Benchmarking for mobilising investments in energy efficiency

ENER/C3/2017-442 – Topic 1
Benchmarking of different renovation concepts for the renovation of similar apartment blocks

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1. Executive summary

The purpose of this report is to present and explain the results of the work done for topic 1 of the Benchmarking for mobilising investments in energy efficiency project.

Topic 1 focused on benchmarking different renovation concepts for the renovation of similar apartment blocks and aimed to identify leading practices and suggest policy updates to boost the renovation of apartment blocks. Four out of 10 Europeans live in apartment blocks, which implies the challenges and opportunities apartment blocks can impose on the EU energy strategy. Renovation of apartment blocks is especially important given that most of the EU apartment blocks were built between the 1950s and 1970s (i.e. before significant important thermal regulations were in place).

For this purpose, topic 1 selected and analysed six case studies, compared different renovation practices in different EU Member States, and derived key success factors for the renovation of similar apartment blocks that could be replicated across the EU. Case studies were compared using the benchmarking technique, a specially designed approach that analysed case studies and compared them based on market, economic, legal, and technical criteria.

Topic 1 heavily relied on the involvement of the topic's Steering Group, which consisted of 12 members from different EU Member States and different areas of expertise. After being selected through the EU-wide online survey, the Steering Group members joined three Steering Group meetings where they had chance to: (a) select case studies to be analysed; (b) propose and select criteria and indicators for the case study analysis; (c) provide feedback on the benchmarking methodology and the results of the case study analysis; (d) discuss and suggest policy recommendations originating from the case study benchmarking; and (e) participate in extensive knowledge sharing as another important target of the topic 1 and benchmarking project.

Following the initial ranking of proposed case studies in the first Steering Group meeting, topic 1 analysed six case studies:

1. Reconstruction of an apartment building, Paldiski Road – Tallinn, Estonia
2. KredEx 2010-2014 and 2015-2020 renovation grant programme – Estonia
3. Refurbishment of a social apartment building, Corazón de María – Bilbao, Spain
4. Refurbishment of an apartment building – Kapfenberg, Austria
5. Refurbishment of 3 blocks of prefabricated residential buildings – Hvalso, Denmark
6. Refurbishment of four residential multifamily buildings – Piaseczno, Poland

Benchmarking of the case studies essentially started during the first Steering Group meeting with the selection of the list of criteria and indicators and continued with the analysis and comparison of the case studies by looking what made each successful. The most important indicators used when benchmarking the case studies were wider benefits, number of dwellings involved, level of CAPEX, final energy saved, and ease of the fundraising process.

Benchmarking of the case studies resulted in the list of key success factors that we believe may significantly support the renovation of apartment blocks in the EU. The key success factors include the following:

- Optimal distribution of private and public financing

- Identified and promoted wider benefits
- High level of project understanding among and ability to raise awareness for all participants
- Highly active and knowledgeable local and national authorities
- High quality of project design, supervision, monitoring, and coordination
- Higher rent applicable after the successful building renovation
- High level of achieved energy savings

Together with the suggestions from the Steering Group members who discussed and provided feedback on the benchmarking results, these key success factors allowed the proposal of policy recommendations and complementary measures to facilitate the renovation of EU apartment blocks. The following lists some of the most important recommendations, applicable at the EU or national levels:

EU level:

- Include different environmental, health, and climate benefits to minimum energy performance (MEP) requirements.
- Develop guidelines that would help financial institutions (FI) take into account climate-related factors and include a property value increase into the financial risk assessment and investment decisions.
- Update regulatory standards for banks to allow reduced capital requirements for investing in building renovation.
- Require every Long-Term Renovation Strategy (LTRS), National Energy and Climate Plan (NECP), or similar strategic document to rely heavily on a dialogue between relevant stakeholders.
- Require Member States to implement dedicated funds to renovate multi-apartment buildings by using the momentum of the current EU budget and the Renovation Wave.

National level:

- Introduce MEP requirements stricter than those defined in national building codes.
- Strongly promote wider benefits of the building renovation.
- Invest in line with national LTRS and NECP by keeping high renovation targets.
- Engage with local authorities in gathering data about local building stock, including clear guidelines on how building-related data can be collected and used in compliance with the General Data Protection Regulation (GDPR).
- Improve the skills in the building renovation sector.
- Develop a strong focus on raising public awareness through extensive awareness-raising campaigns.
- Link grant funding with a higher level of required energy savings.
- Give higher importance and power to homeowners associations (HOAs) and their role in the renovation process. This would include lowering the share of positive votes required for a positive decision in a multifamily building and allow an increase in rent after the building renovation.

2. Objectives

Building on the analysis of the relevant case studies covering renovation of similar apartment blocks throughout the EU, the objective of topic 1 is to identify and compare leading practices and suggest components of relevant policies and programs to boost the renovation of apartment blocks across the EU.

3. Methodology

Identifying and comparing leading practices and suggesting components of relevant policies to boost apartment block renovation was done by identifying, analysing, and benchmarking useful case studies of apartment block renovation throughout EU Member States. Relevant information and data from these case studies was collected and compared (benchmarked) to point out renovation concepts that can serve as examples for renovation of apartment blocks across the EU.

The following steps were used to reach the aims of topic 1:

Step 1. Relevant case studies were screened through an extensive literature review in search of recent projects from the field of renovation of apartment blocks, covering different EU Member States. Screening focused on availability of data that would cover the policy, market, economic, and technical aspects of renovation, which was of high importance for high quality of subsequent benchmarking.

Step 2. Relevant potential stakeholders were surveyed about their interest in joining the Steering Group and asked to provide relevant case studies, and also to provide initial feedback on criteria and indicators.

Step 3. Criteria and indicators for selecting and analysing the selected studies were preselected. Initial analysis of criteria and indicators was done at the level of the project (i.e. together with the benchmarking project partners). This analysis was done by considering every partner's view on both topic 1 and how it fits in the benchmarking project as a whole.

Step 4. Building on steps 1-3, the list of 12 preselected case studies and the preselected criteria and indicators were presented and discussed with the topic Steering Group members in the first Steering Group meeting in September 2019. The first Steering Group meeting resulted in the list of case studies to be analysed, as well as the pool of case studies to draw from during the project, if needed.

Step 5. Six case studies were analysed following a common template agreed at the beginning of the project. The template explained different information including human, technical, economic, and legislative key aspects, as well as success factors and challenges of the case studies, which were used to set the stage for the benchmarking exercise. Special attention was paid to identifying and addressing data gaps and data collection.

Step 6. Following the set of criteria and indicators, the case studies were benchmarked. Wherever possible, criteria were given a quantitative scoring based on the data provided. The purpose of the benchmarking was to identify the gaps and to understand the elements that make the cases particularly good and how these have been implemented. All of these led to the identification of key success factors of the case studies that support the policy recommendations, which are one of the ultimate goals of the project.

Step 7. Based on the benchmarking and identification of key success factors, policy recommendations to support renovation of similar apartment blocks across the EU were developed. Special attention was paid to the potential for replication of successful renovation projects and how this can be supported with updated policies. After they were developed, the draft policy recommendations were discussed with the Steering Group members in the third Steering Group meeting, during which the participants had the chance to comment, provide their feedback, and support finalisation of the policy recommendations.

3.1 Case study selection process

3.1.1 Literature review and preliminary selection process

Our work commenced with the collection of different renovation case studies from the sources outlined in the previous reports and documents issued by the project, such as inception and interim reports and terms of reference, as well as from additional relevant sources. The final list of projects and other sources that provided case studies to be analysed is listed as follows.

- BEEN Project
- Urb.Energy project
- ABRACADABRA project
- EuroPHit project
- IEA – EBC programme
- Chalmers University case studies
- LEAF project
- VTT (Technical research centre of Finland) case studies
- Slovak Sustainable Energy Financing Facility (SlovSEFF) project
- SUNSHINE project
- L'Observatoire des bâtiments Basse Consommation database

Case studies provided by the potential experts who filled out the online survey were also used for this task. These case studies included (the most relevant case studies listed):

- Green retrofit of collective flats in Alba Iulia
- Building Renovations in Berlin
- Improving energy efficiency in low-income communities in Romania
- BetterHome programme in Denmark
- Deep Energy Retrofit project in Germany
- Bulgarian Municipal Energy Efficiency Network EcoEnergy

Putting these together provided an initial collection of 174 case studies out of which approximately 50% (92 case studies) covered the preselected countries. Countries with most of the case studies were Germany, Slovakia, and Latvia, while the largest number of case studies were provided from the database of the IEA – EBC programme, Urb.Energy, and the SlovSEFF project.

The biggest concerns related to the initial selection of the case studies were data availability and focus on apartment buildings, which significantly limited the list of initial sources (from inception and interim reports or terms of reference). The additional sources provided some beneficial case studies.

The selection process also focused on finding relevant case studies with a large number of involved individual property owners, with a financial structure that includes noticeable contribution from the owners, cases with adequate financial feasibility with positive cash flow and a proper debt servicing (in case of a loan), and enough data availability to ensure a proper description of the selection criteria and quantifiable results.

3.1.2 Preselected case studies

The result of the literature review and preselection process was a medium list of case studies, including two main groups.

The first group can be defined as individual case studies and includes nine distinct buildings with different energy renovation obstacles and approaches. The second group concentrates on three successful programmes where more than one building can be used for analysis; a group of buildings rather than a single building will provide the data to be analysed.

