CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

(CT3) Existing Buildings

Status in 2020

AUTHORS
Susanne Geissler, *OIB Austrian Institute of Construction Engineering, Austria*

KEYWORDS
Deep renovation, Building renovation passport, Building valuation, Monetising energy efficiency

1. Introduction

This report provides an overview of the work performed on Existing Buildings during the fifth phase of the Concerted Action (CAV) on the Energy Performance of Buildings Directive (EPBD). Specifically, the Core Team (CT) Existing Buildings has dealt with the relevant EPBD articles and their transposition and implementation in Member States, especially in view of the provisions of the amending Directive 2018/844/EU and the overall goal of achieving a carbon neutral Europe by 2050 (Green Deal[1]). The CT prepared topics for discussion with Member States in close coordination and collaboration with colleagues from other CTs, in order to effectively identify linkages and overlaps, not only with other CAV CTs, but also with previously organised sessions in one of the predecessor Concerted Actions. The process was also well facilitated by a thematic working group consisting of representatives of Member States who volunteered to support the work.

As the current report builds on previous work of the CA EPBD, readers interested in Existing Buildings in the context of the EPBD are recommended to read the thematic reports available from the fourth phase of the Concerted Action EPBD and even earlier phases as well. All reports are easy to find on the CA EPBD website[2].

2. Objectives

The objective of this report is to provide more information about existing buildings, especially in the context of effective ways to increase the rate of deep renovations, thus dealing with Nearly Zero-Energy Buildings (NZEB) requirements and the Building Renovation Passport to facilitate deep renovations, and with financial aspects.

In contrast to single energy efficiency measures, deep renovations aim at a substantial improvement of the building energy performance, which actually means to strive for NZEB targets. NZEB requirements have already demonstrated the important combination of renewable energy systems with energy efficiency measures in achieving high performance buildings. The amending Directive (EU) 2018/844 has strengthened the role of renewable energy systems by including them in the definition of Technical Building Systems (TBS).

Financial aspects are dealt with by looking at monetising the effects of building energy performance at micro-economic (private finance) level. Technical building properties have to be translated into monetary units, for example, to determine real estate values for investment decisions, or to valuate energy related investments.

3. Analysis of Insights

3.1 Deep renovation of existing buildings and the Building Renovation Passport

Basically, there are two main possibilities to achieve a deep renovation, not only from the technical point of view, but also in terms of economic feasibility:

- **In a short time carried out at once**, for instance with prefabricated elements improving the energy efficiency of the building envelope, including the implementation of renewable energy systems;
- **During a longer period of time**, based on the step-wise implementation of renovation measures in the correct sequence, following a renovation plan, which is also called 'renovation roadmap', and uses the so-called 'logbook' to store building data and record the interventions during time.

EPBD Article 19a looks at the possibility of introducing a voluntary Building Renovation Passport (BRP) to stimulate deep renovation in residential buildings and other building types in situations where the budget for deep renovations carried out at once is not available. The BRP is one of the instruments that can stimulate cost-effective renovation in the form of a 'long-term, step-by-step deep renovation roadmap for a specific building based on quality criteria, following an energy audit, and outlining relevant measures and renovations that could improve the energy performance'.

The concept of the BRP builds on the fact that default values and simplified methods are needed for issuing the EPC of existing buildings, because of lack of data and costly data acquisition procedures, but also to create standard conditions making it possible to assess whether a building complies with energy performance minimum requirements and to allow purchasers to compare one building with another. Recommendations for improving building energy performance are included in the Energy Performance Certificate (EPC), but they are not always detailed enough to be useful for actual renovation planning. Therefore, in some Member States, there is already a voluntary extension of the mandatory EPC with fixed input values (for the comparison of buildings) to a building specific supplement, in order to adjust to the building's actual boundary conditions and actual data to be used for planning building renovations, and for assessing the cost-effectiveness of improvements for the current occupants.

3.1.1 Deep step-wise renovation: Building Renovation Passport

The BRP concept builds on national initiatives such as P2E[3], having developed from the Shift project[4] in France, or the iBRoad[5] project funded by Horizon 2020. Relevant concepts are currently also applied in Denmark, Belgium and Germany, with funding coming from both the private and public sector.

