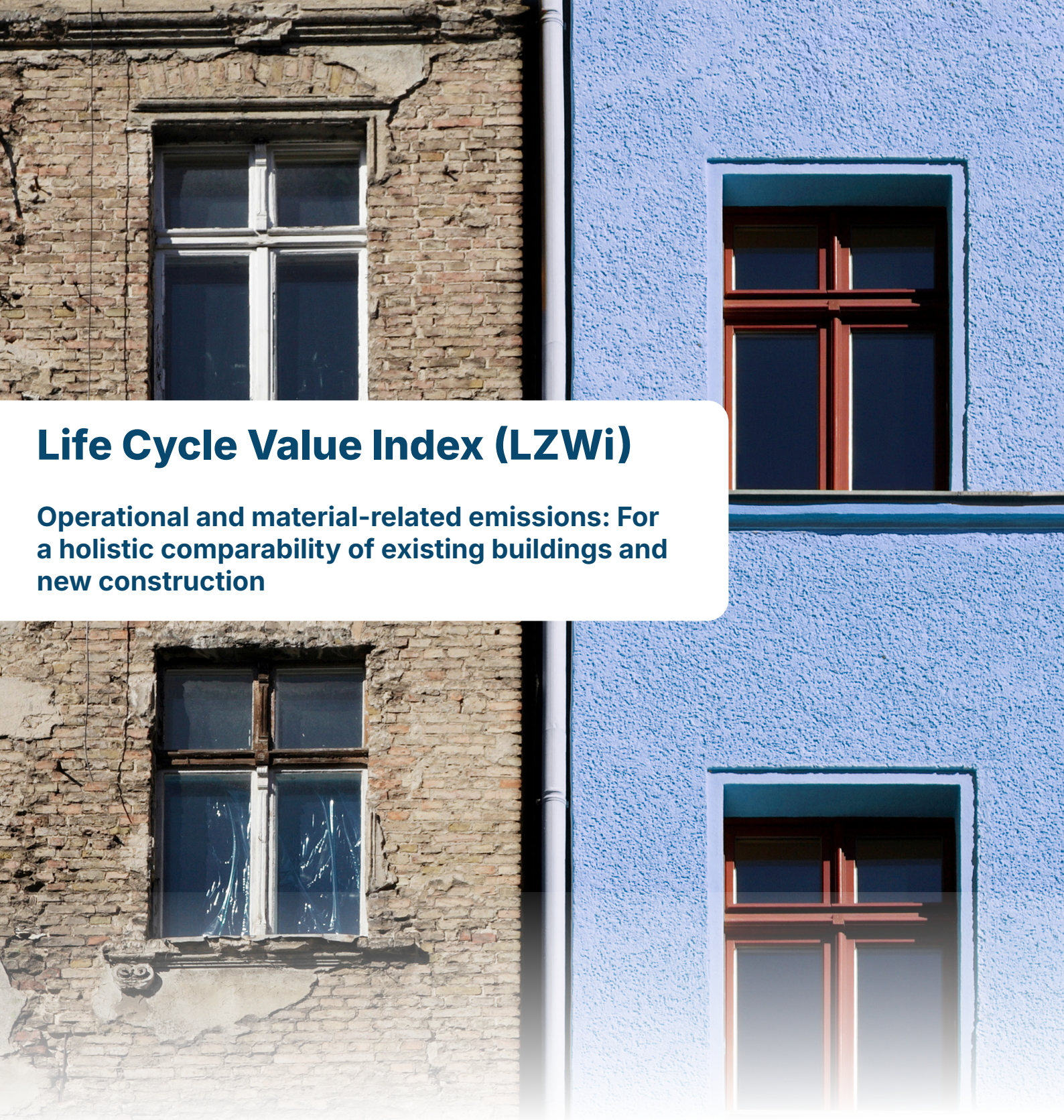

Life Cycle Value Index (LZWi)

Operational and material-related emissions: For a holistic comparability of existing buildings and new construction

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Executive Summary

The energy performance certificate currently focuses on operational emissions, meaning the energy demand during use, and ignores the so-called “grey” - structurally induced (material-related) - emissions that arise during material production. This results in renovations and the preservation of existing buildings not being adequately assessed with regard to their potential to save material-related emissions. The Life Cycle Value Wdings on a balance-sheet basis over their entire life cycle, including their existing structure. In contrast to current approaches, which represent a one-time static burden, the LZWi creates an ongoing annual and dynamic assessment method through the principle of depreciation. The loads assigned to the building are depreciated linearly over the remaining useful life and remain allocated to the building during this period.

