: 805 MJ/m²
GWP-total: 74,9 kg CO_2 equ./m²
GWP-fossil: 155 kg CO_2 equ./m²
GWP-biogenic: -79,6 kg CO_2 equ./m²
AP: 0,521 kg SO_2 equ./m²
EP: 0,240 kg PO_4^{3-}/m²
POCP: 0,0987 kg C_2H_4/m²
ODP: $9{,}83 \cdot 10^{-6}$ kg CFC-11/m²

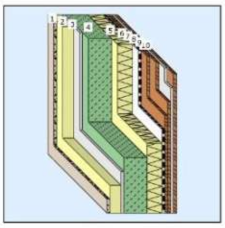
no.	layer (from inside to outside)	d cm	Useful life >b
1	Endbeschichtung, Leer, 1,800.0 kg/m³ *(CR lime cement finish plaster (1800 kg/m³))*	0,50	35
2	Wärmedämmung, Dämmung hart, 15.0 kg/m³ *(Glass wool MW(GW)-W (15 kg/m³))*	12,00	[1]35
3	Klebespachtel, Leer, 1,800.0 kg/m³ *(Synthesa Capatect Klebespachtel 160)*	0,50	35
4	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
5	Mineralwolle weich, Dämmstoff SN55, 40.0 kg/m³ *(ROCKWOOL Steelrock 040)*	13,00	[1]100
6	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
7	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
8	Dampfbremse, Folie, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	25
9	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**64,06**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

AW05c_ Stgh gegen Unbeheizt (30358)



Fläche: 19,1 m²
mass: 698,5 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

0,126 W/m²K — U value [2]

PENRT: 3.255 MJ/m²
PENRE: 2.966 MJ/m²
PENRM: 288 MJ/m²
PERT: 1.365 MJ/m²
PERE: 449 MJ/m²
PERM: 917 MJ/m²
GWP-total: 185 kg CO_2 equ./m²
GWP-fossil: 239 kg CO_2 equ./m²
GWP-biogenic: -53,2 kg CO_2 equ./m²
AP: 0,955 kg SO_2 equ./m²
EP: 0,402 kg PO_4^{3-}/m²
POCP: 0,276 kg C_2H_4/m²
ODP: $1{,}16 \cdot 10^{-5}$ kg CFC-11/m²

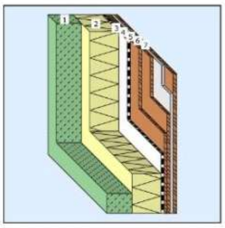
no.	layer (from inside to outside)	d cm	Useful life >b
1	Final coating, empty, 1,800.0 kg/m³ *(CR lime cement finish plaster (1800 kg/m³))*	0,50	35
2	Thermal insulation *(Glass wool MW(GW)-W (15 kg/m³))*	12,00	[1]35
3	Adhesive putty, empty, 1,800.0 kg/m³ *(Synthesa Capatect Klebespachtel 160)*	0,50	35
4	Concrete reinforced, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
5	Wooden construction including thermal insulation, hard insulation, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	16,00	[1]50
6	Vapor diffusion-open wind brake, foil, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	[1]50
7	Timber slats *(Konstruktionsvollholz (KVH))*	0,70	[1]100
8	Timber slats *(Konstruktionsvollholz (KVH))*	0,70	[1]100
9	Fiber cement board, empty, 2,300.0 kg/m³ *(Fibre cement panels (2000 kg/m³))*	1,50	50
10	Wood cladding, solid wood SN21, 700.0 kg/m³ *(Timber (675 kg/m³ - e.g. oak) - planed, technically dried)*	3,60	50
	building element	**60,56**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

AW05d_ Stgh gegen Unbeheizt (30358)



Fläche: 51 m²
mass: 692,1 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

0,119 W/m²K — U value [2]

PENRT: 2.806 MJ/m²
PENRE: 2.749 MJ/m²
PENRM: 57,1 MJ/m²
PERT: 1.351 MJ/m²
PERE: 434 MJ/m²
PERM: 917 MJ/m²
GWP-total: 186 kg CO_2 equ./m²
GWP-fossil: 239 kg CO_2 equ./m²
GWP-biogenic: -53,2 kg CO_2 equ./m²
AP: 1,07 kg SO_2 equ./m²
EP: 0,402 kg PO_4^{3-}/m²
POCP: 0,379 kg C_2H_4/m²
ODP: $9{,}27 \cdot 10^{-6}$ kg CFC-11/m²

no.	layer (from inside to outside)	d cm	Useful life >b
1	Concrete reinforced, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
2	Wooden construction including thermal insulation, hard insulation, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	29,00	[1]50
3	Vapor diffusion-open wind brake, foil, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	[1]50
4	Timber slats *(Konstruktionsvollholz (KVH))*	0,70	[1]100
5	Timber slats *(Konstruktionsvollholz (KVH))*	0,70	[1]100
6	Fiber cement board, empty, 2,300.0 kg/m³ *(Fibre cement panels (2000 kg/m³))*	1,50	50
7	Wood cladding, solid wood SN21, 700.0 kg/m³ *(Timber (675 kg/m³ - e.g. oak) - planed, technically dried)*	3,60	50
	building element	**60,56**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: Case Study 100 years

Bauholz Stütze (30358)

quantity: 59,996 m³
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 28,6 MJ/m²GFA
PENRE: 28,6 MJ/m²GFA
PENRM: 0,00 MJ/m²GFA
PERT: 162 MJ/m²GFA
PERE: 24,6 MJ/m²GFA
PERM: 137 MJ/m²GFA
GWP-total: -11,5 kg CO_2 equ./m²GFA
GWP-fossil: 1,68 kg CO_2 equ./m²GFA
GWP-biogenic: -13,2 kg CO_2 equ./m²GFA
AP: 0,0102 kg SO_2 equ./m²GFA
EP: 0,00464 kg PO_4^{3-}/m²GFA
POCP: 0,00405 kg C_2H_4/m²GFA
ODP: $1,45 \cdot 10^{-7}$ kg CFC-11/m²GFA

components (without component structure) (quantity per m³ building elen	**Useful life >b**
475 kg Konstruktionsvollholz (KVH)	100

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: Case Study 100 years

Bauholz Unterzug (30358)

quantity: 38,6 m³
service life: yes, with integer replacements rates (according to EN 15804 standard)

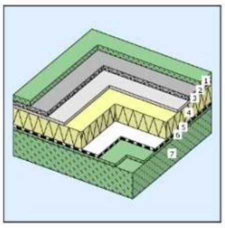
PENRT: 18,4 MJ/m²GFA
PENRE: 18,4 MJ/m²GFA
PENRM: 0,00 MJ/m²GFA
PERT: 104 MJ/m²GFA
PERE: 15,8 MJ/m²GFA
PERM: 88,4 MJ/m²GFA
GWP-total: -7,39 kg CO_2 equ./m²GFA
GWP-fossil: 1,08 kg CO_2 equ./m²GFA
GWP-biogenic: -8,47 kg CO_2 equ./m²GFA
AP: 0,00657 kg SO_2 equ./m²GFA
EP: 0,00299 kg PO_4^{3-}/m²GFA
POCP: 0,00261 kg C_2H_4/m²GFA
ODP: $9,30 \cdot 10^{-8}$ kg CFC-11/m²GFA

components (without component structure) (quantity per m³ building elen	**Useful life >b**
475 kg Konstruktionsvollholz (KVH)	100