The iBRoad project has developed an Individual Building Renovation Roadmap for single-family houses. This tool looks at the building as a whole and provides a customised renovation plan (iBRoad-Plan) over a long-term horizon (15-20 years). The renovation roadmap is, at its core, a home-improvement plan which considers the occupant's needs and specific situation (e.g., age, financial situation, composition and expected evolution of the household, etc.) and avoids the risk of 'lock-in' future renovation solutions due to a lack of foresight. It is combined with a repository/logbook of building information (iBRoad-Log).

The aim is for the iBRoad-Plan to take data directly from the national EPC software and the iBRoad-Log to have links with other services such as financial databases and one-stop shops. Expected benefits of the tool include maintaining an overview of the buildings' history, concrete planning of renovation steps, achieving deep renovation over a long-term horizon and enabling access to finance. The goal is to increase the number of individual deep renovations and enable the adoption of future policies in support of energy performance and decarbonisation of the building stock.

Analyses of current projects and initiatives and discussions resulted in input to be considered when elaborating the BRP concept:

- It is important to specify the purpose of the BRP to avoid wrong expectations; detailed provisions will probably vary, depending on the target group and building type. Owners of single-family buildings have different needs compared with facility managers of multi-unit residential buildings.
- It is important to integrate elements (e.g., logbook) which have already been established in some countries, and not to impose a new scheme.
- It is important to clarify the difference compared with EPC recommendations.
- Actual implementation of measures needs specific planning, and this requires considerable effort, which needs to be paid for.
- Step-wise renovation requires suitable financing tools.

While the iBRoad concept addresses residential buildings, and in particular single-family houses, the ALDREN project[6] tackles step-wise renovations for non-residential buildings, especially offices and hotels. ALDREN developed the concept for a Building Renovation Passport attached to the European Voluntary Certification according to EPBD Article 11(9), including a method for monetising the effects of deep renovations (more details see chapter 3.2).

3.1.2 Deep renovation in one go: Prefabrication and industrialisation

There are technical and economic approaches supporting the cost-effective renovation of the building stock to NZEB level by 2050 based on prefabrication. Prefabrication has the potential to achieve cost and time reductions, good quality of the works and market integration. Prefabrication can be done individually, leading to a substantial reduction in the duration of renovation works and helping to improve the quality of the works by simply reducing the possibilities of making mistakes on the construction site. In terms of cost

reductions, however, only industrialised prefabrication will realise the full potential through economies of scale. Industrialisation consists of the following elements:

- Industrialisation of the fabrication process
    - Pre-manufactured components
    - Modules with integrated components
- Digitalisation of process
    - Digital scanning of the buildings
    - Digital performance monitoring
- Standardisation of process
    - Offers
    - Financing
    - Planning

Energiesprong[7] and other initiatives demonstrate how successful and efficient the process can be: due to the short implementation phase, users do not need to move during renovation, and there are fewer construction errors. However, prefabrication still needs promotion of market uptake to realise the potential for more cost reduction through industrialisation and also aggregation of renovation projects, in order to achieve economies of scale.

In addition to the technical solution, a business model is needed to overcome the split incentive dilemma; e.g., Energiesprong provides a 30-year guarantee by the construction company and energy savings are used to pay back the investment cost.

While Energiesprong offers the whole package consisting of the technical solution including financing, other companies offering nearly zero-energy renovations based on pre-fabrication rely on financing provided by banks and thus on their rules. For example, the Austrian GAP solution[8] has been successfully implemented several times since a decade, and in 30 years, the renovated buildings will still be in top condition regarding energy performance but also visual appearance: materials used are stable without aging, as only glass and aluminium are used on the outside. Maintenance and energy costs are very low, and all materials can be recycled. If the financing period is 25 to 30 years, and provided that the financing cost is very low, investment will be recovered by the energy savings. However, as this is an existing building, the usual financing period is only 15 to 20 years, while the usual financing period for new buildings is 40 to 50 years. Building owners and users are very satisfied with the renovations, and several buildings have been renovated, however mostly with public support and in the sector of public buildings. Due to unfavourable financing conditions but also a lack of economies of scale, the potential has not been fully exploited so far.

Highlights of 3.1	• The Energiesprong initiative demonstrates that there is a business model for deep renovations based on the Energy Service Company (ESCO) approach and making use of prefabrication. • There are several pilot projects on step-wise building renovation, demonstrating different aspects of the Building Renovation Passport as the new instrument for effective implementation of this type of deep building renovation.