Table 1: Case studies – individual buildings

Case studies – individual buildings	Location	Reason for preselection
Reconstruction of an apartment building	Tallinn, Estonia	Extremely detailed data, good fit to the criteria and indicator framework, and excellent results
Refurbishment of four residential multifamily buildings	Piaseczno, Poland	Large number of apartment owners, successfully passing a difficult decision-making process
Refurbishment of a residential apartment building	Saint Etienne, France	High energy savings, good use of the existing EPCs, increased building value
Refurbishment of a residential apartment building	Aachen, Germany	Complex management structures with adequate decision-making, existing laws helped renovation
Refurbishment of a social apartment building	Bilbao, Spain	Social housing with reduced risk of energy poverty, low-income and lack of interest resolved
Refurbishment of an apartment building	Halmstad, Sweden	Improved thermal comfort and indoor air quality, with impact on other buildings renovated in a similar way
Refurbishment of a residential building in a city centre	Morges, Switzerland	Owner-tenant dilemma successfully resolved, significant increase in rents accepted
Refurbishment of an apartment building	Kapfenberg, Austria	Owner-tenant dilemma successfully resolved, significant involvement of renewable energy sources (RES)
Refurbishment of 3 blocks of prefabricated residential buildings	Hvalso, Denmark	Accepted rent increase, high satisfaction of tenants regarding the indoor air quality and reduced energy costs

Table 2: Case studies – programmes

Case studies – programmes	Location	Reason for preselection
Renovation of multifamily residential buildings	Bulgaria	High energy savings, overcoming the initial scepticism, investments provided A or B energy labels
Building modernisation under JESSICA I and II Funds	Lithuania	Moving from grants to energy efficiency revolving funds, successful involvement of commercial banks, increased real estate value
KredEx 2010-2014 and 2015-2020 renovation programme	Estonia	Moving from grants to energy efficiency revolving funds, successful involvement of commercial banks, increased real estate value

3.1.3 Final list of the case studies

Preselected case studies were discussed with Steering Group members in the first Steering Group meeting, which took place in September 2019. Participants of this meeting were also invited to engage in early discussion on the benchmarking methodology, resulting on deciding on a relevant set of criteria and indicators. Steering Group members then voted on the case studies they found the most interesting or relevant for the purpose of topic 1.

After a case study presentation and discussion, the Steering Group members ranked the case studies in the following order of importance:

1. Reconstruction of an apartment building, Paldiski Road – Tallinn, Estonia
2. Building modernisation under JESSICA I and II Funds – Lithuania
3. KredEx 2010-2014 and 2015-2020 renovation grant programme – Estonia

4. Refurbishment of a social apartment building, Corazón de María – Bilbao, Spain
5. Refurbishment of an apartment building – Kapfenberg, Austria
6. Refurbishment of 3 blocks of prefabricated residential buildings – Hvalso, Denmark
7. Renovation of multifamily residential buildings – various locations, Bulgaria
8. Refurbishment of four residential multifamily buildings – Piaseczno, Poland
9. Refurbishment of a residential building in a city centre – Les Charpentiers, Switzerland
10. Refurbishment of a residential apartment building – Klosterweiher, Aachen, Germany
11. Refurbishment of an apartment building – Halmstad, Sweden
12. Refurbishment of a residential apartment building – Saint Etienne, France

Building on this list, data availability, and the potential for case study comparison, BPIE decided to analyse six case studies consisting of the five most important case studies dealing with individual buildings and the KredEx renovation program, which would complement one of the five most important individual case studies.

As the result, the following is the final list of the case studies analysed in topic 1:

1. **Reconstruction of an apartment building, Paldiski Road – Tallinn, Estonia**
2. **KredEx 2010-2014 and 2015-2020 renovation grant programme – Estonia**
3. **Refurbishment of a social apartment building, Corazón de María – Bilbao, Spain**
4. **Refurbishment of an apartment building – Kapfenberg, Austria**
5. **Refurbishment of 3 blocks of prefabricated residential buildings – Hvalso, Denmark**
6. **Refurbishment of four residential multifamily buildings – Piaseczno, Poland**

Some of the topics discussed while presenting and selecting the case studies are:

- When analysing older case studies, it was important to understand if energy consumption following the implementation of energy efficiency measures was reported.
- Municipalities can have different reasons for investing in energy efficiency projects. It was useful to understand these reasons and what they consist of, including how the value of wider benefits was taken into account, if at all.
- Some case studies brought up the valuable topic of an increase in the perceived value of an asset after renovation. This is especially true in cases where residents accepted increased rent as compensation for increased comfort.
- There was noticeable interest from different Steering Group members regarding how specific cases were financed. Following this suggestion, we paid specific attention to this issue when selecting and analysing case studies.

3.2 Benchmarking methodology and indicators

This section elaborates on the list of criteria and indicators that have been presented, adapted, and finally agreed in the Steering Group meetings.

The basis for the benchmarking methodology is the combination of criteria and indicators. A set of different criteria was used to define the case studies relevant for benchmarking. Then indicators were used to quantify how selected case studies fit the criteria matrix. Using the indicators provided a basis for benchmarking the selected case studies.

Criteria and indicators presented and discussed during the first Steering Group meeting are provided in Table 3 and Table 4:

Table 3: Criteria for selection of case studies

Policy/legal	Market	Economic	Technical
-	Being inclusive and addressing the needs of a large number of different stakeholders	-	-
Efficient implementation of existing policies	Raising awareness	Financial feasibility	Renovation depth
Providing ideas for policy improvements	Behavioural changes	Secured funding	Modern technologies
-	Large number of individual property owners	Innovative financing	-

Table 4: Indicators for evaluation of selected case studies

Policy/legal	Market	Economic	Technical
Flawless implementation of the existing policies	Number of different properties (buildings) involved	Financial parameters (NPV>0, IRR>cost of financing, adequate DSCR) for different participants.[1]	Percentage of energy saved
Number of obstacles that could be resolved with policy improvements	Number of individual property owners involved	Total initial investment	Percentage of CO_2 emission avoided
-	Share of project participants with new energy management	Share of the total investment secured from loans and subsidies	Quality of works: share of positive surveys among the occupants
-	Speed of the decision-making among different participants	Share of the total investments secured from private funding	Share of energy savings coming from renewable energy sources
-	-	Speed of the fundraising process	Share of energy savings coming from unconventional technologies[2]

Building on a fruitful discussion of the criteria and indicators, Steering Group members voted by selecting and ranking two criteria and two indicators within each topic (policy/legal,

[1] NPV stands for net present value, and IRR for internal rate of return.

[2] Unconventional technologies may depend on country and here imply innovative approaches to renovation.

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market, economic, and technical). Steering Group members were allowed to add more criteria and indicators and include them in the ranking process as well.

Based on voting results and additional analysis performed after the first Steering Group meeting, the following list of criteria and indicators was used for analysing the case studies.

- **Policy/legal:** Efficient implementation of policies and ideas for policy improvements are equally important when selecting a good case study, while the number of resolved obstacles and flawless implementation of the existing policies are indicators used in case study analysis.
- **Market:** A good case study should include large numbers of individual properties and address the needs of a large number of different stakeholders. The most important indicators to measure are number of dwellings involved and speed of the decision-making process.
- **Economic:** A good case study should focus on financial feasibility but also take into account innovative and secured financing. Indicators to be measured are financial parameters such as NPV and IRR, total investment, and easiness of fundraising process.
- **Technical:** Renovation depth and new technologies (including renewable energy sources, or RES) should be equally valued, while important indicators are percentage of energy saved, share of non-renewable primary energy savings, and share of energy supplied from RES.

While analysing case studies the list of criteria and indicators from above was refined resulting in only few indicators that were used for the benchmarking analysis. The main reasons for this reduction were lack of data, such as in case of quality of works, and high complexity of some indicators that could not be assessed accurately enough to be valid inputs for benchmarking, such as project's net present value (NPV).

As it is explained in the following sections, the final list of indicators used for the benchmarking analysis included:

- Wider benefits achieved
- Number of dwellings participating
- Level of initial investment (CAPEX) needed
- Final energy saved
- Ease of fundraising

3.3 Steering group meetings

Topic 1 heavily relied on the involvement of the topic's Steering Group, which was expected to support different steps of the project. The most important tasks executed by the Steering Group members throughout topic 1 are listed below.