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: Case Study 100 years

DE01_Fußboden Außenraum gegen beheizt (30358)



Fläche: 291,4 m²
mass: 1022,0 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 2.033 MJ/m²
PENRE: 1.526 MJ/m²
PENRM: 507 MJ/m²
PERT: 66,8 MJ/m²
PERE: 66,8 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 151 kg CO_2 equ./m²
GWP-fossil: 152 kg CO_2 equ./m²
GWP-biogenic: -0,0969 kg CO_2 equ./m²
AP: 0,365 kg SO_2 equ./m²
EP: 0,173 kg PO_4^{3-}/m²
POCP: 0,0993 kg C_2H_4/m²
ODP: $8,02 \cdot 10^{-6}$ kg CFC-11/m²

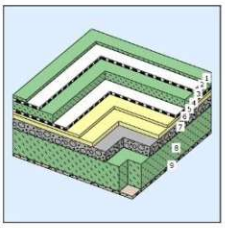
no.	layer	d cm	Useful life >b
1	Concrete plates *(Concrete slabs)*	6,00	50
2	Gravel *(Fillings made of sand, gravel, grit (1800 kg/m³))*	5,00	[1]100
3	EDPM-seal *(COVERiT NOVOtan ® EPDM DA-K Rollenware 1,3/1,5 mm)*	0,15	25
4	EPS W 30 plus *(AUSTROTHERM EPS W30 PLUS)*	20,00	[1]100
5	Vapor barrier, foil, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	[1]100
6	Sloping screed *(Quarzolith Zementestrich E400)*	3,00	[1]100
7	Concrete reinforced, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	30,00	100
	building element	**64,21**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

DE02_Müllraum gegen beheizt (30358)



Fläche: 32,4 m²
mass: 1227,8 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

U value [2]: 0,380 W/m²K

PENRT: 1.744 MJ/m²
PENRE: 1.314 MJ/m²
PENRM: 430 MJ/m²
PERT: 79,1 MJ/m²
PERE: 79,1 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 140 kg CO_2 equ./m²
GWP-fossil: 140 kg CO_2 equ./m²
GWP-biogenic: -0,0174 kg CO_2 equ./m²
AP: 0,340 kg SO_2 equ./m²
EP: 0,179 kg PO_4^{3-}/m²
POCP: 0,0689 kg C_2H_4/m²
ODP: 7,49·10⁻⁶ kg CFC-11/m²

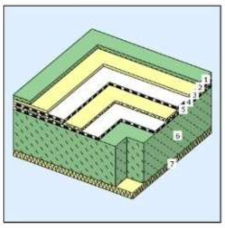
no.	layer	d cm	Useful life >b
1	Concrete plates *(Concrete slabs)*	3,00	50
2	Bituminous moisture sealing ALGV, sealant SN59, 1,100.0 kg/m³ *(BITALBIT E-ALGV-4K)*	0,38	35
3	Screed *(Quarzolith Zementestrich E400)*	10,00	[1]100
4	Polyethylene films, sealant SN59, 1,100.0 kg/m³ *(Polyethylene (PE) sealing sheeting)*	0,15	[1]100
5	EPS system board W T, hard insulation, 15.0 kg/m³ *(Bachl EPS W-15)*	3,00	[1]100
6	EPS W 25 *(Bachl EPS W-25)*	5,00	[1]100
7	Kies *(Fillings made of sand, gravel, grit (1800 kg/m³))*	12,20	[1]100
8	Concrete reinforced, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	30,00	100
9	Filling *(CR lime cement finish plaster (1800 kg/m³))*	0,50	35
	building element	**64,23**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

DE03_Fußboden Keller beheizt (>1.5m unter Erdreich) (30358)



Fläche: 487 m²
mass: 2071,8 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

U value [2]: 0,174 W/m²K

PENRT: 2.949 MJ/m²
PENRE: 2.400 MJ/m²
PENRM: 548 MJ/m²
PERT: 126 MJ/m²
PERE: 126 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 273 kg CO_2 equ./m²
GWP-fossil: 273 kg CO_2 equ./m²
GWP-biogenic: -0,0225 kg CO_2 equ./m²
AP: 0,591 kg SO_2 equ./m²
EP: 0,321 kg PO_4^{3-}/m²
POCP: 0,134 kg C_2H_4/m²
ODP: 9,04·10⁻⁶ kg CFC-11/m²

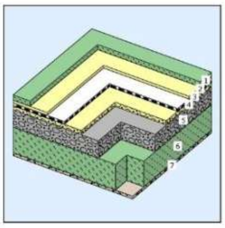
no.	layer	d cm	Useful life >b
1	Estrichbeton, Beton bewehrt SN46, 2,300.0 kg/m³ *(Quarzolith Zementestrich E400)*	7,00	50
2	EPS Systemplatte W T, Dämmung hart, 15.0 kg/m³ *(Bachl EPS W-15)*	3,00	50
3	Dampfbremse, Folie, 1,200.0 kg/m³ *(Würth Dampfbremse Wütop DB 2)*	0,06	25
4	EPS-Granulat, Füllstoff SN56, 15.0 kg/m³ *(Cement-bonded EPS granulate (99 kg/m³))*	3,00	[1]50
5	Bituminous moisture sealing ALGV, sealant SN59, 1,100.0 kg/m³ *(BITALBIT E-ALGV-4K)*	0,38	[1]50
6	Stahlbeton Decke, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	80,00	100
7	XPS, Dämmung hart, 28.0 kg/m³ *(AUSTROTHERM XPS PLUS 30 SF)*	12,00	[1]100
	building element	**105,44**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

DE04_Forum (30358)



Fläche: 149,6 m²
mass: 1245,2 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

U value [2]: 0,412 W/m²K

PENRT: 1.081 MJ/m²
PENRE: 958 MJ/m²
PENRM: 124 MJ/m²
PERT: 52,2 MJ/m²
PERE: 52,2 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 116 kg CO_2 equ./m²
GWP-fossil: 116 kg CO_2 equ./m²
GWP-biogenic: -0,00900 kg CO_2 equ./m²
AP: 0,241 kg SO_2 equ./m²
EP: 0,135 kg PO_4^{3-}/m²
POCP: 0,0499 kg C_2H_4/m²
ODP: 3,00·10⁻⁶ kg CFC-11/m²

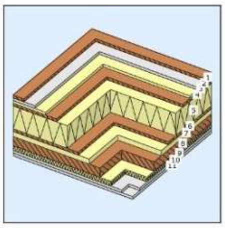
no.	layer	d cm	Useful life >b
1	Betonplatten, Massiv 25 %, 1,400.0 kg/m³ *(Concrete slabs)*	6,00	50
2	EPS system board W T, hard insulation, 15.0 kg/m³ *(Bachl EPS W-15)*	3,00	[1]100
3	Polyethylen Folien, Dichtstoff SN59, 1,100.0 kg/m³ *(Polyethylene (PE) sealing sheeting)*	0,15	[1]100
4	EPS-Granulat, Füllstoff SN56, 15.0 kg/m³ *(Cement-bonded EPS granulate (99 kg/m³))*	5,00	[1]100
5	Gravel *(Fillings made of sand, gravel, grit (1800 kg/m³))*	20,30	[1]100
6	Stahlbeton Decke, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	30,00	100
7	Spachtelung, Leer, 1,800.0 kg/m³ *(CR lime cement finish plaster (1800 kg/m³))*	0,50	35
	building element	**64,95**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