Main Outcomes of 3.1

- Deep renovation of existing buildings can be achieved by mainly two approaches (and a range of interim versions): renovation in one go based on prefabrication and industrialisation as part of an ESCO activity, and step-wise renovation effectively supported by new instruments such as the Building Renovation Passport.
- Industrialisation of deep renovation involves more than pre-fabricated building components and integrated elements. It also includes digitalisation and standardisation of the process.
- Pilot projects on step-wise renovation have been carried out to explore possible ways of implementing the Building Renovation Passport.

3.2 Monetising the effects of Energy Efficiency with a view to facilitate deep renovations

'We have all the technologies to deliver healthy, sustainable and decarbonised buildings. Still, the transformation is not happening. One of the reasons is the financing gap, the lack of trust and common language among building professionals and investors.' (REHVA 2019)[9]

In fact, there is a 'language gap', and translation work is necessary; for example: What is the effect of the technical building quality on monetary yields, on costs and returns, i.e., the influence on rental income, vacancies, supply, administration, insurance, taxes, subsidies, maintenance, risk and financing?

Sector	Language	Bridging the language gap
Building professionals	kWh, U-values, etc.	Monetisation of technical building properties
Investors and real estate valuators	Monetary units, such as EUR	

Table 1: Facilitating the communication between sectors

Monetising the effects of energy efficiency is used to bridge this gap and takes place at **macro-economic (public finance)** and at **micro-economic (private finance)** levels. Always, a translation of technical building properties into monetary units is needed, for example, as a basis for designing funding programmes, or to determine property values for several purposes such as investment decisions.

Monetising the impact of energy efficiency on the level of public finance:

This refers to health benefits from reduced air pollution, health benefits from improved indoor air quality and higher productivity, for which additional jobs are created. Benefits have been quantified as well as

monetised in some cases, for example, by the COMBI project[10] financed under Horizon 2020. Results can be used to estimate the economic benefit to public finances and should help in convincing Finance Ministries to agree that their governments invest in such programmes.

Monetising the impact of energy efficiency on the level of private finance:

This refers to the effect of energy efficiency measures on the building value. The capitalised earnings value assesses the value of a building based on the total income from renting the building, expected to be realised over its economic life span.

Factors influenced by renovation for adjusting the discounted net income (net present value):

- Rental rate
- Occupancy (Vacancy)
- Maintenance costs
- Remaining useful life of the building
- Capitalisation rate (representing the risk concerning the realisation of the expected income)

Deep renovations can extend the useful life of the building, decrease maintenance costs, bring direct benefits from energy costs saving but also indirect non-energy benefits such as health and well-being improvements. If this is reflected in the financing risk assessment and property valuation, it will also impact the building value or value of investment in renovation. It is clear that investments in deep renovations will only pay off if the remaining useful life of the building is sufficiently long. It makes a huge difference whether the remaining life is 15, 20 or 30 years.

The Energy Performance Certificate (EPC) is the central document providing information about a building's energy performance. At micro-economic level, the real estate sector can make use of the EPC in mainly two ways, whereby the second way is explored in more detail in this paper:

- EPCs which have to be presented and handed over when a building or building unit is rented or sold can be used to carry out analyses of real estate transaction data in relation to the energy performance of transacted buildings, in order to show the price premium achieved by energy efficient buildings compared with average buildings, if any. Several studies have demonstrated this price premium under certain conditions, and a fact sheet summarising them was developed in the fourth phase of the CA EPBD[11].

- EPCs, including those issued in the course of major renovations, can be used to identify outliers compared with the average of buildings, to identify the backlog in maintenance and repair and the implication on the remaining use life, and the vacancy risk due to specific characteristics of the building, such as bad comfort and bad indoor air quality. In this way, the EPC can be a valuable tool to support the determination of the building value. However, the EPC must meet certain requirements to be actually useful for this exercise.

The real estate valuation process and its possible link with the EPC is explained by means of the Austrian example, in order to create a better understanding from the energy experts' side regarding the critical aspects on the side of real estate valuers.

3.2.1 Facilitating deep renovations: the EPC as a supporting tool in the real estate valuation process

In Austria, real estate valuation is regulated by law and in addition to this, there are several Austrian standards, including some further instructions during the valuation process.

Before you begin, you have to check whether there are additional laws or business agreements that are applicable and have to be considered during the valuation process, e.g., there are some additional regulations for agricultural and forest real estate as well as for business activities.

