Building renovation passports: a new tool for systematic energy renovation in the context of the European directive EPBD 2024/1275

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This article analyses the implementation of building renovation passports as a key tool of the European Union's energy policy within the revised Energy Performance of Buildings Directive (EPBD 2024/1275). Building renovation passports represent an individualised approach to gradual energy renovation with the aim of achieving a carbon-neutral building stock by 2050. The article provides a comprehensive analysis of the technical requirements, implementation challenges and practical aspects of introducing this tool in EU Member States based on a systematic analysis of official European documents and a comparative study of existing national implementations.

The construction sector is one of the most significant consumers of energy and producers of greenhouse gas emissions in the European Union, accounting for approximately 40% of total energy consumption and 36% of carbon dioxide emissions. In the context of the ambitious climate targets set by the European Green Deal and the achievement of climate neutrality by 2050, the systematic and effective renovation of the existing building stock has been identified as a critical factor for the success of the entire transformation of the European economy. The revised Energy Performance of Buildings Directive (EU) 2024/1275 represents a major evolutionary step in European legislation, introducing an innovative tool, the Building Renovation Passport, as a means of coordinating, optimising and systematising renovation activities across Member States. This regulatory framework reflects a paradigm shift from traditional, often fragmented renovation measures towards a holistic, long-term approach that integrates the technical, economic and social aspects of energy modernisation of buildings. The building renovation passport is a conceptually new tool that goes beyond conventional energy consulting and establishes itself as a strategic document for managing the complex process of energy transformation of individual buildings. This approach takes into account not only the technical characteristics and energy needs of a specific building, but also the specific requirements, financial possibilities and time preferences of the owner, thus creating the conditions for realistic and sustainable implementation of renovation measures.

Methodology and legal framework

Definition

A building renovation passport is defined in Article 2(19) of the revised EPBD as "a tailored plan for the deep renovation of a specific building in a maximum number of steps that will significantly improve its

energy performance". This legislative definition contains several key conceptual dimensions that fundamentally distinguish building renovation passports from existing energy policy instruments. The first fundamental aspect is the principle of individualisation, which requires that each building renovation passport be specifically designed for a particular building, taking into account its unique technical characteristics, construction history, current energy performance and potential for improvement. At the same time, the document must reflect the individual needs and constraints of the owner, including their financial capabilities, preferences regarding comfort and practical aspects of implementing renovation measures. The second principle is the concept of sequence, which structures the renovation process into logically organised steps that optimise both the technical synergies between individual measures and the economic efficiency of the entire renovation cycle. This approach allows investment costs to be spread over time and minimises the risk of technical conflicts between different renovation interventions.

Energy target states

Building renovation passes are designed as a tool for achieving specific energy standards, which are differentiated over time in line with expected technological developments and the gradual tightening of regulatory requirements. For renovations completed before 1 January 2030, the target is to transform the building into a nearly zero-energy building (nZEB), defined as a building with very low energy consumption, where nearly zero or very low energy consumption is covered to a significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.

For renovations carried out from 1 January 2030, more ambitious a target has been set for the transformation into a zero-emission building (ZEB), characterised by very low energy consumption with zero or very low energy requirements, producing zero carbon emissions from fossil fuels on site and exhibiting zero or very low operational greenhouse gas emissions. This temporal differentiation reflects the expected progress in energy-efficient technologies, systems using renewable energy sources, and building materials with a footprint low-carbon.

Implementation obligations of Member States

Article 12 of the revised EPBD sets out clear obligations for Member States, which must establish a functional scheme for building renovation passports by 29 May 2026, which correlates with the transposition deadline for the entire Directive. This implementation must ensure coverage of the entire national building stock without geographical or typological restrictions, including both residential and non-residential buildings, and including the possibility of issuing energy performance certificates for building renovation for entire buildings as well as individual residential or non-residential units.

The Directive provides Member States with significant flexibility in the organisational and institutional aspects of the scheme. Member States may operate the system directly through national or regional agencies, or delegate its operation to specialised public or private entities. This flexibility allows for adaptation to the specific institutional structures and administrative traditions of individual Member States, while at the same time requiring consistency and quality of service across the national territory.

Technical specifications and content requirements

Analysis of current energy performance

The basis for building renovation passport eachis a precise analysis of the current energy performance of the building, which must be expressed at least as a numerical indicator of primary energy consumption per unit of reference floor area per year in kWh/(m²·year), in accordance with the methodological framework set out in Annex I to the EPBD. This quantification must be based on the current state of the building and its technical systems, not on historical data or previous assessments, requiring a current technical survey and, where appropriate, an energy audit. More advanced versions of the may extend this basic information with a more detailed analysis of the energy performance of individual building elements and technical systems, which provides valuable data for more accurate calculations of the potential savings of individual renovation measures and facilitates future updates of the energy balance after the implementation of specific steps in the renovation plan.

Graphical visualisation of the renovation process

Graphical representation of the renovation plan is a communication tool that must provide a clear and comprehensible visualisation of the entire renovation process. This includes a presentation of the building's initial energy status as the starting point of the renovation trajectory, an explicit definition of the long-term target status corresponding to nZEB or ZEB parameters, and a systematic display of individual renovation steps with their key characteristics.