DE05_Decke Wohnung gegen Wohnung (30358)



Fläche: 1415,7 m²
mass: 173,5 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 3.162 MJ/m²
PENRE: 3.027 MJ/m²
PENRM: 135 MJ/m²
PERT: 3.010 MJ/m²
PERE: 979 MJ/m²
PERM: 2.031 MJ/m²
GWP-total: 60,4 kg CO_2 equ./m²
GWP-fossil: 208 kg CO_2 equ./m²
GWP-biogenic: -148 kg CO_2 equ./m²
AP: 1,53 kg SO_2 equ./m²
EP: 0,476 kg PO_4^{3-}/m²
POCP: 0,356 kg C_2H_4/m²
ODP: $1{,}51 \cdot 10^{-5}$ kg CFC-11/m²

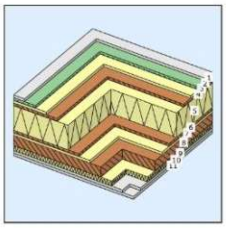
no.	layer	d cm	Useful life >b
1	Parkett, Vollholz SN21, 700.0 kg/m³ *(Solid parquet)*	2,00	50
2	Gipsfaser Estrich-Elemente, Beton bewehrt SN46, 2,300.0 kg/m³ *(FERMACELL Gipsfaser Estrich-Elemente)*	2,50	50
3	Trittschalldämmung, Dämmung hart, 64.0 kg/m³ *(ISOVER Trittschall-Dämmplatte S TDPS)*	2,00	50
4	OSB, Holzwerkstoff SN23, 610.0 kg/m³ *(SterlingOSB/3-Zero)*	2,20	50
5	Holzkonstruktion inzw. Wärmedämmung, Dämmung hart, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	24,50	[1]50
6	OSB, Holzwerkstoff SN23, 610.0 kg/m³ *(SterlingOSB/3-Zero)*	1,50	50
7	Trittschalldämmung, Dämmung hart, 64.0 kg/m³ *(ISOVER Trittschall-Dämmplatte S TDPS)*	5,50	50
8	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
9	Mineralwolle weich, Dämmstoff SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	5,00	50
10	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
11	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**58,20**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

DE05a_Decke Wohnung gegen Naßzelle (30358)



Fläche: 163,2 m²
mass: 164,7 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 3.104 MJ/m²
PENRE: 2.984 MJ/m²
PENRM: 119 MJ/m²
PERT: 2.181 MJ/m²
PERE: 508 MJ/m²
PERM: 1.672 MJ/m²
GWP-total: 82,8 kg CO_2 equ./m²
GWP-fossil: 204 kg CO_2 equ./m²
GWP-biogenic: -121 kg CO_2 equ./m²
AP: 1,28 kg SO_2 equ./m²
EP: 0,411 kg PO_4^{3-}/m²
POCP: 0,345 kg C_2H_4/m²
ODP: $1{,}52 \cdot 10^{-5}$ kg CFC-11/m²

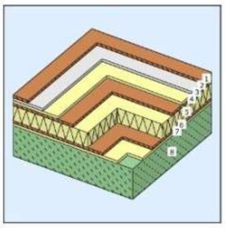
no.	layer	d cm	Useful life >b
1	White tiles, empty, 1,750.0 kg/m³ *(Ceramic tiles (2300 kg/m³))*	1,00	50
2	Screed *(Quarzolith Zementestrich E400)*	0,50	50
3	Impact sound insulation *(ISOVER Trittschall-Dämmplatte S TDPS)*	2,00	50
4	OSB, wood material SN23, 610.0 kg/m³ *(SterlingOSB/3-Zero)*	2,20	50
5	Wooden construction including thermal insulation, hard insulation, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	24,50	[1]50
6	OSB, wood material SN23, 610.0 kg/m³ *(SterlingOSB/3-Zero)*	2,20	50
7	Impact sound insulation *(ISOVER Trittschall-Dämmplatte S TDPS)*	2,00	50
8	CLT, solid wood SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
9	Soft mineral wool, insulation material SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	5,00	50
10	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
11	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**52,40**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

DE05b_Decke Wohnung 1OG (30358)



Fläche: 288,4 m²
mass: 1294,3 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 3.165 MJ/m²
PENRE: 3.082 MJ/m²
PENRM: 83,3 MJ/m²
PERT: 1.979 MJ/m²
PERE: 760 MJ/m²
PERM: 1.219 MJ/m²
GWP-total: 207 kg CO_2 equ./m²
GWP-fossil: 275 kg CO_2 equ./m²
GWP-biogenic: -68,1 kg CO_2 equ./m²
AP: 1,34 kg SO_2 equ./m²
EP: 0,477 kg PO_4^{3-}/m²
POCP: 0,342 kg C_2H_4/m²
ODP: $1{,}26 \cdot 10^{-5}$ kg CFC-11/m²

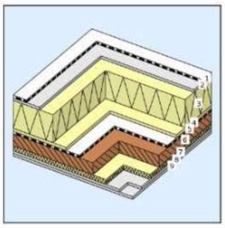
no.	layer	d cm	Useful life >b
1	Parquet, solid wood SN21, 700.0 kg/m³ *(Solid parquet)*	2,00	50
2	Gypsum fiber screed elements, concrete reinforced SN46, 2,300.0 kg/m³ *(FERMACELL Gipsfaser Estrich-Elemente)*	2,50	50
3	Impact sound insulation *(ISOVER Trittschall-Dämmplatte S TDPS)*	2,00	50
4	OSB, wood material SN23, 610.0 kg/m³ *(SterlingOSB/3-Zero)*	2,20	50
5	Wooden construction including thermal insulation, hard insulation, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	24,50	[1]50
6	OSB, wood material SN23, 610.0 kg/m³ *(SterlingOSB/3-Zero)*	1,50	50
7	Impact sound insulation *(ISOVER Trittschall-Dämmplatte S TDPS)*	2,00	50
8	Concrete reinforced, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	50,00	100
	building element	**86,70**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

DE06_Extensives Gründach mit reduziertem Aufbau (30358)



Fläche: 243,9 m²
mass: 103,1 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 5.636 MJ/m²
PENRE: 3.612 MJ/m²
PENRM: 2.024 MJ/m²
PERT: 1.343 MJ/m²
PERE: 366 MJ/m²
PERM: 977 MJ/m²
GWP-total: 140 kg CO_2 equ./m²
GWP-fossil: 235 kg CO_2 equ./m²
GWP-biogenic: -95,3 kg CO_2 equ./m²
AP: 1,24 kg SO_2 equ./m²
EP: 0,340 kg PO_4^{3-}/m²
POCP: 0,384 kg C_2H_4/m²
ODP: $1{,}99 \cdot 10^{-5}$ kg CFC-11/m²