Following §3 to 5 of the Austrian Real Estate Valuation law, there are three kinds of valuation approaches:

1) Comparable approach

Within this approach a main unit must be defined and a representative sample of similar properties must be collected for comparison. Next, the valuator has to check the quality of the data. Based on the results, the value of the property has to be increased or reduced according to its specifications and differences, e.g., the condition of the building, the energy performance of the building, the remaining use time, technical equipment, location, different market situation, etc. **This approach is mainly used for condominiums and private houses (one family dwelling or terraced house).**

2) Valuation of physical assets

In this case, the building valuation is based on the technical characteristics of the property, such as defects in construction, energy performance of the building, and all repair works so that the effective age of the building can be determined. This is added to the value of the land to calculate the value of the total real estate. **This method is mainly used for empty or completely vacant properties.**

3) The third approach within the property valuation law is the capitalised earning value.

Based on a pre-calculated interest rate and the assumed remaining use time of the building, a multiplication factor is generated to calculate the capitalised earning value, based on the expected income from rent. **This method is mainly used for multi-storey dwellings, office buildings and buildings for commercial use.**

All three approaches are based on field observation in order to check the condition and location, and if the local situation matches the documentation and plans which were approved by the authorities. The actual status of the property has to be recorded by photo documentation.

There is some important information for property valuators the EPC could provide, namely:

- The EPC should show the technical status of the building, i.e., whether the building is from a technically point of view state-of-the-art or whether it is outdated. It has to show if required health and safety standards have been fulfilled.
- Recommendations should refer to upgrading the building in connection with further technical requirements.

The EPC must meet some criteria to be acceptable for property valuation purposes, and this applies particularly to existing buildings. If an EPC is to be used for real estate valuation, it will have to meet the following criteria:

- It has to represent the actual guidelines for calculating the EPC;
- It has to be issued by a qualified engineer;
- It has to be based on a site visit;
- It is based on the actual condition and construction of the building, which means it has to be specific for that building, and;
- The EPC should not be older than one year, due to the fact that buildings age.

3.2.2 Selected activities facilitating monetisation of energy efficiency at micro-economic level

The ALDREN project[6] (1 November 2017 to 30 April 2020) developed the **ALDREN-TAIL index**[12] **for indoor air quality (IEQ) and productivity, which can be taken into account in the capitalisation rate in building valuation.** The index is used to document IEQ in a building before and after renovation and embraces four major components of IEQ, namely:

- thermal environment (T);
- acoustic environment (A);
- indoor air quality (I);
- luminous (visual) environment (L).

For each of these components, several indicators were determined.

The European Standard ValERI[13]provides a method for identifying wider benefits of Energy Related Investments (ERI) and how to consider them in the valuation report.

"Energy quality" in the German Real Estate Valuation Regulation

The German Real Estate Valuation Law (ImmoWertV[14]) in Germany stipulates that the energetic condition of a building should be taken into account in the valuation report, but it does not say how. In the Capitalised Earnings Value method, the rent can be used for assessing the value of a building. In Germany, municipalities have the legal right according to § 588c and § 588d BGB (Civil Law Code) to issue Municipal Rent Schedules (*Mietspiegel*), and so-called Qualified Municipal Rent Schedules (*qualifizierter Mietspiegel*) which can take into account specific aspects considered relevant, provided they are developed based on scientific evidence.

The appropriate consideration of energy aspects in rent indexes is a concern that has been increasingly pursued in recent years by local authorities, tenants' associations and representatives of the housing industry. The Tenancy Law Amendment Act of 11 March 2013 (BGBl. I, p. 434) clarified, with an addition in § 558 (2) BGB, that energy-related characteristics of the condition and equipment of dwellings must also be taken into account when determining the comparative rent. This legal amendment came into force on 1 May 2013, and the German Federal Office BBSR (*Bundesinstitut für Bau-, Stadt- und Raumforschung*) issued a brochure to promote the appropriate consideration of energy-related features in the compilation of rent comparisons. The brochure is intended to serve as a working aid for the municipal preparation of so-called energy-related rent comparisons. Methodological notes and examples were compiled as implementation

aids. They should facilitate implementation against the background of the respective municipal representative list of rents in qualified and simple representative lists of rents of individual municipalities[15].