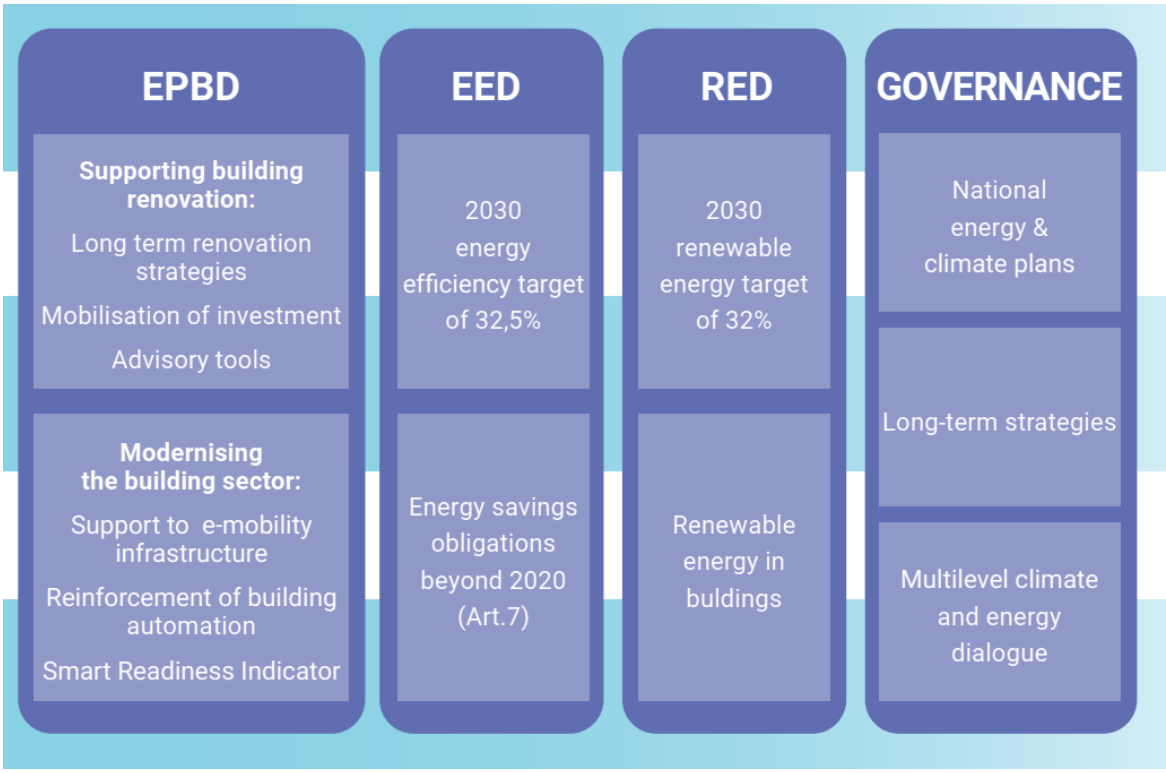
- By using their expertise from the building renovation field, Steering Group members were asked to support the selection of the case studies to be analysed. In addition, Steering Group members voted on the set of criteria and indicators for the case study analysis and provided suggestions on the case study template. These actions took place during the stakeholder survey in the initial phase of the project and during the first topic 1 Steering Group meeting organised in September 2019.

- In the second Steering Group meeting that took place in April 2020, Steering Group members were presented the draft case study analysis where the main results were used as inputs to benchmarking exercise. In addition, the Steering Group members provided feedback and approved the benchmarking methodology by suggesting how it can be used to provide practical conclusions about the case studies.
- Finally, in the third Steering Group meeting, benchmarking results and the key success factors for different case studies and policy recommendations supporting the renovation of apartment buildings were presented to the Steering Group members. Steering Group members provided significant feedback to these topics and offered important suggestions on what updated policy should entail to boost the renovation of apartment blocks across the EU. In addition, Steering Group members suggested different events and other channels for disseminating the project results and sharing the knowledge developed in the project.

4. Context

Case studies are analysed within the context of the building-related EU legislation applicable to each Member State. Relevant EU legislation is based on a few key documents, which are explained in Figure 1. Existing requirements for this legislation and potential for their improvement was one of the main considerations when analysing case studies and proposing policy recommendations.

Figure 1: Clean Energy Package elements related to buildings



Source: A Guidebook to European Building Policy, BPIE, 2020

European building policy has been under development for around 20 years with regular improvements such as added focus on financing solutions, renewable energies, indoor environmental quality, and energy poverty. Some of the main characteristics of the EU legislation are explained below.

The Energy Efficiency Directive (EED) imposes the overarching legal framework for energy efficiency policy in the EU. The most important EED requirements are energy savings obligations, the energy efficiency target for 2030, the requirement for Member States to renovate their public buildings, and the application of MEP requirements.

The Energy Performance of Buildings Directive (EPBD) is the most important piece of legislation guiding building renovation in the EU. The directive was adopted in 2002, recast in 2010, and amended in 2018. EPBD contains a long list of requirements for the building sector, existing and new. For instance, EPBD requires that renovation of buildings is done in line with MEP requirements based on a cost-optimal methodology. Also, each Member State should establish an LTRS to support the renovation of the national building stock into highly energy efficient and decarbonised buildings, including an evidence-based estimate of energy savings and wider benefits. Furthermore, EPBD requires that public funds are used to leverage private investment to building renovation because it is clear that reaching energy efficiency goals will not be possible by relying on public money only.

The Renewable Energy Directive (RED) imposes the targeted share of renewable energy in final energy and may be crucial for the significant reduction of high energy consumption in buildings. This could be achieved through the installation and use of solar water heaters, heat pumps, or district heating relying on RES, to name a few.

5. Case studies

After ranking 12 case studies in the first Steering Group meeting, six case studies were thoroughly analysed. The final list of case studies was based on data availability and the potential for comparison between the selected case studies.

One should remember that the case study analysis provides value only to the extent to which the results and data from such analysis can be compared. For this reason, only data found in all case studies was analysed, which slightly reduced the amount of information processed but allowed for an effective and reasonable comparison of case studies.

Another important fact affecting the analysis of the case studies is that the level of information in individual projects, as opposed to information from investment programmes, is more appropriate for explaining and benchmarking the case studies. For this reason, selection of the case studies heavily focused on individual projects rather than on investment programmes, with the only investment program involved serving also as a complement to one of the case studies dealing with individual renovation.

Keeping these in mind, topic 1 analysed and presented six case studies, which are listed in Table 5 together with their most important characteristics.

Table 5: Case studies overview and their most important characteristics

Case study	Market	Economic	Technical	Wider benefits
Estonia, Tallinn	Interest in wider benefits, lack of interest in complex renovation, and successful awareness raising	Relatively low CAPEX, with partial grant support and grant linked to renovation target	Satisfactory level of energy savings	Moderate wider benefits, and high level of satisfaction with the results

Case study	Market	Economic	Technical	Wider benefits
Estonia, KredEx renovation grant programme	Lack of private financing resolved with provided grant support	Grant scheme designed to ensure financial attractiveness for residents	High level of energy savings required for grant support	Significant and well documented wider benefits
Spain, Bilbao	Low-income families with low interest in energy savings, residents involved in decisions	Mid-range CAPEX needed, coupled with the full grant support	Low energy savings with achieved onsite RES used	Moderate wider benefits that should be visible for local government
Austria, Kapfenberg	High interest in energy savings and improving the building quality, with focus on reduced disruption for tenants	High CAPEX required but with impossible rent increase and with support for innovative solutions	Deep renovation achieved and supported by innovative solutions	Significant wider benefits, mostly applicable to tenants
Denmark, Hvalso	High interest in building quality, and additional interest in energy savings, coupled with awareness raising for tenant democracy	High CAPEX requirements financed from the national fund combined with accepted increase in rent	Satisfactory level of energy savings with moderate implementation of onsite RES	Moderate wider benefits
Poland, Piaseczno	Interest in energy improvements with low interest in loan financing and improved budgeting of local governments	Low CAPEX required, with significant grants from local government	Satisfactory level of energy savings	Modest wider benefits

5.1 Estonia, Tallinn – Reconstruction of an apartment building

Summary:

- Building of 3,145 m^2 and 60 dwellings
- Final energy consumption was reduced by 32%
- Renovation costs of €128/m^2
- Financing based on own funds (9.2%) plus bank loans (66.7%) plus grants (24.1%)
- Of tenants, 87% were satisfied with the refurbishment works

Figure 2. Front view of Paldiski Road, 171 before and after the renovation

5.1.1 Context and general information

Energy-saving policy in Estonia is defined through the Estonian Energy Sector 2030 Development Plan[3], which covers energy consumption in buildings and sets relevant energy consumption targets. The Estonian government put in place a system of financial support schemes through KredEx, one of the most important renovation support programmes in the residential sector.

The Estonian construction industry recovered, with an annual increase in building permits of around 20% between 2010 and 2016. Although the number of job vacancies in the construction sector experienced a significant increase, the total number of workers is still much lower than it was before the 2008 crisis. Furthermore, business confidence in the construction sector has been in flux and has affected financing opportunities, resulting in a decrease in lending to the construction industry at rate of approximately 2% per annum.

Interest rates on housing loans have been decreasing constantly from 3% in 2010 to 1.7% in 2016, but this resulted in stricter lending standards. The majority of the Estonian building stock is owner-occupied, with 81.5% owners and 18.5% tenants—mostly due to policy favouring home ownership over tenancy. However, recent trends have gone towards housing rentals, with increasing share of tenants.

5.1.1.1 Project timespan

From June 2006 (deadline for applications from HOAs) until the beginning of 2008 (end of the refurbishment works in the winning building).

5.1.1.2 Project location

The project was executed in Estonia, Tallinn, Paldiski Road 171.

5.1.1.3 Project objective

[3] https://ec.europa.eu/energy/sites/ener/files/documents/ee_final_necp_main_en.pdf

The Paldiski Road 171 apartment building was used for 25 years, or half of its expected lifetime, prior to the HOA deciding to refurbish the building to lengthen the lifecycle, lower the maintenance costs, and raise the quality of life.