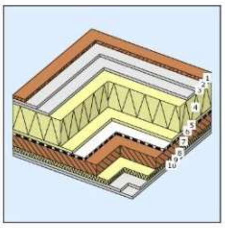
no.	layer	d cm	Useful life >b
1	Dachdichtung, Folie, 1,200.0 kg/m³ *(Enkolan Abdichtung 1K LF)*	0,10	[1]25
2	EPDM-Abdichtung, Dichtstoff SN59, 1,100.0 kg/m³ *(COVERiT NOVOtan ® EPDM DA-K Rollenware 1,3/1,5 mm)*	0,13	25
3	Gefälledämmung, Dämmung hart, 15.0 kg/m³ *(AUSTROTHERM EPS W30)*	28,00	[1]25
4	Trittschalldämmung TDPT 30, Dämmung hart, 64.0 kg/m³ *(ISOVER Trittschall-Dämmplatte S TDPS)*	3,00	[1]25
5	Bituminous moisture sealing ALGV, sealant SN59, 1,100.0 kg/m³ *(BITALBIT E-ALGV-4K)*	0,38	[1]25
6	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	12,00	100
7	Mineralwolle weich, Dämmstoff SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	5,00	50
8	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
9	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**51,61**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

DE07_Decke unter Freibereich (30358)



Fläche: 468,9 m²
mass: 126,0 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 7.699 MJ/m²
PENRE: 4.495 MJ/m²
PENRM: 3.204 MJ/m²
PERT: 1.894 MJ/m²
PERE: 426 MJ/m²
PERM: 1.468 MJ/m²
GWP-total: 173 kg CO_2 equ./m²
GWP-fossil: 290 kg CO_2 equ./m²
GWP-biogenic: -117 kg CO_2 equ./m²
AP: 1,51 kg SO_2 equ./m²
EP: 0,474 kg PO_4^{3-}/m²
POCP: 0,427 kg C_2H_4/m²
ODP: 2,29·10⁻⁶ kg CFC-11/m²

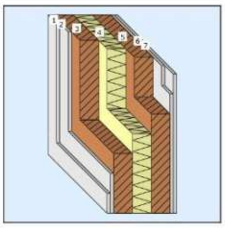
no.	layer	d cm	Useful life >b
1	Wooden covering on substructure *(Rema 3-Schicht Massivholzplatte nord. Fichte)*	3,20	50
2	Rubber granulate mat *(Rubber granulate mat)*	1,50	25
3	EPDM sealing *(COVERiT NOVOtan ® EPDM DA-K Rollenware 1,3/1,5 mm)*	0,15	25
4	Sloped insulation, hard insulation, 15.0 kg/m³ *(AUSTROTHERM EPS W30)*	28,00	[1]25
5	Impact sound insulation TDPT 30, hard insulation, 64.0 kg/m³ *(ISOVER Trittschall-Dämmplatte S TDPS)*	3,00	[1]25
6	Bituminous moisture sealing ALGV, sealant SN59, 1,100.0 kg/m³ *(BITALBIT E-ALGV-4K)*	0,38	[1]25
7	CLT, solid wood SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	12,00	100
8	Soft mineral wool, insulation material SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	5,00	50
9	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
10	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**56,23**	

[1] deviating from service life catalogue [2] U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

IW01_ Wohnung gegen Wohnung (30360)



Fläche: 328,7 m²
mass: 159,5 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 1.510 MJ/m²
PENRE: 1.468 MJ/m²
PENRM: 41,5 MJ/m²
PERT: 2.133 MJ/m²
PERE: 529 MJ/m²
PERM: 1.604 MJ/m²
GWP-total: -69,3 kg CO_2 equ./m²
GWP-fossil: 89,6 kg CO_2 equ./m²
GWP-biogenic: -159 kg CO_2 equ./m²
AP: 0,446 kg SO_2 equ./m²
EP: 0,177 kg PO_4^{3-}/m²
POCP: 0,130 kg C_2H_4/m²
ODP: 8,37·10⁻⁶ kg CFC-11/m²

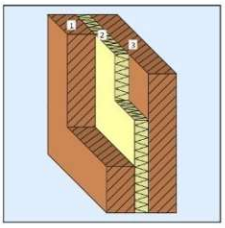
no.	layer (from inside to outside)	d cm	Useful life >b
1	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
2	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
3	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
4	Heralan-TW, Dämmung hart, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	10,00	[1]100
5	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
6	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
7	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**36,00**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

IW02_ Modultrennwand (30360)



Fläche: 580,9 m²
mass: 80,2 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 703 MJ/m²
PENRE: 670 MJ/m²
PENRM: 33,2 MJ/m²
PERT: 1.599 MJ/m²
PERE: 316 MJ/m²
PERM: 1.283 MJ/m²
GWP-total: -83,9 kg CO_2 equ./m²
GWP-fossil: 41,6 kg CO_2 equ./m²
GWP-biogenic: -125 kg CO_2 equ./m²
AP: 0,245 kg SO_2 equ./m²
EP: 0,100 kg PO_4^{3-}/m²
POCP: 0,0752 kg C_2H_4/m²
ODP: 3,66·10⁻⁶ kg CFC-11/m²

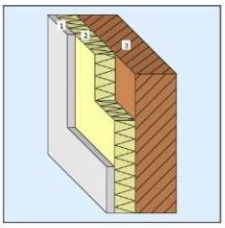
no.	layer (from inside to outside)	d cm	Useful life >b
1	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	8,00	100
2	Heralan-TW, Dämmung hart, 115.0 kg/m³ *(Rock wool MW(SW)-PT 5 (105 kg/m³))*	4,00	[1]100
3	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	8,00	100
	building element	**20,00**	

[1] deviating from service life catalogue

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

IW02a_ Modultrennwand einseitig (30360)



Fläche: 143 m²
mass: 53,3 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

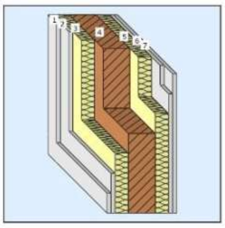
PENRT: 472 MJ/m²
PENRE: 451 MJ/m²
PENRM: 20,8 MJ/m²
PERT: 836 MJ/m²
PERE: 191 MJ/m²
PERM: 644 MJ/m²
GWP-total: -34,7 kg CO_2 equ./m²
GWP-fossil: 28,6 kg CO_2 equ./m²
GWP-biogenic: -63,3 kg CO_2 equ./m²
AP: 0,142 kg SO_2 equ./m²
EP: 0,0594 kg PO_4^{3-}/m²
POCP: 0,0309 kg C_2H_4/m²
ODP: $2{,}78 \cdot 10^{-8}$ kg CFC-11/m²

no.	layer (from inside to outside)	d cm	Useful life >b
1	GKF, gypsum board SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
2	Dachdämmung weich *(ROCKWOOL Termarock 40)*	4,00	50
3	CLT, solid wood SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	8,00	100
	building element	**13,50**	

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

IW03_ Gang gegen Wohnung (30360)



Fläche: 345,3 m²
mass: 104,5 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