For example, Darmstadt issued a Qualified Municipal Rent Schedule in 2018[16] which lays the foundation for rent increases for privately financed apartments over the next two years. It makes a major contribution to making the rental price structure in the non-price-fixed residential portfolio transparent in order to avoid disputes between the parties to the rental agreement. It also contains references to the consideration of the energetic condition, also with reference to the EPC as shown in Table 2 and Table 3.

Highlights of 3.2	• Monetisation of energy efficiency at micro-economic level must be performed in compliance with the legislation on real estate valuation. The ALDREN project has developed guidelines for this at both EU and national level. • If Member States create a specific framework including guidelines, like Germany, this will support monetisation of energy efficiency at micro-economic level in practice. • There is a link between the Energy Performance Certificate (EPC) and the real estate valuation process, as the EPC can provide useful information to valuators.

Main Outcomes of 3.2

- If the EPC meets some defined quality criteria, the EPC will provide useful information for monetising building energy efficiency in the course of the valuation procedure. Among others, EPC recommendations should refer to upgrading the energy efficiency of the building in connection with further technical requirements.
- In this regard, there is a clear link with the new Building Renovation Passport. Future specifications regarding the Building Renovation Passport should also ensure the usefulness of the Building Renovation Passport for the real estate valuation procedure.
- Valuators will also benefit from an EPC database expanded by the Building Renovation Passport and cross-linked with other databases through improved data availability.

New building (construction year from 1995)	**5% surcharge**
Passive house standard, OR	
Three-pane glazing, OR	
Use of renewable energy (heat pump, solar thermal system), OR	
Very well insulated outer wall (minimum 13 cm insulation or U-value maximum 0.26), OR	
Energy Performance Certificate: Final energy indicator (maximum 80 kWh/m^2year including hot water, 53kWh/m^2.year without hot water)	
Existing building (construction year until 1995)	**5% surcharge**
Passive house standard, OR	
Minimum 12 points from measure in table below, OR	
Energy Performance Certificate: Final energy indicator (maximum 80 kWh/m^2year including hot water, 53kWh/m^2.year without hot water)	

Table 2: Surcharge in rent for energy performance

Walls	Points	**Technical building system**	Points
Insulation of outer wall, minimum 6 cm but less than 13 cm	3	Renewal of boiler between 1987 and 1994	1
Insulation of outer wall, minimum 13 cm but less than 20 cm	4	Renewal of boiler from 1995 on	2
Insulation of outer wall, minimum 20 cm	5	Condensing boiler (in addition to Renewal of boiler after 1995)	1
Insulation of roof or upper ceiling, minimum 6 cm	2	Connection with district heating	1
Insulation of basement ceiling, minimum 4 cm	1	Heat pump as main heating source	1
Windows	Points	Solar thermal system	1
Two-pane window, double glazing	2	Mechanical ventilation with heat recovery system	1
Two-pane window, thermal insulation glazing	3		
Three-pane thermal insulation glazing (passive house window)	5		

Table 3: Improvement measures and allocated points

4. Main Outcomes

Topic	Main discussions and outcomes	Conclusion of topic	Future directions
3.1	Deep renovation of existing buildings can be achieved by mainly two approaches (and a range of interim versions): renovation in one go based on prefabrication and industrialisation as part of an ESCO activity, and step-wise renovation effectively supported by new instruments such as the Building Renovation Passport.	Which is the best approach to deep renovation depends on the conditions.	Based on pilot projects and good examples, further exchange of experience among Members States could be useful.
3.1	Industrialisation of deep renovation involves more than pre-fabricated building components and integrated elements. It also includes digitalisation and standardisation of the process.	There is still scope for development in exploiting the potential for industrialisation of deep renovation of existing buildings.	EU-funded projects could support the integrated further development of sustainable solutions.
3.1	Pilot projects on step-wise renovation have been carried out to explore possible ways of implementing the Building Renovation Passport.	A lot of information from projects is available to help Member States in conceptualising, implementing, and/or improving a Building Renovation Passport concept suitable for their conditions.	Based on pilot projects and good examples, further exchange of experience among Members States could be useful.
3.2	If the EPC meets some defined quality criteria, the EPC will provide useful information for monetising building energy efficiency in the course of the valuation procedure. Among others, EPC recommendations should refer to upgrading the energy efficiency of the building in connection with further technical requirements.	Collaboration with the real estate sector is essential to ensure that the EPC can be used for monetising energy efficiency.	Cost-optimality of recommendations considers neither the costs of required health and safety requirements, nor other benefits that could help make deep renovation more feasible. This should be investigated more closely.
3.2	In this regard, there is a clear link with the new Building Renovation Passport. Future specifications regarding the Building Renovation Passport should also ensure the usefulness of the Building Renovation Passport for the real estate valuation procedure.	It is important to develop the strategy for implementation of the Building Renovation Passport together with the real estate sector to exploit the full potential of step-wise deep renovation.	EU-funded projects could support the joint development of sustainable solutions.
3.2	Valuators will also benefit from an EPC database expanded by the Building Renovation Passport and cross-linked with other databases through improved data availability.	Once more, building and energy related databases and data access are proving to be of central importance.	Compliance with the Data Protection Regulation must be ensured. Exchange of experience among Member States could be useful.