Through a methodological separation and simplification (focusing on essential and identical cost groups and modules) of a classical LCA (Life Cycle Assessment - balancing the environmental impacts of a product) combined with the accounting concept of depreciation from finance, it becomes possible to evaluate any type of building in a comparable way. The material-related emissions that have already been emitted and are contained in the building are recognized in the sense of an “emissions backpack.” This has the effect of increasing the balance-sheet value of existing buildings, making the preservation of existing structures economically more attractive, since the amount of emissions to be depreciated is higher and would be transferred to the new building or the property in the event of demolition.

The Life Cycle Value Index creates transparency and equality - from existing buildings to new construction - by bringing together all emission sources on a simple, comprehensible, and uniform basis within a comprehensive assessment framework. This allows existing buildings, renovations, replacement construction, and new buildings - regardless of age or construction method - to be compared in terms of their environmental impact. Particularly through the inclusion of material-related emissions, existing buildings often perform significantly better, highlighting the ecological advantages of renovation compared to new construction.

The present development of the LZWi does not represent a final result, but the starting point of a necessary evolution. The introduction of the LZWi as a standard assessment tool for buildings is demanded. The goal is to create a steering effect by treating a building’s emissions as an accounting asset, thereby making the preservation of existing buildings economically more attractive. Integration into financial structures ensures that the ecological impact of a building does not “disappear” after completion but remains visible in the accounting system. This results in an economic revaluation of buildings and reduces false incentives created by viewing energy consumption in isolation and by considering emissions only once at completion.

Problem Statement and Objective

The energy performance certificate reports operational emissions - that is, the energy demand during use - and ignores the so-called “grey” - structurally induced (material-related) - emissions. These arise during material production. As a result, renovations and the preservation of existing buildings are currently not sufficiently promoted and are not adequately evaluated with regard to their potential for emission savings, because the material-related emissions contained in the building are neglected. The LZWi integrates both life phases, meaning that buildings are evaluated on a balance-sheet basis over their entire life cycle, including their existing structure. By linking operational and material-related emissions, it also follows the revised EPBD Directive and thus supports the implementation of the EU’s climate targets. The central aspect is that the LZWi creates a uniform and transparent basis for comparing existing buildings, replacement construction, and new buildings – by expanding the system boundaries and focusing on the essential, emission-intensive, long-lasting components such as the load-bearing structure and building envelope.

In contrast to current approaches, which represent a one-time static burden, the LZWi creates an ongoing annual and dynamic assessment method through the principle of depreciation. The loads assigned to the building are depreciated linearly over the remaining useful life and remain allocated to it during this period. Thus, the one-time burden is expanded into a long-term, balance-sheet component, making the potential of preserving existing buildings visible.

EU requirements: It provides a basis for compliance with EU directives, specifically the EPBD, for introducing limit values for the cumulative life-cycle greenhouse gas potential of new buildings. Additionally, it can be introduced - in accordance with the EPBD - as a potential renovation passport under Article 12.

Methodology of the Life Cycle Value Index

The LZWi combines a methodological calculation with physical data in order to provide a functional and practice-oriented methodology. This is based on a balance-sheet perspective, through which emissions are systematically recorded and depreciated over the service life of a building. This does not represent a full life-cycle assessment but rather a simplified instrument for the comparable recording of a building's emissions.

It is limited to the central life-cycle modules (A1–A3 for material production, C1–C4 for deconstruction, as well as B6 for operational energy) and to the mass-intensive and long-lasting components: the load-bearing structure and the building envelope. Complex factors such as future credits for recycling or life cycles of materials are not considered in detail. Additionally, the methodology of the LZWi is limited to the fossil emissions of materials in order to ensure equal treatment of all materials in phase A1–A3, by not crediting any carbon storage in the production phase. The calculated emissions are converted to the building's total gross floor area to ensure comparability between existing buildings, renovations, and new construction.

Through this methodological separation and simplification of a classical LCA, combined with the balance-sheet and accounting concept of depreciation from finance, it becomes possible to evaluate any type of building in a comparable way.