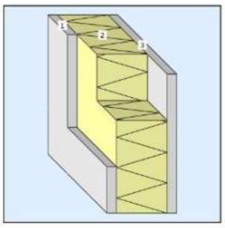
PENRT: 1.030 MJ/m²
PENRE: 1.010 MJ/m²
PENRM: 20,7 MJ/m²
PERT: 1.132 MJ/m²
PERE: 330 MJ/m²
PERM: 802 MJ/m²
GWP-total: -20,1 kg CO_2 equ./m²
GWP-fossil: 60,4 kg CO_2 equ./m²
GWP-biogenic: -80,5 kg CO_2 equ./m²
AP: 0,271 kg SO_2 equ./m²
EP: 0,108 kg PO_4^{3-}/m²
POCP: 0,0730 kg C_2H_4/m²
ODP: $5{,}96 \cdot 10^{-8}$ kg CFC-11/m²

no.	layer (from inside to outside)	d cm	Useful life >b
1	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
2	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
3	Trennwand Klemmfilz, Dämmstoff SN55, 40.0 kg/m³ *(KI Klemmplatte KP, KP-HB (ab Juni 2016))*	5,00	50
4	CLT, Vollholz SN21, 500.0 kg/m³ *(Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir))*	10,00	100
5	Trennwand Klemmfilz, Dämmstoff SN55, 40.0 kg/m³ *(KI Klemmplatte KP, KP-HB (ab Juni 2016))*	5,00	50
6	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
7	GKF, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**26,00**	

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

IW04_LB 10cm einfach Metallständerwand (30360)



Fläche: 1139,6 m²
mass: 30,5 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

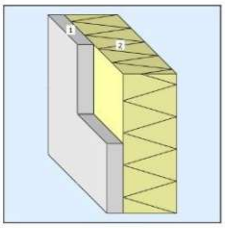
PENRT: 331 MJ/m²
PENRE: 322 MJ/m²
PENRM: 8,53 MJ/m²
PERT: 75,6 MJ/m²
PERE: 70,3 MJ/m²
PERM: 5,28 MJ/m²
GWP-total: 21,8 kg CO_2 equ./m²
GWP-fossil: 22,9 kg CO_2 equ./m²
GWP-biogenic: -1,09 kg CO_2 equ./m²
AP: 0,0878 kg SO_2 equ./m²
EP: 0,0318 kg PO_4^{3-}/m²
POCP: 0,00787 kg C_2H_4/m²
ODP: $2{,}21 \cdot 10^{-8}$ kg CFC-11/m²

no.	layer (from inside to outside)	d cm	Useful life >b
1	Gipskarton, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
2	Mineralwolle weich, Dämmstoff SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	8,00	50
3	Gipskarton, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**11,00**	

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

IW04a_LB 6,25cm einfach Vorsatzschale (30360)



Fläche: 108,8 m²
mass: 15,7 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

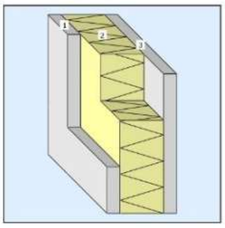
PENRT: 174 MJ/m²
PENRE: 169 MJ/m²
PENRM: 5,33 MJ/m²
PERT: 39,1 MJ/m²
PERE: 35,8 MJ/m²
PERM: 3,30 MJ/m²
GWP-total: 12,0 kg CO_2 equ./m²
GWP-fossil: 12,5 kg CO_2 equ./m²
GWP-biogenic: -0,550 kg CO_2 equ./m²
AP: 0,0500 kg SO_2 equ./m²
EP: 0,0176 kg PO_4^{3-}/m²
POCP: 0,00436 kg C_2H_4/m²
ODP: $1,16\cdot10^{-6}$ kg CFC-11/m²

no.	layer (from inside to outside)	d cm	Useful life >b
1	Gipskarton, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
2	Mineralwolle weich, Dämmstoff SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	5,00	50
	building element	**6,50**	

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

IW04b_LB 7,5cm Vorsatzschale (30360)



Fläche: 100,8 m²
mass: 29,2 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 304 MJ/m²
PENRE: 299 MJ/m²
PENRM: 5,33 MJ/m²
PERT: 71,6 MJ/m²
PERE: 68,3 MJ/m²
PERM: 3,30 MJ/m²
GWP-total: 18,6 kg CO_2 equ./m²
GWP-fossil: 19,7 kg CO_2 equ./m²
GWP-biogenic: -1,06 kg CO_2 equ./m²
AP: 0,0695 kg SO_2 equ./m²
EP: 0,0265 kg PO_4^{3-}/m²
POCP: 0,00658 kg C_2H_4/m²
ODP: $2,02\cdot10^{-6}$ kg CFC-11/m²

no.	layer (from inside to outside)	d cm	Useful life >b
1	Gipskarton, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
2	Mineralwolle weich, Dämmstoff SN55, 40.0 kg/m³ *(ROCKWOOL Termarock 40)*	5,00	50
3	Gipskarton, Gipsplatte SN45, 900.0 kg/m³ *(Gypsum wallboards (900 kg/m³))*	1,50	50
	building element	**8,00**	

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

STB Stütze (30358)

quantity: 35,275 m³
service life: yes, with integer replacements rates (according to EN 15804 standard)

PENRT: 17,6 MJ/m²GFA
PENRE: 17,6 MJ/m²GFA
PENRM: 0,00 MJ/m²GFA
PERT: 0,940 MJ/m²GFA
PERE: 0,940 MJ/m²GFA
PERM: 0,00 MJ/m²GFA
GWP-total: 2,34 kg CO_2 equ./m²GFA
GWP-fossil: 2,34 kg CO_2 equ./m²GFA
GWP-biogenic: 0,00 kg CO_2 equ./m²GFA
AP: 0,00422 kg SO_2 equ./m²GFA
EP: 0,00280 kg PO_4^{3-}/m²GFA
POCP: 0,000672 kg C_2H_4/m²GFA
ODP: $5,42\cdot10^{-8}$ kg CFC-11/m²GFA

components (without component structure) (quantity per m³ building elen	Useful life >b
2400 kg ÖKOBETON C25/30 XC1	100

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

STB Unterzug (30358)

quantity: 1,6 m³
service life: yes, with integer replacements rates (according to EN 15804 standard)

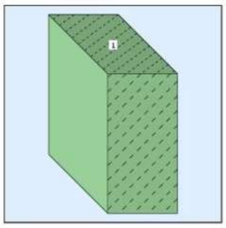
PENRT: 0,799 MJ/m²GFA
PENRE: 0,799 MJ/m²GFA
PENRM: 0,00 MJ/m²GFA
PERT: 0,0426 MJ/m²GFA
PERE: 0,0426 MJ/m²GFA
PERM: 0,00 MJ/m²GFA
GWP-total: 0,106 kg CO_2 equ./m²GFA
GWP-fossil: 0,106 kg CO_2 equ./m²GFA
GWP-biogenic: 0,00 kg CO_2 equ./m²GFA
AP: 0,000191 kg SO_2 equ./m²GFA
EP: 0,000127 kg PO_4^{3-}/m²GFA
POCP: $3{,}05 \cdot 10^{-5}$ kg C_2H_4/m²GFA
ODP: $2{,}46 \cdot 10^{-9}$ kg CFC-11/m²GFA

components (without component structure) (quantity per m³ building elen	**Useful life >b**
2400 kg ÖKOBETON C25/30 XC1	100