At the same time, KredEx announced a competition to Estonian apartment buildings called "Turn Your Apartment Building More Energy Efficient." This competition aimed at finding one apartment building in Estonia that would be prepared to carry out complex reconstruction works to gain maximum energy efficiency. The reconstruction works of the winning apartment building would be supported by a grant of 1 million EEK within the framework of the BEEN project. One condition was a minimum €320,000 (or 5 million EEK) investment from the homeowners.

A prerequisite to participate was to make an apartment building at least 30% more energy efficient by means of a deep renovation. The selected building was supported by a grant of around €64,000 (~EEK 1 million) from the BEEN project funds.

5.1.1.4 The building competed against three other contestants, while KredEx and the other BEEN partners decided the winner. Actors and their role in the project

- **HOA:** Key figure in the decision-making process that has been managing the building since 2002. The HOA took the initiative by applying to the KredEx contest set up in the framework of the BEEN project.
- **KredEx Foundation:** Foundation set up by the Ministry of Economic Affairs and Communications of Estonia in 2001, with the aim of providing financial solutions based on global leading practices. As a partner of the BEEN project, one of the financing sources for the KredEx Fund was EU funds provided through the INTERREG IIIB programme.
- **Other Estonian partners of the BEEN project:**
  - Tallinn University of Technology (TTÜ)
  - Estonian Union of Cooperative Housing Associations (EKÜL)
  - Association of Estonian Facilities Administrators and Maintainers (EKHHL)
  - Estonian Ministry of Economic Affairs and Communications (MKM)
  - Tallinn City Government (Tallinna LV)

  Along with KredEx, these partners participated in the meetings to decide the winning building and to select contractors for the project management. They also provided advice to the project manager from their experience with different construction companies.
- **Ehitusseire OÜ:** Selected project management company that, along with the HOA managing board, was responsible for selecting contractors.
- **Building contractors:** The project relied on more than one contractor to cover different construction works executed (e.g. reconstruction of the roof or windows replacement).
- **Local commercial bank** – **Hansapank:** They provided two loans to the HOA:
  - Loan of 3.2 million EEK (~€204,500) in August 2006 (15 years, 6.937% fixed interest for the first 5 years and then 3% plus EURIBOR)
  - Loan of 1 million EEK (~€64.000) in August 2007 (14 years, 7.536% fixed interest for the first 5 years and the rest at 3% plus EURIBOR).

5.1.1.5 Main project results and how these were achieved

This case study refers to the building in Estonia where homeowners wanted to renovate the building to **increase its quality and reduce energy expense**. Homeowners were **supported with a renovation grant** requiring complex renovation and a certain level of investment from the homeowners.

The HOA managed to find a consensus between a large number of homeowners and manage the application process, while KredEx provided important support to the HOA, which helped in initial strong **awareness raising**.

Success factors: Homeowners' focus on wider benefits, grant support, and awareness raising.

5.1.1.6 Description of financing mechanisms

The final project cost was €403,035 financed from:

- Homeowners' funds (9.2%)
- Bank loans (66.7%)
- Two grants: BEEN project (16.1%) and Republic of Estonia (8%)

5.1.1.7 Energy savings: nature and level

The energy savings come from the reduction of the heating demand by means of improvement to the thermal envelope as well as improvement of the heating system efficiency. As a result, the final energy consumption for heating and domestic hot water (DHW) was reduced by 47.4%.

5.1.2 Project description

5.1.2.1 Project initiation

Concerned by the poor state of the building, the HOA managing board decided to participate in the competition launched by the Estonian government program in the framework of the BEEN project called "Turn Your Apartment Building More Energy Efficient." After being selected by the BEEN project committee, the renovation works were scheduled to be executed in a timeframe of 1 year, from December 2006 until December 2007: They consisted of:

- Insulation of roof
- Windows replacement
- Heating system improvement
- Insulation of the facade
- Glazing balconies

5.1.2.2 Description of the decision-making process (for different participants)

- **HOA:** The whole HOA decided on the works performed and approved the bank loans; its managing board, in collaboration with the project manager, selected the

contractors in charge of carrying out the different parts of the building's refurbishment.

- **Project manager:** The project manager from Ehitusseire OÜ planned the development of the different stages of the refurbishment, oversaw the works and decided on technical issues when necessary.
- **KredEx:** Along with their partners from the BEEN project, they chose the winner applicant from the contest in June 2006 and selected the project management company after a call of tenders. They also provided support and advice to the HOA and the project manager when requested.

5.1.2.3 Main barriers faced during the project planning and implementation and solutions

- Passive attitudes and non-participation of some residents in the decision-making process where they have been invited to take part hindered the refurbishment. The HOA could not even reach a decision on which measures to take to avoid the dilapidation of the building during the 2 years prior to the start of the project (2004-2005).

  Solution: The HOA managing board decided to act on the basis of the Apartment Ownership Act, Section 15, subsection 2 and the Law of Property Act, Section 72, Subsection 4, which essentially state that an apartment owner can perform works over common ownership parts of the building without the consent of other apartment owners, with the right to claim a compensation of expenses to them for the works performed over the common ownership to prevent the dilapidation of the building.

- The windows were not replaced in four apartments initially, as the apartment owners refused to let the workers in because of different individual reasons.

  Solution: KredEx had to intervene, by organising several meetings with the partners and the above-mentioned apartment owners, to negotiate and find ways to resolve the issues and achieve possible compromises. Thanks to these compromises, two apartments had their windows replaced and the case of the other two apartments was referred to the court. On the basis of the court decision, the compulsory replacement of windows took place.

- For replacing the windows, not all the apartment owners had the necessary finances (this part of the refurbishment was agreed to be financed with owners' own funds), and this had to be done quickly (before the walls could be insulated).

  Solution: The managing board of the HOA decided to help and gave a 0% loan for 10 years to those apartment owners who wished it. The apartment owners paid for the windows to the association according to the agreed schedule (monthly with all the other housing expenses).

- The fundraising process can be described as difficult because, in addition to the problem with the windows financing, negotiations with the Hansapank lasted for up to 5 months, while the bank was monitoring the payment discipline of the association and confirmed the association was solvent.

5.1.3 Impact

5.1.3.1 Analysis of different case study indicators

Category	Indicator	Result
Market	Number of dwellings involved (per building apartment)	60
	Speed of the decision-making process among participants	Slow[4]
Economic[5]	Project NPV	not available / not used
	Owner's NPV	not available / not used
	Financial institution's NPV	not available / not used
	Total investment per renovated area	€128/m^2
	Ease of the fundraising process	Difficult[6]
Technical	Percentage of final energy saved	31.59%
	Percentage of non-renewable primary energy savings	23.70%
	Percentage of final energy consumed from onsite RES	0%

5.1.4 Co-benefits

- Improved aesthetics—flat owners highly value the transformed exterior looks of their building.
- Better thermal conditions (warmer rooms), possibility for individual regulation of heat, and economising the costs among the tenants.
- Expected rise of the market value of their apartments due to these improvements.

5.1.5 Success factors and barriers

5.1.5.1 How the project objective was accomplished

- Increasing the thermal performance of the envelope (insulation of the roof and external walls and windows replacement).
- Improving the heating system efficiency by using a smaller recirculation pump with a frequency converter, installing a new two-pipe system, and changing heaters by radiators.
- Enabling the distribution of the heating costs by means of a heating cost distributor system. For the tenants there is now a total correlation between their actual heating

[4] Passive attitudes and nonparticipation on the part of the residents in the decision-making process were an obstacle to the project, as during 2 years, no progress could be done due to disagreements regarding renovation depth. The management board of the HOA's attitude was considered too autonomous by some residents, who then acted as an opposition force to the development of the project.

[5] Economic parameters such as NPV and IRR could not be estimated with high accuracy and were not used for analysing this case study.

[6] Negotiations concerning financing with Hansapank lasted for up to 5 months while the bank was monitoring the payment discipline of the association and confirmed it was solvent. In addition to this, some residents declared themselves unable to meet the expenses associated with the windows' replacement (which were agreed to be replaced using owners' funds) when the renovation process was already underway, and that step of the renovation could not be delayed. This forced the HOA to adopt an improvised solution consisting of providing a 0% interest loan to those residents.

consumption and their monthly expenses, which affects their awareness regarding heating usage.

5.1.5.2 Added value from the case study

- The experience of the divided groups of supportive and opposing flat owners suggests that there is a need for the involvement of wider circles of residents into the facilities management training, which would avoid unnecessary miscommunication and misinterpretation of information concerning the project and financing the renovation.
- Residents' attitudes, especially those originally of opposing nature, were mostly transformed during the process of renovation along with the gradually increasing visibility of the results. There is a clear correlation between the level of satisfaction and information provided, inquired, interpreted, and understood.
- Attitudes towards renovation in any of its respects, including the assessment of costs, had no clear relationship with residents' age or socio-economic position.