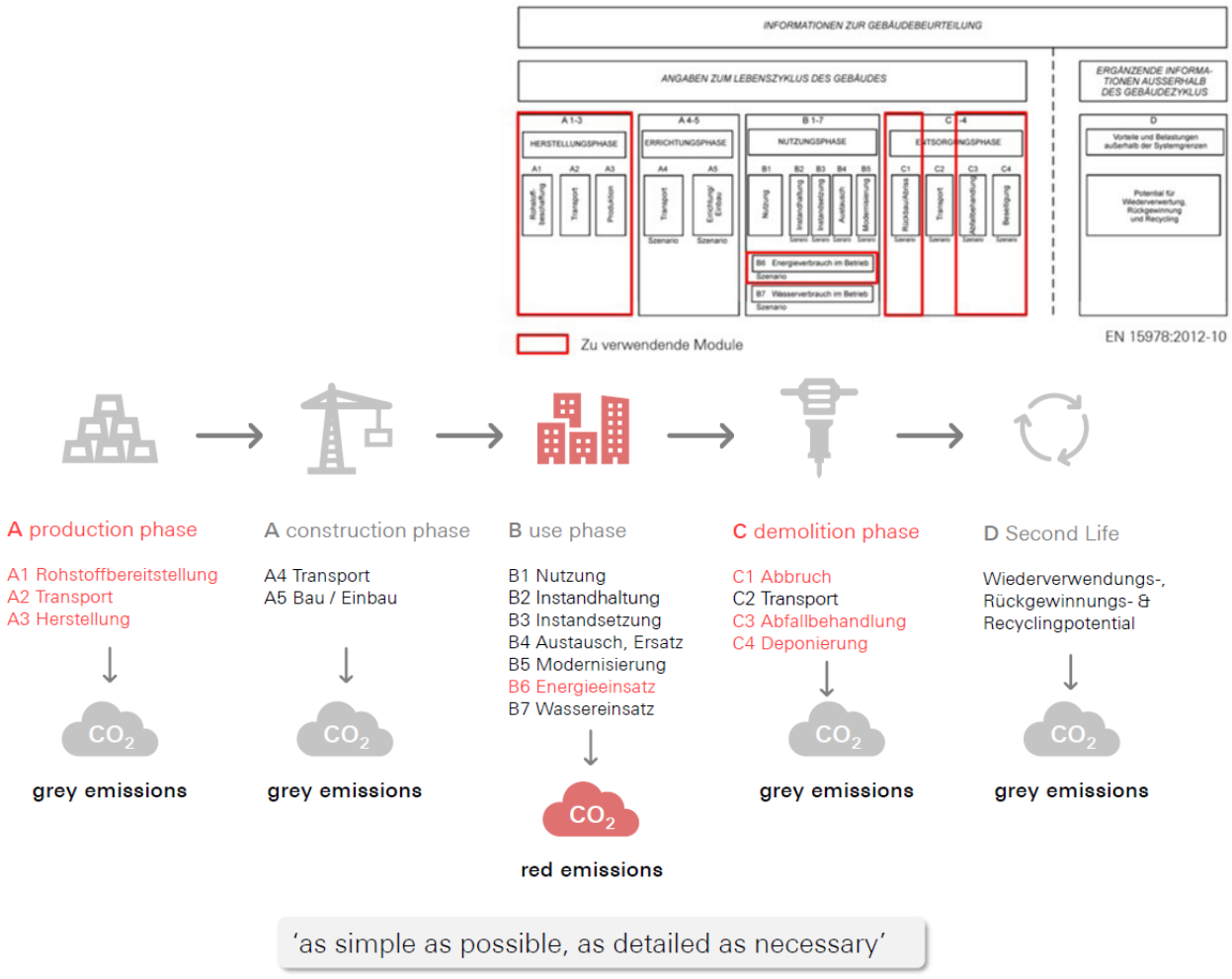

Figure 1: Considered life-cycle modules

A LZWi can thus be assigned to the building at any given time, based on the calculation of emissions according to the Life Cycle Value Index (LZWi) methodology. The value calculated for the building is depreciated or reduced annually in percentage terms from the date of construction, depending on the prescribed service life of the building. Consequently, the absolute value of the LZWi decreases over the life cycle and ultimately reaches zero at the end of the prescribed service life, provided the building remains standing for that long.

A key aspect of the LZWi methodology is the assessment of existing buildings. In this process, material-related emissions that have already been emitted and are present in the building are accounted for on a balance-sheet basis, in the sense of an "emissions backpack." Additionally, through retroactive factoring, older materials - which emitted more emissions during their production than current products - are considered more burdensome. As a result, existing buildings are recorded with a higher balance, making building preservation economically more attractive, since the amount of emissions to be depreciated is higher and would be transferred to the new construction or the site in the event of a planned demolition. There are two mechanisms that come into play during demolition, which are reflected in the LZWi. Emissions that have not yet been fully depreciated from Modules A1–A3 (production phase) are attributed to the replacement new construction. In addition, the emissions generated during demolition (Module C) are fully assigned to the replacement new construction. Both the retroactive accounting and the cause-effect principle of Module C aim to represent neglected and not yet incurred environmental impacts and to include them in the assessment of buildings.