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

STB Wand 25 cm KG (30358)



Fläche: 199,4 m²
mass: 600,0 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

U value ¹ 3,922 W/m²K

PENRT: 447 MJ/m²
PENRE: 447 MJ/m²
PENRM: 0,00 MJ/m²
PERT: 23,8 MJ/m²
PERE: 23,8 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 59,2 kg CO_2 equ./m²
GWP-fossil: 59,2 kg CO_2 equ./m²
GWP-biogenic: 0,00 kg CO_2 equ./m²
AP: 0,107 kg SO_2 equ./m²
EP: 0,0709 kg PO_4^{3-}/m²
POCP: 0,0170 kg C_2H_4/m²
ODP: $1{,}37 \cdot 10^{-6}$ kg CFC-11/m²

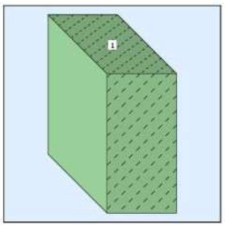
no.	**layer** (from inside to outside)	d cm	**Useful life >b**
1	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	25,00	100
	building element	**25,00**	

¹ U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

Project name: **Case Study 100 years**

STB Wand 50 cm KG (30358)



Fläche: 44 m²
mass: 1200,0 kg/m²
service life: yes, with integer replacements rates (according to EN 15804 standard)

U value ¹ 2,632 W/m²K

PENRT: 893 MJ/m²
PENRE: 893 MJ/m²
PENRM: 0,00 MJ/m²
PERT: 47,7 MJ/m²
PERE: 47,7 MJ/m²
PERM: 0,00 MJ/m²
GWP-total: 118 kg CO_2 equ./m²
GWP-fossil: 118 kg CO_2 equ./m²
GWP-biogenic: 0,00 kg CO_2 equ./m²
AP: 0,214 kg SO_2 equ./m²
EP: 0,142 kg PO_4^{3-}/m²
POCP: 0,0341 kg C_2H_4/m²
ODP: $2{,}75 \cdot 10^{-6}$ kg CFC-11/m²

no.	**layer** (from inside to outside)	d cm	**Useful life >b**
1	Stahlbeton Wand, Beton bewehrt SN46, 2,400.0 kg/m³ *(ÖKOBETON C25/30 XC1)*	50,00	100
	building element	**50,00**	

¹ U value (Heat transfer coefficient) calculated according to ÖNORM EN ISO 6946.

15. 09. 2024, Margarita Fedorova (TU Wien)