5.2 Estonia – KredEx 2010-2014 and 2015-2020 renovation grant programme

Summary

- Average buildings of 2,000 m^2 and 30 dwellings
- Financing based on a revolving fund and private loans; grants of 15%, 25%, and 40% depending on renovation depth
- Two types of renovation schemes analysed: moderate (25% grant) and deep (40% grant)
- Final energy consumption of buildings (on average) was reduced by 21.60% (moderate renovation) and 47.39% (deep renovation)
- Average renovation costs of €170/m^2 (moderate renovation) and €268/m^2 (deep renovation)
- Average total investment per building of around €500,000
- 661 buildings renovated during 2010-2014 and around 600 during 2015-2020

Figure 3. Examples of buildings refurbished through the KredEx renovation scheme

Source: KredEx

5.2.1 Context and general information

In Estonia, there are approximately 27,000 apartment buildings, with around 90% of them built before 1990. Most of those buildings share similar problems, such as high energy consumption levels, insufficient ventilation, uneven indoor temperatures, and poor thermal comfort levels, whose solution requires extensive refurbishments (and consequently significant investments). The magnitude of these renovations is challenging as around 82% of dwellings in the country are privately owned. In the case of apartment buildings, these are generally managed by apartment associations, in which all the apartment owners in each building must agree on the magnitude of any renovation work and also on its budget.

5.2.1.1 Project timespan

The KredEx grant scheme analysed was executed in three different stages: 2003-2007, 2010-2014, and 2015-2020. This case study analyses the most recent grant scheme characteristics, while paying attention to the previous stage, to understand how changes in the scheme affected the programme results.

5.2.1.2 Project location

The project is entirely located in Estonia, where the KredEx grant scheme operated during the periods mentioned above. The scheme covered apartment buildings across the whole country, without focusing on specific regions or cities.

5.2.1.3 Project objective

KredEx managed renovation grants aimed at all-inclusive and wide-ranging renovation of apartment buildings. Direct benefits of the renovation grants are not only focused on the energy performance of the building, but also at extension of its lifetime, increase in its value, and better living conditions within the building.

Apart from few other purposes, the main objectives of the renovation grants are energy efficient apartment buildings achieving better indoor climate, promotion of use of renewable energy sources, reduction of the energy costs for households, and reduced energy dependency and greenhouse gas (GHG) emissions. For measuring achieved impacts, KredEx established a series of indicators: a) number of apartments with improved energy efficiency class; b) refurbished area (indicated by total renovated floor area in m^2); c) total energy savings achieved per year (in GWh); d) average energy savings per building (in %); e) estimated annual CO_2 reduction; and f) total investments (in millions of €).

5.2.1.4 Actors and their role in the project

- **HOAs:** Key figures in the decision-making process. Conditions for approving any refurbishment works are subject to a 51% of positive votes at the HOA meetings. They are the recipients of the loans and the grants.
- **KredEx:** Foundation set up by the Ministry of Economic Affairs and Communications of Estonia in 2001, with the aim of providing financial solutions based on global leading practices. It supervises HOA applications as well as the fulfilment of the conditions for accession to grants. During the 2010-2014 period it was the main manager of the revolving fund scheme set.
- **Technical consultancy:** In charge of steering the grant application process. Provides guidance and assessment to HOAs or local municipalities concerning the

renovation works that must be performed to comply with the requirements set to be eligible for the grant desired (15%, 25%, or 40%).

- **Designer:** Conducts the energy audit of the building and determines the specific renovation works that must be done to comply with the grant requirements. Responsible for determining the future EPC of the building after the refurbishment.
- **Building contractors:** They perform the renovation works planned by the designer during the grant application process.
- **Commercial banks:** They give loans to HOAs (completely private during the 2015-2020 period and under a revolving fund scheme under a certain set of conditions established by KredEx during the 2010-2014 period).

5.2.1.5 Main project results and how these were achieved

Lack of adequate private financing and loans that would accompany potential grants was resolved with an increased share of grants and with **higher energy savings required for the grant support and required obligatory energy audits**, which helped overcome low targeted energy savings.

Careful design of grants helped fighting the barrier of low cost-effectiveness of renovation investments. Covering 40% of CAPEX with grants was enough to keep monthly expenses intact—energy bills before and reduced energy bills plus monthly loan repayments after the renovation. A holistic approach to the grant scheme was applied, **including raising awareness through TV campaigns, different technical studies**, and promoting practice projects, to name a few.

In addition, **co-benefits of energy renovation were investigated and documented**, proving a win-win situation for all project participants.

Success factors: Properly designed grant support, higher energy savings as a prerequisite for the grant, awareness raising, and documented co-benefits.

5.2.1.6 Description of financing mechanisms

The renovation works are funded through three main sources:

- Self-financing (minimum 15%, coming from own funds, a grant or a private loan).
- Loan to HOAs (of a private nature during the 2015-2020 period, with average conditions of 2.5%-3,5% fixed interest rate for 5 years, 15-20 years' maturity). During the 2010-2014 period a revolving fund scheme was put in place by KredEx, with loans made through commercial banks (fixed interest rate of 4% for 10-20 years' maturity).
- State-sponsored grant (15%, 25%, or 40% depending on renovation depth). Payments are made in two parts: the first part when 80% of the renovation work is handed over and the second part when the whole renovation work is completed. These funds come from the Green investment scheme (from the revenue the Estonian state gained from trading with other states' rights for emission allowances under the Kyoto Protocol).

5.2.1.7 Energy savings: nature and level

The energy savings come from both moderate and deep renovations from the reduction of heating demand thanks to the increase in the insulation levels of the envelope and the improvement of the heating system's performance; the heating system now allows room temperature control in dwellings (with the installation of individual thermostats). In the case of deeply renovated buildings, the implementation of heat recovery on mechanical ventilation systems means an important additional reduction on this heating demand. As a result of these measures, the final energy consumption of buildings (on average) was reduced by 21.60% in the case of moderate renovations (25% grant) and 47.39% in the case of deep renovations (40% grant). Concerning non-renewable primary energy savings, these amount to 16.73% for moderate renovations and 34.32% in the case of deep renovations.

5.2.2 Project description

5.2.2.1 Project initiation

Taking into consideration the great share of privately owned buildings in Estonia (82%) and the characteristics of the country's building stock (with an important presence of pre-1990 apartment buildings due to the Soviet past) policies and state-sponsored programs to undertake ambitious renovation works in these types of buildings where needed, with a focus on providing attractive financial solutions to homeowners. Learning from past experiences (e.g. the 2003-2007 period whose grants were considered insufficient to trigger ambitious renovation endeavours) led to a reframe of the whole program to encourage the population to perform deeper renovations.

The renovation works under the grant schemes established by KredEx during the 2010-2014 and 2015-2020 periods have different requirements depending on the renovation depth:

- In the case of renovations with a 15% grant (minor renovations), the only requirements are achieving an EPC class E, with primary energy level (PE) ≤220 kWh/(m^2/year) while reducing heating demand by at least a 20%.
- In the case of renovations with a 25% grant (moderate renovations), the requirements are more numerous and exigent:
    - Achieving an EPC class D, with PE ≤180 kWh/m^2/year
    - Installing a mechanical ventilation system
    - Balance the heating system and install thermostats in every radiator
    - Insulating the envelope up to certain U-values:
        - External walls: 0.25 W/m^2/K
        - Roof: 0.15 W/m^2/K
        - Windows: 1.1 W/m^2/K
- In the case of deep renovations with a 40% grant (35% in the case of 2010-2014), the requirements tighten even more:
    - Achieving an EPC class C, with PE ≤150 kWh/m^2/year,
    - Installing a mechanical ventilation system with heat recovery
    - Insulating the envelope up to certain U-values:
        - External walls: 0.22 W/m^2/K
        - Roof: 0.11 W/m^2/K

- Windows: 1.1 W/m^2/K
- Linear window-external wall thermal transmittance 0.05 W/m/K

5.2.2.2 Decision-making process (for different participants)

- **HOA:** Assessed in every moment by a technical consultant, it decides to apply for the grants and proceed to commission the energy audit to the designer to determine the extent of the works needed to attain the requirements established to be eligible for the grant desired. Once KredEx confirms the eligibility, the HOA proceeds with the tendering with contractors for undertaking the works planned by the designer during the application process. It is the recipient of the grant funds and the private loan (in case it is needed) with a commercial bank, under the best conditions it manages to agree.
- **Commercial bank:** It provides funding to HOAs (in the case they wanted so) under the conditions agreed by both parties.
- **KredEx:** In charge of supervising HOA grant applications and their compliance with the requirements established to gain access to funding. They also reserve the right to supervise the construction works.

5.2.2.3 Main barriers faced during the project planning and implementation and solutions

- Lack of private financing at attractive conditions to accelerate building renovation as a consequence of a global economic crisis comprising the 2010-2014 period.

  Solution: A revolving fund was put in place and managed by KredEx, with European Regional Development Fund (ERDF), Council of Europe Development Bank (CEB), and other public funds, to minimise risks by collaborating with solid commercial banks (that fulfilled a set of strict requisites). The availability of funds was limited but enough to ensure renovation rates that would be unattainable otherwise.

- During the 2010-2014 period, the supervision of the technical documentation (more specifically, energy audits) provided by HOAs during the grant application process was too lax, as it was proven that certain audits were too optimistic.

  Solution: KredEx tightened its control over technical aspects for the 2015-2020 period, raising the standards of the technical documentation to be provided (such as more complex energy efficiency calculations), requiring post-maintenance agreements, and making compulsory the presence of technical consultants, among other adjustments.