Transparency and Equality

The Life Cycle Value Index (LZWi) creates transparency and equality - from existing buildings to new constructions - by bringing together all sources of emissions, both operational and structural, on a simple, comprehensible, and consistent basis within a comprehensive assessment framework. This makes existing buildings, renovations, replacement constructions, and new buildings comparable in terms of their environmental impacts, regardless of age or construction type. The LZWi provides a clear and transparent evaluation basis by focusing on essential and identical cost groups and modules, which remain understandable at any time through simplified life cycle assessment and depreciation approaches. Furthermore, it accounts for both historically higher emissions and the materials still present in existing buildings. The typically higher energy demand of unrenovated older buildings, compared to the reduced demand of new constructions, is also included by relating it to the additional material consumption for the new building and the associated emissions. Additionally, it is essential that the LZWi considers both a retrospective projection of past emissions and predicted future emissions, surpassing the conventional assessment boundary of 50 years.

Benefits, areas of application and conclusion

The aim of the LZWi is to create a steering effect by claiming a building‘s emissions as an accounting asset, thereby making building maintenance more economically attractive. Integration into the financial structure ensures that the ecological impact of a building does not ‘disappear’ after completion but remains visible in the accounting system. This results in an economic revaluation of buildings and reduces misguided incentives that arise from an isolated view of energy consumption and the one-off consideration of emissions upon completion.

By integrating emissions into the financial structure of companies, the LZWi improves the long-term value of real estate, taking into account its ecological impact. Traditionally, assets are depreciated in the balance sheet over their economic useful life to reflect their loss in value. In the case of the life cycle value index, this is reflected in a revaluation of the buildings in the balance sheet. In summary, the life cycle value index represents a significant addition to existing CO_2 pricing by integrating the life cycle concept into the economic valuation of buildings and making new construction comparable to existing buildings in terms of a ‘laboratory-based’ valuation.

Demands

This discussion of the LZWi does not represent a final conclusion, but rather the starting point for a necessary development.

The mandatory introduction of a life cycle value index as a standard assessment tool for buildings plays a central role in making their emissions balance transparent and comparable across their entire life cycle. This LZWi should be integrated into energy performance certificates and climate strategies and legally anchored in building and energy regulations. A uniform assessment is not only relevant for new buildings but should also include existing buildings in order to avoid misguided incentives for demolition and new construction and to enable a realistic overall view of the entire life cycle.

Furthermore, it is essential to integrate the LZWi into economic and tax models. Through accounting and tax depreciation as an economic asset, as well as targeted subsidies and financing models, long-lasting and resource-efficient buildings are rewarded. In addition, a CO_2 shadow price and subsidies linked to actual savings over the entire life cycle can create further incentives for sustainable construction. Another important component is the systematic recording and documentation of emissions, whereby the LZWi can serve as a relevant decision-making criterion in public tenders and architectural competitions. The LZWi should play a central role in weighing up demolition, new construction and renovation, as it also highlights the responsibility of owners and investors for existing buildings and provides comparative values for various alternative courses of action. Benchmarks and comparative values are necessary in order to set specific targets and measure progress. These should refer, among other things, to the residual value in relation to the remaining emissions budget and be continuously adapted to new technologies and decarbonisation targets.

At the same time, continuous development of the database is essential to ensure that the assessment can be carried out even more precisely over the entire life cycle. Finally, for widespread application, it is also necessary to integrate the LZWi into energy efficiency guidelines and the OIB Guideline 7 (note: The OIB guidelines are a set of technical building regulations issued by the Austrian Institute of Construction Engineering (OIB). These guidelines get adopted into regional building codes.). Raising awareness of material-related emissions must and can also be promoted with the LZWi. The LZWi makes it possible to map the climate and environmental impact of buildings and reduce it in the long term.

Integration of LZWi into energy efficiency directives

LZWi must be established as a supplementary assessment method to the EU Buildings Directive (EPBD), as well as a possible component thereof, for example via Article 12, in order to enable a uniform consideration of operational and material-related emissions.