Effective graphic visualisation presents information on the expected renovation measures in each step, the estimated investment costs, the expected energy savings expressed both in absolute values and in relative changes in energy class, and the potential improvements in indoor environment quality and user comfort. Current international practice shows the effectiveness of using colour gradients or similar visual elements for intuitive communication of the gradual improvement in a building's energy performance.

Integration of the regulatory context

The building renovation passport must provide clear information on relevant national regulatory requirements that affect or will affect the energy performance of the building. This context includes current and future minimum energy performance standards for buildings, rules for the phasing out of fossil fuels from heating and cooling, including relevant timetables, and any other regulatory instruments such as minimum energy standards for buildings.

Integration of this information into the building renovation passport enables building owners to understand not only current requirements but also anticipate future regulatory changes, which is critical for optimally timing individual renovation steps and minimising the risk that the measures implemented will not meet stricter standards in the future.

Optimisation of the sequence of renovation measures

One of the most sophisticated aspects of building renovation passports is the systematic justification of the sequence of optimal renovation steps, which must reflect the complex interactions between different types of measures. The correct sequence and coordination of the implementation of measures minimises disruption to the normal operation of the building, maximises economic efficiency through the use of synergistic effects, and prevents situations where one renovation step could complicate or prevent the implementation of subsequent, technically more important measures.

A typical example of inappropriate an sequence is the implementation of measures on the building envelope before the modernisation of technical systems, because reducing heat losses and possibly gains in the building can completely change the requirements for the capacity and configuration of the heating system. Similarly, it is important to coordinate electrical installation work with the installation of renewable energy sources or intelligent building management systems.

Detailed specification of renovation steps

Each renovation step must be documented with sufficient precision to enable its practical implementation and verification of the results achieved. Documentation includes a concise title and technical description of all renovation measures, including specifications of alternative technological solutions, materials and implementation techniques, which allows the owner to make informed decisions about the specific form of implementation.

The quantitative aspects of the documentation include estimates of primary and final energy savings expressed both in absolute values in kWh and as a percentage improvement compared to the situation before the implementation of the given step. At the same time, the expected reductions in greenhouse gas emissions and projected savings on energy bills must be calculated, with explicit reference to the energy price assumptions used in the calculation.

Another important element is the prediction of the energy class that the building will achieve after completion of each renovation step, which allows monitoring of progress towards the defined target state and possible adjustments to the renovation plan based on interim results.

Discussion

Technical issues

The successful introduction of energy performance certificates for building renovation faces several technical issues that require careful consideration and strategic approaches. The first critical area relates to harmonising the methodology for calculating energy performance between energy performance certificates for building renovation and existing energy certification systems. Inconsistencies in calculation approaches can create confusion among building owners and undermine the credibility of the concept.

The second significant challenge relates to data quality and availability. High-quality building renovation passports require comprehensive information on building characteristics, properties building elements, technical systems, and local conditions affecting energy performance. In many Member States, this information is not systematically available or is fragmented across multiple databases and institutions.

Interconnection: Building renovation passports must communicate seamlessly with energy performance certificate databases, digital construction logs,

financial support platforms and contractor qualification systems, which requires sophisticated technical and digital infrastructure.

Economic impacts and market transformation potential

Building renovation passports have significant potential to channel investment into energy renovation through several economic mechanisms. One mechanism is based on reducing costs. Standardised, professional renovation planning reduces uncertainty and search costs for building owners, making renovation investments more attractive and financially feasible.

A second mechanism relates to the availability of financing. The potential of bank-acceptable building renovation passports is particularly significant in the small residential building segment, where the lack of professional energy advice has been a persistent barrier to high-quality renovation.

Environmental efficiency and policy integration

From an environmental perspective, represents a systematic approach to building renovation that offers significant advantages over ad hoc renovation activities. Optimising the sequence of renovation measures can maximise lifetime energy savings and minimise embodied energy and emissions associated with renovation activities. A well-thought-out sequence of steps will prevent quick fixes from blocking the path to better solutions later on. Integration with broader climate and energy policies creates synergistic effects. They also facilitate the integration of renewable energy sources and connection to district heating through thoughtful planning. However, long-term environmental effectiveness depends on implementation and updating mechanisms. Building renovation passports must be living documents that are updated as renovations are completed and new technologies become available, rather than static planning documents that become obsolete over time.

Conclusions

Building renovation passports represent a new element of European energy policy with significant potential to accelerate the energy renovation of the building stock and achieve climate targets. A systematic approach addresses many of the issues that have long hampered renovations, particularly in single-family homes, where expert advice and coordination of work were lacking.

However, successful implementation requires careful attention to several critical success factors. The technical infrastructure must be robust and interoperable, ensuring that building renovation passports can integrate seamlessly with existing policy instruments and administrative systems. Professional capacity must be adequate to meet expected demand, requiring strategic investment in training and certification programmes for qualified professionals.

Affordability mechanisms are essential to ensure that building renovation passports serve all segments of the population, not just wealthy owners. Targeted support for vulnerable households is not only a declaration of intent, but also critical to achieving comprehensive renovation goals, as these households often occupy the most energy-intensive buildings.

Quality assurance mechanisms must be built into implementation systems from the outset. This includes technical standards for the preparation of building renovation passports, monitoring systems to track the effectiveness of implementation, and feedback mechanisms for continuous improvement of system performance.

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