4.1 Deep renovation of Existing Buildings and the Building Renovation Passport

The BRP would need to be connected in some way to the EPC in order to use the data that the EPC gathers, be it calculated or real energy consumption. The EPC also contains reliable data such as the size and age of the building and could form part of the base of the passport. It is, however, imperative to capture data from other databases already available if the data is reliable, such as heating system inspections or other sources of building data/information. Links to these databases should be automated.

The BRP must convey additional benefits above and beyond the recommendations and information provided in the EPC. The passport is seen as going one step further by establishing a timeline for renovation steps. Questions were raised over the use of real data for the BRP, i.e., actual energy consumption of the building. This would enable the calculation of real savings that could be realised by following the steps outlined in the renovation roadmap. Including information on real savings would be important for the passport and indicates its different goals compared to the EPC. BRPs could enable the pooling of houses in a neighbourhood for retrofits, which may help with access to finance. However, collecting the information would be a challenge for the Energy Auditor given the pressure to cut prices.

With a view to explore making the BRP mandatory, it is important to consider its cost. Mandatory provisions must only cause additional cost if there is a very strong justification. It was suggested that there is a need to differentiate between the logbook and the roadmap. The former is labour intensive and perhaps only justified for multi-family buildings and non-domestic cases. However, for large/complex buildings the logbook can be a valuable tool, especially if combined with inspections, in order to document and track all technical interventions having occurred in a building. The combination of the logbook with inspections should be investigated further. The renovation roadmaps are tools for all types of buildings because they put recommendations for improving energy efficiency into the correct sequence.

4.2 Monetising the effects of Energy Efficiency by means of the EPC

Energy performance in building valuation can be included in the maintenance backlog, in the risk of loss of rent, in the yield and in the amount of rent.

The EPC is a source of information for the valuator if it is not calculated with predefined default values, but with **actual values, i.e., actual data of the building structure and the technical condition of the individual technical components and reflects the current condition of the building. This means that the EPC must not be older than one year**.

The EPC can help to assess the condition of the building in comparison with average buildings of that age. Outliers can be identified.

From the valuation point of view, the EPC would have to contain information on the condition of the building compared to typical buildings of this age. If this results in a backlog of investment or maintenance and this is backed up with costs, the expert can take this into account in the valuation.

The EPC would have to make statements which improvement measures are to be taken, which energy efficiency increase can be achieved, and which costs would result from this, i.e., as a forecast for the maintenance to be carried out in the next few years.

Whoever takes care of the building, whether it be homeowners themselves or property management companies, will take into account what maintenance is needed in the next few years. Measures planned or

scheduled in the near future can be taken into account as a backlog of maintenance and it is precisely the cost levels of measures helping the valuation expert in determining the backlog of maintenance. **Real estate valuation does not differentiate in maintenance whether it is a maintenance backlog due to poor substance or lack of energy saving measures. The fundamental question is whether an energy efficiency measure will massively increase the life span of the building.**

Buildings from the 1970s today often have a calculated remaining useful life of 30 years. In theory, the remaining useful life can be increased to 50 years through the thermal insulation on the façade; however, the building will generally be in such bad condition that the façade would need to be repaired and the windows would be a large part of a maintenance backlog. Thus, an improvement of a building from the 1970s with only thermal insulation will not massively increase the remaining life of the building. If you mainly had to renovate the whole main supply lines, then this would increase the life span, but not necessarily the energy efficiency.