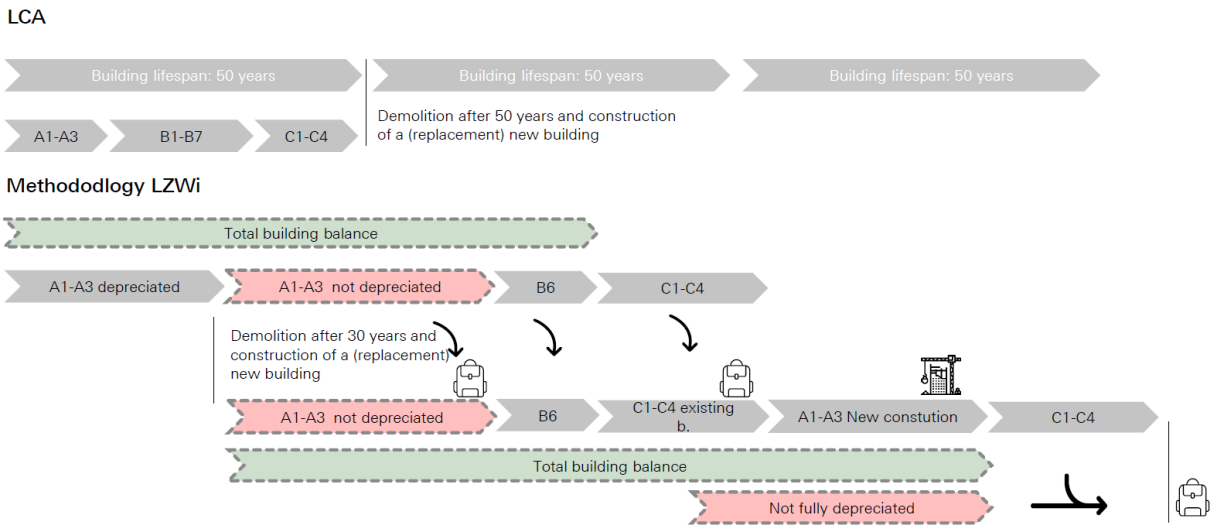

Figure 2: LZWi methodology

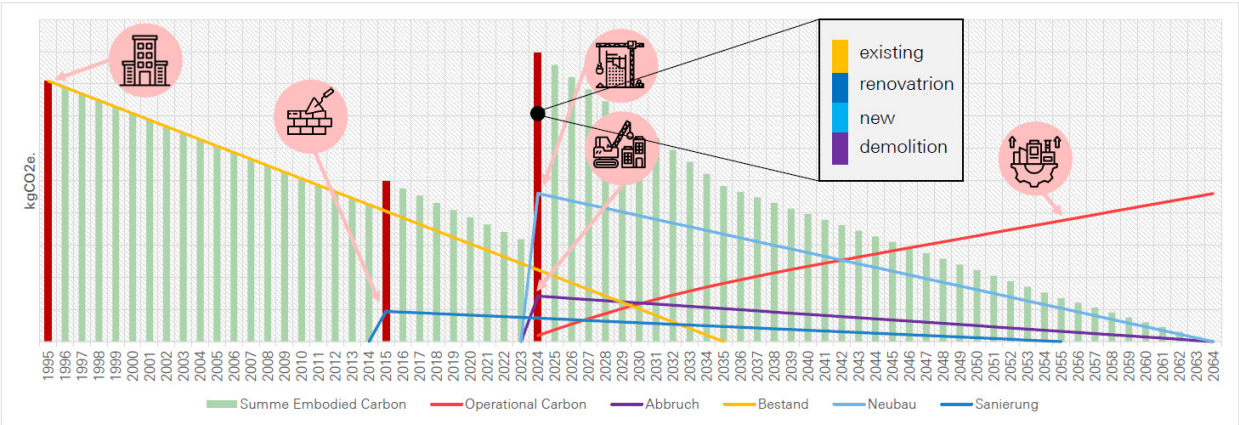

Figure 3: Depreciation according to LZWi methodology

The following scenarios are considered:

Demolition: All emissions that have not yet been depreciated and those generated during demolition are attributed to the replacement construction or renovation. This represents the “emissions backpack.”

Existing Buildings: The emissions of a building are accounted for retrospectively, depreciated back to the present day, and included in the balance.

Renovation: A combination of existing, demolished, and newly added materials and their emissions is considered according to the present methodology.

New Construction: Building on a “greenfield” site - i.e., the construction of new buildings on previously undeveloped land – initially presents a challenge for the LZWi methodology, as there are no existing or prior “grey” emissions on the site that could be transferred to the new building as a “backpack.” This is resolved, however, by considering the fundamental purpose of the LZWi: to make buildings comparable in a transparent and consistent manner. Thus, it should also enable comparison between new construction and replacement construction. Additionally, greenfield construction is subject to different regulations.

Replacement Construction: Includes the emissions of the replacement building, covering the production phase, the demolition of the existing building, and any emissions of the existing building that have not yet been fully depreciated.

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