5.2.3 Impact

5.2.3.1 Analysis of different case study indicators:

Category	Indicator	Result
Market	Number of dwellings involved (per building apartment)	30 (on average) – ~2,000 m^2/building

Category	Indicator	Result
	Speed of the decision-making process among participants	N/A[7]
Economic[8]	Project NPV (20 years, i=3.5%)	not available / not used
	Owner's NPV	not available / not used
	Financial institution's NPV	not available / not used
	Total investment per renovated area	€170/m^2 (moderate ren.) / €268/m^2 (deep ren.)
	Easiness of the fundraising process	Normal[9]
Technical	Percentage of final energy saved	21.60% (moderate ren.) / 47.39% (deep ren.)
	Percentage of non-renewable primary energy savings	16.73% (moderate ren.) / 34.32% (deep ren.)
	Percentage of final energy consumption onsite generated from RES	0% (in both cases)

5.2.4 Co-benefits

5.2.4.1 Noticeable co-benefits

Different studies examined and confirmed different, wider renovation benefits. Provision of grants, as shown by the KredEx example, supports the investment decision and mobilises private investments, increasing both the level of economic benefits and the number of potential beneficiaries.

Main co-benefits confirmed in case of KredEx grant schemes are:

- Tax return to the government budget equalling 32% of total renovation costs. The biggest position of the tax return originates from the increase in construction activities (28% out of 32% of the direct tax returns come from this source) and is executed either through value-added tax (VAT) or labour taxes.
- Each €1 million of renovation costs results in around 18 new jobs generated per year.
- In each year, the Estonian government budget saved €186 million by reducing expenses that would otherwise have to be used to cover different costs associated

[7] Depends on each particular case rather than in the grant scheme itself, especially from the side of HOAs, which need 51% positive votes to validate any decision. Disagreements on the renovation depth can be a reason to hinder decision-making.

[8] Economic parameters such as NPV and IRR could not be estimated with high accuracy and were not used for analysing this case study.

[9] During the 2010-2014 period, the revolving fund system provided a well-defined framework in terms of financing, as the conditions to give a loan by the participant banks to the HOAs were mainly set by KredEx. Conversely, the amount of funds available was limited. During the 2015-2020 period, loan concession was completely private, increasing the availability of funds. This concession had to be done as a result of a negotiation between HOAs and the bank, which depending on the case, would take more or less time. As, according to KredEx, these loan conditions for renovation projects were reportedly very similar across the Estonian banking sector, there were not reasons to argue that the difficulty of obtaining private funds by HOAs depended on these conditions (Or, in other words, it is not likely that they could be a reason to block undertaking renovation works by residents, lengthening the whole process).

with improper indoor air quality. Different research confirmed that around 4,900 disability-adjusted life years (DALY) has been saved each year, where DALY is a metric representing the loss of the equivalent of 1 year of full health.

5.2.5 Success factors and barriers

5.2.5.1 How the project objective was accomplished

- Increasing the thermal performance of the envelope (insulation of the roof and external walls and windows replacement) to comply with defined threshold values of thermal transmittance (U-value) in the case of moderate and deep renovations. In the case of the less popular minor renovations (15% grant), there were not any specific requirements concerning any part of the building, as long as a 20% reduction of the heating demand was achieved.
- Improving the performance of the heating system, balancing the heating network of each building (if not already done), and installing thermostats on every radiator to allow room temperature control, reducing unnecessary consumption (in both moderate and deep renovations).
- Increasing air quality conditions (with a positive impact in users' health) by installing mechanical ventilation systems in moderate and deep renovations, with heat recovery systems in the case of deep ones, significantly reducing the heating demand.

5.2.5.2 Added value from the case study

- The requirements set by the 2012/27/EU directive demand the adoption of quick and effective measures to encourage energy efficiency endeavours across all segments of society.
- Enough favourable loan conditions to hasten energy renovations among homeowners require of a finance market in good shape. The lack of these conditions due to the global economic crisis forced the adoption of a more limited and mainly subsidised revolving fund system during the 2010-2014 period.
- Low awareness among homeowners about the existence of these programs and asymmetry of information are obstacles that need to be overcome to accelerate the renovation rate of countries.
- A general perception of non-willingness and inability to take long-term commitments by homeowners was noticed along the project, which is an issue that hinders energy renovation projects' commissioning, so measures need to be taken to tackle this problem.
- Nothing apart from grant-based schemes turned out to be attractive enough alternatives to convince homeowners to undertake energy renovation works on apartment buildings.
- Grant mainly serves to compensate the lack of cost benefit. Deep renovation percentage was raised from 35% (2010-2014) to 40% (2015-2020) to make it more appealing.
- A tight supervision of technical documentation is key to avoid too optimistic audits. This was a problem during the 2010-2014 period that was corrected for the 2015-2020 period.

5.3 Spain, Bilbao – Refurbishment of a social apartment building

Summary:

- Social building renovated through public funds bringing different
- Building with useful area of 8,325 m^2 and 111 dwellings
- Final energy consumption was reduced by 12%
- Total renovation costs of around €4.2 million, or €498/m^2
- Positive NPV of €2.1 million from inhabitants' perspective

Figure 4. Partial external views of Bilbao's building before and after the renovation

Source: https://www.premiosdearquitectura.es/

5.3.1 Context and general information

The Spanish government, in line with the requirements of the EU EED, has published its Fourth National Energy Efficiency Action Plan 2017-2020[10], in which the cumulative energy savings target has been lowered from 21,305 ktoe to 15,979 ktoe, for the period between 1 January 2014 and 31 December 2020. The Action Plan for Energy Savings launched in 2011 for 2011-2020 aims to improve the energy efficiency of the existing building stock and focuses on thermal and lighting equipment, with the renovation of 8.2 million m^2 per year and the replacement of 500,000 devices per year. This plan is managed by the Institute for Diversification and Energy Savings, a public body under the Ministry of Energy in charge of contributing to the achievement of the objectives that Spain has in terms of energy efficiency, renewable energy, and other carbon technologies. This public body promotes and manages several programs focused on energy efficiency of existing buildings promoted by the EU.

The construction sector was severely hit after the global financial crisis of 2007-2008, as it brought to an end the so-called Spanish property bubble. However, in recent years the sector has shown signs of recovery—its total turnover grew by 26.9% between 2013 and

[10] https://ec.europa.eu/energy/sites/default/files/documents/es_neeap_2017_en.pdf

2017. Despite this, values for the production of construction and civil engineering are 5.0% and 16.9% below the 2010 levels, respectively.

Regarding the housing market, the number of finished dwellings increased by 36% between 2016 and 2017, reaching 54,521, ending nine consecutive years of downward trends. In parallel, the number of transactions in the first 9 months of 2017 was 13.6% higher than in 2016. The demand for housing is expected to increase in the years to come, and the need for additional housing has been estimated at 140,000 units annually until 2024. Households' investments in housing renovation have also been increasing since 2013. Housing prices increased 11.1% between 2015 and 2017, causing issues around housing affordability (especially in big cities).

5.3.1.1 Project timespan

The refurbishment was approved in October 2012, and the works were carried out between late 2014 and June 2015.

5.3.1.2 Project location

Plaza Corazón de María 2-9, Bilbao, Spain

5.3.1.3 Project objectives

- Improve energy performance
- Improve the thermal conditions in the apartments
- Improve accessibility
- Improve the aesthetics of the neighbourhood while keeping the original architectural characteristics of the building

5.3.1.4 Actors and their role in the project

- **HOA:** Main protagonist in the decision-making process. They approved to undertake the renovation in October 2012. The works' commission created for the project counted with the presence of each portal president and the president of the whole association.
- **Viviendas Municipales de Bilbao:** Local autonomous body attached to the Housing Area of the Bilbao City Council. Its mission is to satisfy the demand for decent housing of the people of Bilbao through a social rental system following criteria of energy efficiency and sustainability. It is the owner of the 70.86% of the dwellings of this building and, therefore, manages it. It actively participated in the works' commission.
- **Basque and provincial (Bizkaia) government:** Through programs supporting the energy renovation of buildings (REVIVE project, for example), these bodies provided funding to the project based on the compliance of a series of requirements.
- **Building contractors:** They performed the renovation works planned. As each stage (reconstructing the roof, replacing the windows, etc.) had its own call of tenders, different contractors participated in the project.

5.3.1.5 Main project results and how these were achieved

Renovation objectives of low-income families living in this social building in Spain were **improvement of indoor air quality, accessibility, and attractiveness of the neighbourhood** rather than improvement of energy performance. The project success was strongly dependant on local authorities that got involved in supervision and management of the project and funding through a public grant thanks to strong cooperation between local and regional governments. What was also important is that **homeowners were fully involved in the decision-making** and that **their expectations were understood and fulfilled**.

Success factors: Importance of wider benefits in case of low-income families, full involvement of the residents, strong role of local authorities, and the availability of grant financing.

5.3.1.6 Description of financing mechanisms

The final project cost was approximately €4.2 million. Financing was provided entirely by public funds, and the local government benefited from the regional government grants that covered around 50% of the investment costs.

5.3.1.7 Energy savings: nature and level

The energy savings come from the reduction of the heating demand by means of improving the thermal envelope and the individual heating systems' efficiency. As a result, the final energy consumption for heating and DHW was reduced by 16.5%.

5.3.2 Project description

5.3.2.1 Project initiation

The main purpose of the intervention was to improve the overall comfort of the dwellings (social housing) while improving the energy performance of the building, which had not been renovated since its construction in 1956.