A completely renovated building can often be the same as a new building, especially in terms of the full lifetime of such an object. The assessment is based on what is offered on the local market on comparable other buildings. With the property class on the one hand and the local market on the other hand, the question is **how to improve the old building to this comparable standard with full lifetime.** Sometimes, this will not be possible, for example, if room heights are important for a specific purpose but beyond control, then even a complete renovation will not result in the maximum possible rent because the renovated building does not meet all characteristics of a new building.

The entire façade and windows are certainly a large part of a renovation and typically all the building services are very massively involved in the quality of the building but do not necessarily increase the remaining useful life. It is assumed that the building services of a building have to be renewed every 15-30 years anyway, depending on the type of building and the technical equipment. The more complex the equipment is, the more often it has to be replaced; the simpler it is, the fewer mechanical parts are involved and the less often it will have to be renewed.

Cost-optimality of recommendations is a good approach, but the method also has to show the costs of required health and safety requirements. For example: if an old façade is insulated with a polystyrene product, it might be necessary to install further fire protection systems. **Currently, this is not reflected in the cost-optimal methodology, nor are other benefits that could help make deep renovation more feasible.**

It is important to note that real estate valuation takes the market into account, that is, how much demand there is for this type of building at the given location. If properties are in poor technical condition and there is a high demand for properties to rent or buy, then these properties will also be rented or sold. If the demand is decreasing and there are vacancies, the property manager will consider what measures would reduce these vacancies. These are not necessarily the measures that reduce the operating costs or improve the energy performance. For example, if a window is broken and air moves in, there will be a rent reduction, and if the window is replaced, rents will be higher again or the vacancy rate reduced. If there is thermal insulation on the facade, then the operating costs will be reduced and the tenant in the unregulated rental area may be willing to pay more for the rent.

5. Lessons Learned and Recommendations

Both options need to be considered and the more suitable approach will be chosen: **step-wise renovations** for improving the building energy performance can be a good option for specific cases, while **deep renovations** carried out at once can be more feasible in other cases.

The Energiesprong model does not only address deep renovations but also provides a solution to the split incentive dilemma (investor/user conflict), which is a pressing issue in many countries. The Energiesprong model was developed by bringing the four key stakeholder groups together in order to discuss and develop feasible solutions: construction companies, building owners, financing institutions, and regulatory bodies. This procedure could be replicated in other countries to overcome the split incentive dilemma which could eventually result in an increase in the rate of deep renovations.

Nevertheless, if a step-wise renovation is envisaged, the BRP has good potential because:

- It can reduce lock-in effects;
- It could be a good tool as part of a larger scheme of building management (however, not so much as a stand-alone instrument).

However, the added value compared with the recommendations in the EPC has to be explained better, including: what level of detail is provided compared with the level of detail the recommendations in the EPC are presented, at what cost, and how can this be financed. A lot of specific details are needed to ensure actual implementation of measures and tailor-made solutions are necessary, but they are expensive. This can hardly be done in half a day as suggested by one of the analysed examples. Schemes certainly must be sufficiently detailed to demonstrate the reduction of risk to financing institutions. Regarding financing, it would be necessary to adapt financing schemes to the step-by-step renovation approach.

Also, the long-term perspective could create some challenges, for example, the situation of the building owner might change over time, requiring adaptations in order not to make the BRP obsolete.

The scope and objective of the BRP must be adapted to the different types of buildings as well as the related challenges. This is demonstrated by ongoing initiatives in countries which already employ elements of the BRP, such as the Building Dossier in Latvia for multi-unit residential buildings (a kind of logbook). The German BRP clearly addresses uninformed homeowners of single-family homes with the objective to develop an integrated home improvement plan together with them, where energy performance is just one element among many others. In Sweden, there is a discussion to have a logbook, to make information about poor building performance available. There is also discussion on a carbon certificate for the construction of buildings. It is the objective to show the investment in EUR as well as the result in CO_2 emissions, being done according to European Standard 15804 on creating Environmental Product Declarations (EPDs). There is a need for adapting the BRP concept to individual countries and regions, in order to make sure that existing initiatives can be incorporated.