List of materials

material	mass kg	mass-percentage	cumulated percentage	Building material ID	Density kg/m³	λ-Value W/m²K	PENRT MJ/FU (functional unit)	PENRE MJ/FU (functional unit)	PENRM MJ/FU (functional unit)	PERT MJ/FU (functional unit)	PERE MJ/FU (functional unit)	PERM MJ/FU (functional unit)	GWP-total kg CO_2 equ./FU (functional unit)	GWP-fossil kg CO_2 equ./FU (functional unit)	GWP-biogenic kg CO_2 equ./FU (functional unit)	AP kg SO_2 equ./FU (functional unit)	EP kg PO_4^{3-}/FU (functional unit)	POCP kg C_2H_4/FU (functional unit)	ODP kg CFC-11/FU (functional unit)	FU (functional unit)
ÖKOBETON C25/30 XC1	2.409.240	68,2%	68,2%	P2142732948	2.400	2,000	0,744	0,744	0,00	0,0397	0,0397	0,00	0,0987	0,0987	0,00	0,000178	0,000118	$2,84\cdot10^{5}$	$2,29\cdot10^{9}$	kg
Laminated timber, glued external use (475 kg/m³ - e.g. spruce/fir)	292.139	8,3%	76,5%	R2142715634	475	0,120	8,07	7,64	0,436	21,0	4,11	16,9	-1,20	0,451	-1,65	0,00257	0,00115	0,000710	$4,42\cdot10^{8}$	kg
Gypsum wallboards (900 kg/m³)	179.874	5,1%	81,6%	R2142714767	900	0,320	4,80	4,80	0,00	1,20	1,20	0,00	0,226	0,264	-0,0380	0,000719	0,000328	$8,23\cdot10^{5}$	$3,18\cdot10^{8}$	kg
Quarzolith Zementestrich E400	93.776	2,7%	84,2%	P2142721699	2.000	1,520	1,34	1,34	0,00	0,124	0,124	0,00	0,151	0,151	0,00	0,000315	0,000204	$4,82\cdot10^{5}$	$4,85\cdot10^{9}$	kg
Rock wool MW(SW)-PT 5 (105 kg/m³)	90.665	2,6%	86,8%	R2142714906	105	0,038	21,3	21,3	0,00	0,785	0,785	0,00	1,74	1,74	0,00	0,0118	0,00311	0,00506	$7,01\cdot10^{8}$	kg
Fillings made of sand, gravel, grit (1800 kg/m³)	88.005	2,5%	89,3%	R2142715135	1.800	0,700	0,104	0,104	0,00	0,00262	0,00262	0,00	0,00708	0,00708	0,00	$4,83\cdot10^{5}$	$1,46\cdot10^{5}$	$5,24\cdot10^{6}$	$7,53\cdot10^{10}$	kg
Concrete slabs	65.837	1,9%	91,2%	R2142727922	2.400	2,000	0,702	0,702	0,00	0,0374	0,0374	0,00	0,0926	0,0926	0,00	0,000169	0,000111	$2,68\cdot10^{5}$	$2,19\cdot10^{9}$	kg
Konstruktionsvollholz (KVH)	57.081	1,6%	92,8%	P2142718934	475	0,120	3,59	3,59	0,00	20,3	3,08	17,2	-1,44	0,210	-1,65	0,00128	0,000583	0,000508	$1,81\cdot10^{8}$	kg
FERMACELL Gipsfaser Estrich-Elemente	48.993	1,4%	94,2%	P2142704485	1.150	0,320	5,40	5,40	0,00	3,23	3,23	0,00	0,0845	0,376	-0,292	0,00157	0,000485	0,000132	$3,85\cdot10^{8}$	kg
SterlingOSB/3-Zero	42.140	1,2%	95,3%	P2142703692	600	0,130	8,56	7,35	1,20	19,5	3,17	16,3	-1,15	0,418	-1,57	0,00210	0,000808	0,000452	$3,53\cdot10^{8}$	kg
Fibre cement panels (2000 kg/m³)	38.878	1,1%	96,4%	R2142714823	2.000	1,500	13,2	13,2	0,00	1,56	1,56	0,00	0,947	1,01	-0,0650	0,00300	0,00189	0,000521	$4,71\cdot10^{8}$	kg
Timber (675 kg/m³ - e.g. oak) - planed, technically dried	37.449	1,1%	97,5%	R2142715109	675	0,160	2,68	2,68	0,00	21,6	5,08	16,5	-1,50	0,154	-1,66	0,000947	0,000447	0,000322	$1,30\cdot10^{8}$	kg
Solid parquet	25.221	0,7%	98,2%	R2142684313	740	0,160	8,49	8,49	0,00	28,1	11,6	16,5	-1,19	0,488	-1,68	0,00333	0,00145	0,000380	$4,10\cdot10^{8}$	kg
ISOVER Trittschall-Dämmplatte S TDPS	10.339	0,3%	98,5%	P2142723365	71	0,032	40,9	35,6	5,25	1,88	0,550	1,33	2,12	2,12	0,00	0,0423	0,0121	0,00155	$2,20\cdot10^{7}$	kg
ROCKWOOL Termarock 40	9.861	0,3%	98,8%	P2142717911	44	0,034	10,1	8,90	1,21	1,51	0,760	0,750	1,21	1,23	-0,0170	0,00696	0,00200	0,000486	$6,94\cdot10^{8}$	kg
Rema 3-Schicht Massivholzplatte nord. Fichte	6.752	0,2%	99,0%	P2142704948	450	0,120	9,20	8,83	0,374	17,7	0,633	17,1	-1,01	0,510	-1,52	0,00288	0,00138	0,00104	$4,41\cdot10^{8}$	kg
AUSTROTHERM EPS W30	5.489	0,2%	99,1%	P2142711067	28	0,035	98,9	58,9	40,0	0,959	0,959	0,00	4,21	4,21	0,00	0,0149	0,00261	0,00914	$1,32\cdot10^{7}$	kg
BITALBIT E-ALGV-4K	5.151	0,1%	99,3%	P2142735114	1.100	0,230	41,6	17,2	24,4	0,664	0,664	0,00	0,822	0,824	-0,00200	0,00556	0,00182	0,00114	$3,16\cdot10^{7}$	kg
Rubber granulate mat	4.501	0,1%	99,4%	R2142684398	640	0,170	51,5	19,7	31,8	1,20	1,20	0,00	1,29	1,29	0,00	0,00566	0,00266	0,000547	$3,31\cdot10^{8}$	kg
Ceramic tiles (2300 kg/m³)	4.375	0,1%	99,5%	R2142715203	2.300	1,300	13,2	13,2	0,00	0,680	0,680	0,00	0,781	0,781	0,00	0,00277	0,00119	0,000237	$9,17\cdot10^{8}$	kg
AUSTROTHERM EPS W30 PLUS	3.286	0,1%	99,6%	P2142686797	28	0,030	98,9	58,9	40,0	0,959	0,959	0,00	4,21	4,21	0,00	0,0149	0,00261	0,00914	$1,32\cdot10^{7}$	kg
Würth Dampfbremse Wütop DB 2	2.684	0,1%	99,7%	P2142718757	1.160	0,330	86,0	43,5	42,5	1,30	1,30	0,00	2,84	2,86	-0,0210	0,00832	0,00161	0,00248	$3,91\cdot10^{8}$	kg
Cement-bonded EPS granulate (99 kg/m³)	2.187	0,1%	99,8%	R2142715090	99	0,047	25,1	16,0	9,11	0,300	0,300	0,00	1,31	1,31	0,00	0,00394	0,000967	0,00219	$3,57\cdot10^{8}$	kg
CR lime cement finish plaster (1800 kg/m³)	2.065	0,1%	99,8%	R2142714798	1.800	1,050	1,43	1,43	0,00	0,286	0,286	0,00	0,153	0,154	-0,00100	0,000348	0,000179	$4,87\cdot10^{5}$	$6,49\cdot10^{9}$	kg
AUSTROTHERM XPS PLUS 30 SF	1.753	0,0%	99,9%	P2142721407	30	0,032	93,6	53,6	40,0	0,879	0,879	0,00	4,24	4,24	0,00	0,0155	0,00257	0,00816	$6,13\cdot10^{8}$	kg
COVERiT NOVOtan ® EPDM DA-K Rollenware 1,3/1,5 mm	1.749	0,0%	99,9%	P2142716922	1.200	0,170	83,8	47,9	35,9	1,89	1,89	0,00	2,60	2,65	-0,0460	0,0107	0,00370	0,00221	$6,42\cdot10^{7}$	kg
KI Klemmplatte KP, KP-HB (ab Juni 2016)	1.036	0,0%	100,0%	P2142722586	30	0,038	21,3	21,3	0,00	0,785	0,785	0,00	1,74	1,74	0,00	0,0118	0,00311	0,00506	$7,01\cdot10^{8}$	kg
Synthesa Capatect Klebespachtel 160	438	0,0%	100,0%	P2142731707	1.850	1,310	26,9	18,6	8,33	0,607	0,607	0,00	1,08	1,09	-0,00500	0,00414	0,00155	0,000896	$9,72\cdot10^{8}$	kg
Enkolan Abdichtung 1K LF	317	0,0%	100,0%	P2142719726	1.300	0,500	49,9	33,3	16,5	1,25	1,25	0,00	2,33	2,33	0,00	0,00927	0,00211	0,00186	$1,95\cdot10^{8}$	kg
Bachl EPS W-15	271	0,0%	100,0%	P2142705761	14	0,042	98,9	58,9	40,0	0,959	0,959	0,00	4,21	4,21	0,00	0,0149	0,00261	0,00914	$1,32\cdot10^{7}$	kg
Polyethylene (PE) sealing sheeting	268	0,0%	100,0%	R2142712507	980	0,500	69,7	27,3	42,5	1,53	1,53	0,00	2,09	2,09	0,00	0,00788	0,00152	0,00274	$3,03\cdot10^{8}$	kg
ROCKWOOL Steelrock 040	103	0,0%	100,0%	P2142717905	28	0,039	10,1	8,90	1,21	1,51	0,760	0,750	1,21	1,23	-0,0170	0,00696	0,00200	0,000486	$6,94\cdot10^{8}$	kg
Glass wool MW(GW)-W (15 kg/m³)	85	0,0%	100,0%	R2142714916	15	0,040	45,7	45,7	0,00	2,11	2,11	0,00	2,42	2,42	-0,00500	0,0150	0,00686	0,00165	$2,61\cdot10^{7}$	kg
Bachl EPS W-25	37	0,0%	100,0%	P2142705753	23	0,036	98,9	58,9	40,0	0,959	0,959	0,00	4,21	4,21	0,00	0,0149	0,00261	0,00914	$1,32\cdot10^{7}$	kg