With this is mind, the renovation works were carried out from late 2014 to June 2015. They consisted of the following:

- Windows replacement (double glazing with PVC frames)
- Insulation of the roof with rock wool
- Insulation of the facade with external thermal insulation composite system (ETICS) system, thermal bridging treatment
- Individual old heating systems replaced with condensing boilers
- Installation of a solar thermal boiler, which supports the individual systems up to 50%
- Improve the building's accessibility, with the construction of new stairs and the installation of lifts (especially important considering the presence of old residents)

5.3.2.2 Description of decision-making process (for different participants)

Following the decision of the HOA to undertake renovation works in October 2012, a works' commission was created for the project to manage these works and to simplify the decision-making process. This commission involved the main representatives of the homeowners,

commercial local owners, and Viviendas Municipales de Bilbao in a way that nothing could be decided without agreement of all the parties involved.

5.3.2.3 Main barriers faced during the project planning and implementation

- The most important barrier to renovation was the low-income profile of the building residents, which resulted in low interest in the renovation.

  Solution: Residents' participation has been promoted throughout the project, with the focus being on building accessibility and redevelopment of a depressed part of Bilbao rather than on improving building thermal performance and reducing the energy bills. Another key factor for success was funding provided by the public administration.

- Funding sources were obtained from a public administration, which involved an increase in bureaucracy and led to a fundraising process that would be defined as with normal level of difficulty.

5.3.3 Impact

5.3.3.1 Analysis of different case study indicators

Category	Indicator	Result
Market	Number of dwellings involved (per building apartment)	111
	Speed of the decision-making process among participants	Normal[11]
Economic[12]	Project NPV	not available / not used
	Owner's NPV	not available / not used
	Financial institution's NPV	N/A
	Total investment per renovated area	€498.5/m^2
	Easiness of the fundraising process	Normal[13]
Technical	Percentage of final energy saved	11.74%

[11] Viviendas Municipales de Bilbao is the owner of more than the 70% of the apartments so it had enough power to make any decision promptly. However, as a social housing association dependent on public funds, residents' participation has been promoted over the project and taken into account very seriously. Residents were initially reluctant to carry out the renovation works, and, in many cases, the main motivation to undertake the renovation was not the improvement of the building's thermal performance, but the building accessibility, which finally served as a main argument to convince them. Taking into consideration this data, the speed of the decision-making process was deemed normal.

[12] Economic parameters such as NPV and IRR could not be estimated with high accuracy and were not used for analysing this case study.

[13] 100% of the funds came from the public administration due to the social housing character of the building, which avoided potential solvency problems linked to low-income residents; conversely, it entailed an increase in bureaucracy to apply for funding. For these reasons, the easiness of the fundraising process was considered as normal.

Category	Indicator	Result
	Percentage of non-renewable primary energy savings	36.46%
	Percentage of final energy consumed from onsite RES	10.55%[14]

5.3.4 Co-benefits

- Enhanced aesthetics of a depressed area of the city.
- The energy retrofit eased providing affordable heating to low-income households, reducing the risk of energy poverty and poor thermal conditions in the dwellings.
- Building accessibility was significantly improved.
- Market value of the apartments has increased.

5.3.5 Success factors and barriers

5.3.5.1 How the project objective was accomplished

- Increasing the thermal performance of the envelope (insulation of the roof and external walls and windows replacement)
- Improving the heating system efficiency by replacing all the boilers with condensing boilers, supported (up to a 50%) by a new solar thermal system.
- Improving the accessibility of the building by installing elevators and wider stairs.

5.3.5.2 Added value from the case study

- It is important and necessary, from the beginning, to make an effort that what can be met in practice complies with the expectancies of the final users. This mean that the residents have to be an important part of the decision-making process.
- It is also important to consider that the users' motivations are not as intensely related to the energy performance of the building, as with other aspects, such as accessibility.

  This makes sense considering the low-income profile of the tenants, which often led to energy poverty, so potential energy savings were not as interesting for them—their expenses on heating were already low even before the renovation at the cost of poor indoor conditions. To encourage them to undertake the renovation, positive effects on the thermal comfort had to be highlighted rather than economical savings.
- Although both the climatic conditions and spatial availability of the building were suitable for PV auto-consumption, the Spanish legislation in force in 2015 hindered its installation (current legislation concerning PV auto-consumption changed in 2019 to encourage it—see Real Decreto 244/2019).

[14] Considering a solar thermal contribution of the 50%.

5.4 Austria, Kapfenberg – Refurbishment of an apartment building

Summary:

- Deep renovation relying on a public grant and substantial use of RES
- Building of 2,845 m^2 and 67 dwellings
- Final energy consumption was reduced by 70%
- Total renovation costs of €4.3 million or €1,510/m^2
- Grant from the public administration of the 35% of the total costs
- Positive energy building in terms of electricity

Figure 5. Kapfenberg's building before and after the renovation

Source: International Energy Agency (IEA)

5.4.1 Context and general information

The Austrian Federal Energy Efficiency Act[15] (Energieeffizienzgesetz, or EEffG) was passed in 2014, and will be in force until end of 2020, implementing the EU EED. The law sets an energy consumption target for Austria of 1,050 PJ for 2020, corresponding to final energy savings of 310 PJ. To reach the target, a series of measures were taken, including the renovation of federal buildings, which is expected to achieve energy savings of 48.2 GWh and corresponds to a renovation rate of 3% per year.[16]

The Act sets rules for the creation of an Energy Pass (Energieausweis) for all new buildings and for the sale of existing ones, which has to contain information on the overall energy efficiency of the building; the final goal is to achieve a transition toward zero energy houses. These certificates should contain information such as the building type, location, specific heating and cooling demand, primary energy demand, final energy demand, CO_2 emissions, and energy efficiency classes (A ++ to G).

[15] https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20008914
[16] https://www.iea.org/policies/17-austrian-energy-efficiency-law

Several sustainable construction initiatives have been launched in Austria. These include the Austrian Society for a sustainable building economy (ÖGNI), the Austrian Programme on Technologies for Sustainable Development, and Klimaaktiv, among others.

Along with the economy, the broad construction sector in Austria exhibited positive developments in previous years. In particular, production in construction rose by 5.6% between 2015 and 2017, and the overall growth of the sector is projected to continue throughout 2018 (forecast to increase by 1.5%). One of the main reasons for this growth was the housing market, as the house price index rose by 14.3% between 2015 and 2017, and by 48.8% since 2010.

These developments are in line with a strong growth in the investments in dwellings, amounting to €16.2 billion in 2017, which represents a 10.6% rise since 2015 and a 26.5% increase since 2010.

5.4.1.1 Project timespan

From March 2012 to January 2014.

5.4.1.2 Project location

Johann Böhm Straße 34/36, 8605 Kapfenberg, Austria.

5.4.1.3 Project objectives

- 80% reduction of the energy demand of the existing building
- 80% of the total energy consumption of the renovated building provided by RES
- 80% reduction of the CO_2 emissions of the existing building

5.4.1.4 Actors and their role in the project

- **Ennstal SG:** Owner of the building and constructor. It is a non-profit cooperative that rents apartments all over Austria (has properties in 160 municipalities), which aims to provide affordable, comfortable, and energy efficient housing.
- **AEE INTEC:** Institute for Sustainable Technologies founded in 1988 as a non-university research institution, focused in the field of applied research on the topics of solar thermal energy, low energy, and zero energy buildings and in the area of energy efficiency in industry. Designers of the energy concept and coordinators of the project.
- **Building contractors:** They performed the renovation works planned. Each stage of the works was performed by a different company.
- **Additional collaborators:** Institute for Materials Testing and Building Materials Technology at TU Graz, Kulmer Holz-Leimbau GesmbH, Geberit Huter GmbH, other partners from the Building of Tomorrow research and technology program, and support from the Province of Styria.

5.4.1.5 Main project results and how these were achieved

This is a 50-year-old building in Austria rented to tenants where the main incentives for renovation were **improvements in the building's energy profile with the 80% target**: 80%

of final energy reduction, 80% of RES, and 80% reduction in GHG emissions. **Innovative solutions** were implemented to reach **deep renovation** and noticeable **wider benefits,** such as better comfort, more balconies, and inner layout of apartments.

Together with the design company, building owner managed to engage tenants and **consider their interests**, providing a lot of information needed for their positive attitude. The increase in rent was not possible, but the project used a 35% reduction grant applicable to costs of the innovative technologies applied.

Success factors: Devotion to deep energy renovation, innovative solutions, and significant wider benefits made this project successful despite the high upfront costs.

5.4.1.6 Description of financing mechanisms

The final project cost was approximately €4,300,000, with 35% of this amount provided by different public administration grants.

5.4.1.7 Energy savings: nature and level

Energy savings come from reducing the U-value of the facade and the roof by improving their levels of insulation, reducing the ventilation and infiltration levels (by installing a mechanical ventilation system with heat recovery), and installing a more efficient (and centralised) heating system. These measures led to a reduction of the heating consumption of 75.9%. Additionally, RES were installed (PV and solar thermal), reaching an annual PV production of 80 MWh and 39.5 MWh, respectively. This led to a reduction in non-renewable energy consumption of 89.29%.

5.4.2 Project description

5.4.2.1 Project initiation

The project intended to turn a typical post-war Austrian residential building into an energy-positive building. It was originally made of prefabricated sandwich concrete walls without insulation and with various heating systems—central gas heating, electric and coal furnaces, electric storage heaters, etc.—without any kind of mechanical ventilation system in place. All these conditions were the cause of thermal discomfort and high heating and operating costs for the residents.