When further developing the elements of the BRP concept, it should be considered that the Renovation Roadmap and Logbook as (voluntary) part of the EPC could provide the information requested by real estate valuers, provided that the requirements described in the previous chapters are met (actual building information, on-site visit and documentation, recent up-to-date information). From the real estate valuers' perspective, the ideal solution would be to see a maintenance & repair plan displaying the possibilities for energy performance upgrades and an estimation of associated cost. This is quite close to the Renovation

Roadmap (showing the sequence of renovation measures) and the Logbook (documenting the intervention over time). With this information it will be possible for real estate valuers to determine the backlog in maintenance, repair and technological upgrade having an impact on the remaining use life with reasonable effort. Deeply renovated buildings corresponding to up-to-date buildings available on the real estate market will increase in value while the backlog in maintenance, repair and technical upgrade will be easier to determine and thus more likely be properly reflected in the valuation result.

Endnotes

1. A European Green Deal: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en (https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en)

2. Concerted Action Energy Performance of Buildings 2015-2018: https://epbd-ca.eu/ca-outcomes/outcomes-2015-2018 (https://epbd-ca.eu/ca-outcomes/outcomes-2015-2018)

3. French initiative P2E: http://www.experience-p2e.org/ (http://www.experience-p2e.org/)

4. The Shift Project – the Carbon Transition Think Tank: https://theshiftproject.org/en/home/ (https://theshiftproject.org/en/home/)

5. EU project iBRoad – Individual Building Renovation Roadmaps: https://ibroad-project.eu/ (https://ibroad-project.eu/)

6. EU project ALDREN – Alliance for Deep Renovation: https://aldren.eu/about-aldren/ (https://aldren.eu/about-aldren/)

7. Energiesprong Foundation - The Netherlands: https://energiesprong.org/ (https://energiesprong.org/)

8. Gap Solutions - Austria: http://www.gap-solutions.at/ (http://www.gap-solutions.at/)

9. REHVA (2019): REHVA Brussels Summit 2019. SESSION 2 – Building performance certification to bridge the finance gap. Available online at https://www.rehva.eu/events/details/rehva-brussels-summit-2019 (https://www.rehva.eu/events/details/rehva-brussels-summit-2019), updated on 11/4/2019, checked on 1/9/2020.

10. EU project COMBI - Calculating and Operationalising the Multiple Benefits of Energy Efficiency in Europe: https://combi-project.eu/tool/ (https://combi-project.eu/tool/)

11. Concerted Action Energy Performance of Buildings: https://epbd-ca.eu/wp-content/uploads/2019/06/12-CT3-Factsheet-EPC-impact-on-property-value.pdf (https://epbd-ca.eu/wp-content/uploads/2019/06/12-CT3-Factsheet-EPC-impact-on-property-value.pdf)

12. https://aldren.eu/aldren-tail/ (https://aldren.eu/aldren-tail/)

13. prEN 17463:2020: Methodology for the Valuation of Energy Related Investments (ValERI)

14. Immobilienwertermittlungsverordnung vom 19. Mai 2010 (BGBl. I S. 639), die durch Artikel 16 des Gesetzes vom 26. November 2019 (BGBl. I S. 1794) geändert worden ist: https://www.gesetze-im-internet.de/immowertv/BJNR063900010.html (https://www.gesetze-im-internet.de/immowertv/BJNR063900010.html)

15. Bundesministerium für Verkehr, Bau und Stadtentwicklung (2013): Hinweise zur Integration der energetischen Beschaffenheit und Ausstattung von Wohnraum in Mietspiegeln - Arbeitshilfen für die kommunale Mietspiegelerstellung: https://www.bmi.bund.de/SharedDocs/downloads/DE/publikationen/themen/bauen/wohnen/arbeitshilfe-mietspiegel-energetisch.pdf?__blob=publicationFile&v=4 (https://www.bmi.bund.de/SharedDocs/downloads/DE/publikationen/themen/bauen/wohnen/arbeitshilfe-mietspiegel-energetisch.pdf?__blob=publicationFile&v=4)

16. Mietspiegel für Darmstadt 2018 - Qualifizierter Mietspiegel nach § 558d BGB: https://www.darmstadt.de/fileadmin/PDF-Rubriken/Leben_in_Darmstadt/wohnen/Mietspiegel-2018.pdf (https://www.darmstadt.de/fileadmin/PDF-Rubriken/Leben_in_Darmstadt/wohnen/Mietspiegel-2018.pdf)

Special thank goes to Austrian real estate valuation experts having supported us with expert interviews:

Martina Hoffmann, Expert for Real Estate Management and Energy Performance Certificates at University of Applied Sciences FH Wien der WKW

Rainer Altmann, Valuator and Course Director 'Real Estate Management' at Danube University

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement № 820497.