Attachment G – Results – EU-Taxonomy

Material name in German (original)	Material name in English (translation)	Floor area [m²]	Volume [m³]	GWP-total, A1-A3 [kg CO2 eq.]	GWP-total, B4, 50 years [kg CO2 eq.]	GWP-total, B4, 100 years [kg CO2 eq.]	GWP-total, C1 [kg CO2 eq.]	GWP-total, C2 [kg CO2 eq.]	GWP-total, C3 [kg CO2 eq.]	GWP-total, C4 [kg CO2 eq.]
Brettschichtholz - Standardformen	Glued laminated timber - standard forms	6,256.8	613.8	-373,460.3	0.0	0.0	0.0	411.9	506,786.3	0.0
Konstruktionsvollholz	Solid structural timber		98.6	-63,347.9	0.0	0.0	0.0	63.2	80,454.3	0.0
Schnittholz	Sawn timber	1,849.7	77.1	-56,060.7	0.0	-40,883.1	0.0	111.8	58,696.5	0.0
Oriented Strand Board	Oriented strand board	3,734.6	69.1	-44,169.3	0.0	-44,169.3	0.0	56.9	67,929.4	0.0
Mehrschichtparkett (generisch)	Multi-layer parquet (generic)	2,173.0	48.1	-12,244.9	0.0	-12,244.9	0.0	196.9	29,124.1	0.0
Fliesenkleber	Tile adhesive	47.7	0.2	127.5	0.0	51.9	0.0	1.6	0.0	6.3
Kies (Korngröße 2/32)	Gravel (grain size 2/32)	473.4	48.9	237.0	0.0	0.0	26.5	294.3	612.0	0.0
Mineralwolle (Fassaden-Dämmung)	Mineral wool (facade insulation)	52.8	5.8	395.7	0.0	143.0	0.0	1.1	7.3	4.3
EPS-Hartschaum (Rohdichte 15 kg/m³)	EPS rigid foam (bulk density 15 kg/m³)	669.0	20.1	910.8	0.0	0.0	0.0	0.9	1,009.5	0.0
Gründach extensiv (ohne Geländer)	Extensive green roof (without railing)	243.9		1,032.2	1,032.2	3,096.6	0.1	100.1	1,344.4	6,046.3
Kunstharzputz	Synthetic resin plaster	229.7	1.1	1,332.3	1,332.3	2,664.5	0.0	7.9	0.0	31.4

Material name in German (original)	Material name in English (translation)	Floor area [m^2]	Volume [m^3]	GWP-total, A1-A3 [kg CO2 eq.]	GWP-total, B4, 50 years [kg CO2 eq.]	GWP-total, B4, 100 years [kg CO2 eq.]	GWP-total, C1 [kg CO2 eq.]	GWP-total, C2 [kg CO2 eq.]	GWP-total, C3 [kg CO2 eq.]	GWP-total, C4 [kg CO2 eq.]
PE-HD mit PP-Vlies zur Abdichtung	PE-HD with PP fleece for sealing	425.9	0.3	1,336.0	765.1	2,295.3	0.0	2.0	2,061.4	0.0
Keramische Fliesen und Platten	Ceramic tiles and panels	187.7	1.9	1,777.5	0.0	1,777.5	0.3	4.1	8.5	3.1
EPS-Hartschaum (Rohdichte 25 kg/m^3)	EPS rigid foam (bulk density 25 kg/m^3)	669.0	23.7	1,836.3	0.0	0.0	0.0	1.8	1,991.6	0.0
Bitumenbahnen G 200 S4	Bitumen sheets G 200 S4	988.3	9.9	2,632.8	1,249.1	3,833.8	0.0	21.7	0.0	416.6
Mineralwolle (Innenausbau-Dämmung)	Mineral wool (interior insulation)	2,183.6	128.4	5,044.1	213.7	5,257.7	0.0	13.6	92.6	55.0
EPS-Hartschaum (Rohdichte 30 kg/m^3)	EPS rigid foam (bulk density 30 kg/m^3)	291.4	58.3	5,113.5	0.0	0.0	0.0	5.3	5,886.3	0.0
A2-Betonpflaster-Standardstein grau mit Vorsatz	A2 concrete paving - standard stone gray with facing	473.4	27.4	6,860.7	0.0	6,860.7	167.0	631.0	291.4	0.0
EPDM-Dach- und Dichtungsbahnen EVALASTIC®V,VG, VSGK	EPDM roof and sealing sheets EVALASTIC®V,VG,VSGK	1,004.2	1.8	10,128.2	6,783.0	20,348.9	0.0	67.1	828.5	0.0
Extrudierter Polystyrol Dämmstoff	Extruded Polystyrene insulation	840.9	116.5	10,958.1	0.0	0.0	0.0	12.1	13,763.1	0.0

Material name in German (original)	Material name in English (translation)	Floor area [m^2]	Volume [m^3]	GWP-total, A1-A3 [kg CO2 eq.]	GWP-total, B4, 50 years [kg CO2 eq.]	GWP-total, B4, 100 years [kg CO2 eq.]	GWP-total, C1 [kg CO2 eq.]	GWP-total, C2 [kg CO2 eq.]	GWP-total, C3 [kg CO2 eq.]	GWP-total, C4 [kg CO2 eq.]
Trockenestrich - Gipsfaserplatte/Tool	Dry screed - gypsum fiberboard/tool	1,704.1	51.1	14,367.6	0.0	14,367.6	0.0	257.1	0.0	6,076.8
DuPont™ AirGuard® Dampfsperre (5816X)	DuPont™ AirGuard® vapor barrier (5816X)	3,883.7	1.8	14,405.8	0.0	400.9	0.0	0.0	0.0	2,148.9
Mineralwolle (Boden-Dämmung)	Mineral wool (floor insulation)	2,291.7	114.6	14,907.5	0.0	14,907.5	0.0	39.2	267.2	158.7
Zementestrich	Cement screed	974.0	54.2	14,935.5	0.0	2,247.3	0.0	259.9	0.0	1,221.0
Faserzementplatte	Fiber cement board	1,541.4	23.1	16,066.8	0.0	16,066.8	0.0	80.7	0.0	2,541.8
EPS-Hartschaum (Rohdichte 30 kg/m^3)	EPS rigid foam (density 30 kg/m^3)	712.8	192.5	16,266.4	16,266.4	48,799.1	0.0	17.1	19,438.1	0.0
Gummi-Bodenbelag mit Schaumstoffbeschichtung EN 1816	Rubber floor covering with foam coating EN 1816	468.9	7.0	20,274.1	20,274.1	60,822.2	0.0	5.8	5,148.5	0.0
ISOVER Trittschall-Dämmplatte S TDPS	ISOVER impact sound insulation board S TDPS	4,447.4	170.8	25,704.0	3,218.7	32,141.4	0.0	51.5	0.0	49.6
Rigips GaBi Duraline bzw. Riduro - 15 mm; 14,85 kg / m^2	Rigips GaBi Duraline or Riduro - 15 mm; 14.85 kg / m^2	13,116.9	196.0	30,180.5	0.0	30,180.5	636.4	609.3	0.0	12,891.3

Material name in German (original)	Material name in English (translation)	Floor area [m²]	Volume [m³]	GWP-total, A1-A3 [kg CO2 eq.]	GWP-total, B4, 50 years [kg CO2 eq.]	GWP-total, B4, 100 years [kg CO2 eq.]	GWP-total, C1 [kg CO2 eq.]	GWP-total, C2 [kg CO2 eq.]	GWP-total, C3 [kg CO2 eq.]	GWP-total, C4 [kg CO2 eq.]
Bewehrungsstahl	Reinforcing steel		18.7	35,249.6	0.0	0.0	47.0	521.5	0.0	0.0
ROCKWOOL Steinwolle-Dämmstoff im hohen Rohdichtebereich	ROCKWOOL rock wool insulation in the high-density range	4,712.9	854.1	167,920.1	4,449.5	102,206.5	0.0	435.6	0.0	2,101.1
Beton der Druckfestigkeitsklasse C 25/30	Concrete of compressive strength class C 25/30	2,303.6	993.1	195,631.8	0.0	0.0	3,078.5	11,916.7	5,968.3	0.0
				66,349.3	55,584.0	271,172.5	3,955.7	16,200.0	801,709.3	33,752.2