To perform an ambitious transformation of the building, the renovation works were carried out from March 2012 to January 2014. They consisted of the following:

- Installation of facade in prefabricated modules that provide support to solar panels (PV or thermal) and at the same time allow rear ventilation; insulated with 24 cm of mineral wool
- Installation of a new roof, highly insulated, with a thickness of 35-40 cm
- Modernisation of the interior of the apartments, changing the layout
- Installation of a new and more efficient district heating system
- Installation of a mechanical ventilation system with heat recovery (65% efficiency)
- Installation of PV and thermal solar panels as RES that can provide up to 80 and 39.5 MWh/year, respectively

- New and larger balconies in every apartment

5.4.2.2 Decision-making process (for different participants):

- Ennstal SG, as the owner company of the building, had complete control over the decision-making process, and was advised by the other collaborators in the project.

5.4.2.3 Main barriers faced during the project planning and implementation and solutions

- Certain renovation works inside the building, such as the change of the layout, made a resettlement of the residents necessary, and there were no apartments available in Kapfenberg at the time of these works.

  Solution: Planning two different construction phases to guarantee residents an apartment during the renovation period.

- The financing of the renovation was a barrier because it was not possible to excessively increase the rental price for the apartments due to governmental regulations.

  Solution: Alternative funding and financing solutions were necessary to carry out the renovation project.

- The fundraising process can be described as normal because the project was carried out with governmental support providing 35% of the grant and being backed by different research institutions under different programs. Access to funding through these institutions was significantly easier than in case of a typical building renovation project.

5.4.3 Impact

5.4.3.1 Analysis of different case study indicators

Category	Indicator	Result
Market	Number of dwellings involved (per building apartment)	67
	Decision-making process among participants	N/A[17]
Economic[18]	Project NPV	not available / not used
	Owner's NPV	not available / not used
	Financial institution's NPV	not available / not used
	Total investment per renovated area	€1 511/m^2

[17] There was no data found in the sources available concerning this topic

[18] Economic parameters such as NPV and IRR could not be estimated with high accuracy and were not used for analysing this case study.

Category	Indicator	Result
	Easiness of the fundraising process	Normal[19]
Technical	Percentage of final energy saved	69.73%
	Percentage of non-renewable primary energy savings	89.29%
	Percentage of final energy consumed from onsite RES	62.72%

5.4.4 Co-benefits

- New and larger balconies for every flat
- Improvement of the reputation of the building
- New functional area for the residents
- Improved thermal quality by reduction of thermal bridges
- Barrier-free access to all flats by the installation of an elevator and an arcade
- Changed layout of the flats enables new modern living with windows to both east and west
- Better indoor climate provided by the new mechanical ventilation system with heat recovery
- Renewal of old heating and domestic hot water systems improved the operational comfort by a new centralised and automatically controlled system

5.4.5 Success factors and barriers

5.4.5.1 How the project objective was accomplished

- The renovation depth in this case study was significant, as several measures were taken that contribute to maximise comfort levels (in terms of temperature and ventilation) while minimising the consumption, especially from non-renewable energy sources.
- Installation of a mechanical ventilation system with highly efficient (65%) heat recovery, guaranteeing healthy ventilation levels by minimising thermal losses, and keeping heating consumption as low as possible.
- Substantial implementation of RES (PV and thermal solar), whose production accounts as the 62.72% of the building's consumption. What is more, the building produces an electricity surplus of 33 MWh/year, benefiting from a feed-in-tariff from the grid. From an electrical point of view, it is a positive energy building.
- Increasing the thermal performance of the envelope (insulation of the roof and external walls and windows replacement), minimising heat losses and reducing infiltration levels.

[19] The project was backed by a series of research institutions and supported by public funds (at national, regional, and local levels), providing a grant of the 35% of the total investment. This variety of participants providing financial support made the fundraising process more complex, but the compromise with the project and the cooperation of the parts involved in it helped to ease the process, whose difficulty was deemed as normal.

- Increasing the efficiency of the heating system, with a new one centralised with automatic control, guaranteeing optimal indoor thermal conditions while keeping the consumption as low as possible.

5.4.5.2 Added value from the case study

- The expectations of the tenants to the retrofit were generally satisfied. The tenants were also satisfied with the housing association and the different companies that carried out the renovation.
- Assessing their housing situation, some tenants criticised the natural lighting in the apartments, the temperatures at the beginning (too cold), and the noise because of the renovation works of the second construction phase.
- The tenants were satisfied with the information they received regarding the mechanical ventilation system and the heating and domestic hot water preparation.
- The synergies achieved due to a proper combination of energy efficiency measures, both active and passive, resulted in significant reductions of consumption while also improving the indoor conditions of the building (to a large extent). This highlights the importance of good planning prior to committing to a refurbishment.

5.5 Denmark, Hvalso – Refurbishment of 3 blocks of prefabricated residential buildings

Summary:

- Building with high turnover of tenants renovated to achieve better indoor conditions and increased attractiveness
- Building of 5,293 m^2 and 66 dwellings
- Final energy consumption was reduced by 19%
- Total renovation costs of €6.6 million or €1,310/m^2
- Financing provided by a national social housing fund
- 30% of the rent increase covered by the energy savings

Figure 6. One of the three blocks in Hvalsø before and after the renovation

Source: International Energy Agency (IEA)

5.5.1 Context and general information

Sustainable construction is a growing focus in Denmark. A number of governmental incentives and favourable framework conditions are in place to support green innovation. At the same time, the public sector regulations demand increasingly sustainable solutions in all future construction and renovation projects, and the national government passed ambitious energy agreements, with the aim to invest 60 billion DKK in energy efficiency initiatives over the period of 2012-2020.

The Danish government's strategy for energy efficiency and renovation of the existing building stock, named "The road to energy-efficient buildings in the Denmark of the future"[20] consists of 21 initiatives to support renovation, in compliance with the EED and EPBD. The initiatives aim to reduce net energy consumption for heating and hot water in existing buildings by 35% by 2050. Some of the measures target all building segments, whereas others are specific to single-family houses, multifamily buildings, and commercial and public buildings.

[20] https://www.buildup.eu/sites/default/files/content/2014_article4_en_denmark.pdf

With respect to the Danish construction sector, it has been on the revival path since 2010, in line with the overall improvement in the general economy. In 2018, there were 74,810 enterprises in the broad construction sector in Denmark, with the narrow construction sub-sector accounting for 49.6% of the total. The number of firms in the broad construction sector has increased by 18.3% since 2010, with architectural and engineering activities experiencing the greatest growth (+21.9%). However, the broad construction sector faces the shortage of skilled labour. According to the 2018 European Investment Bank (EIB) investment survey, the availability of skilled staff is the main investment barrier for firms in Denmark. In 2018, all sub-sectors reported the lack of skilled staff as the most significant investment barrier. The broad construction sector is particularly affected, with 92% of companies reporting difficulties in this area.

Additionally, house prices in Denmark have been picking up despite falling demand due to the introduction of tighter lending standards in 2018, coupled with a slowing economic growth. In 2018, the house price index for total dwellings was 26.6% above the 2010 level. Specifically, existing dwellings reported the highest increase (+14.9% since 2015).

5.5.1.1 Project timespan

2011-2012.

5.5.1.2 Project location

Building blocks are located at Traneparken 2-20 | 4330 Hvalsø, Denmark.

5.5.1.3 Project objectives

- The buildings were in bad condition (especially external walls) and had to be renovated.
- The indoor climate was unsatisfactory, and the energy consumption unacceptably high.
- The building seemed unattractive due to its grey appearance. The intention was to make Traneparken more attractive for both existing and new residents.

5.5.1.4 Actors and their role in the project

- **Building owner:** Hvalsø Boligselskab (Building Association Hvalsø) delegates management on another association.
- **Building administrator:** Boligselskabet Sjælland (Building Association Zealand) – administrator of the building and main promoter of the renovation works.
- **HOA:** Fundamental figure in the decision-making process. According to Danish law, only upon 51% of positive votes renovation works can be undertaken.
- **Financiers:** Danish fund for social housing “Landsbyggefonden.” This is a National Building Fund, established by law, organised a self-governing institution and founded by public housing organisations.
- **Technical collaborators:** ARKIPLUS 1969 (Architectural company) and Rådgivende Ingeniørfirma (Engineering company) are in charge of managing the renovation project.

- **Building contractors:** No detailed information has been processed. This topic is considered as a current data gap.

5.5.1.5 Main project results and how these were achieved

Reason for renovation in this social building owned by the local building association and rented to tenants was resolving a poor condition of the building, improving energy performance and comfort, adding balconies, and improving common areas between the buildings.

Different project actors were involved including building owner, building administrator, tenants, design and construction companies, and national fund for renovation. **Capital requirements were high** and covered with an **increase in rent** accepted after **significant awareness raising**, and with **contribution from the national building renovation fund**.

Success factors: Intense awareness raising, acceptance of increased rent, and contribution from the national fund for social housing.

5.5.1.6 Description of the financing mechanism

The final project cost was approx. €6,610,000, with financing provided, to a large extent, from the Danish fund for social housing “Landsbyggefonden.”

5.5.1.7 Energy savings: nature and level

- Facade and roof insulation
- Improved airtightness
- Improved ventilation control with a heat recovery system
- Final energy consumption reduced by 18.6%
- Installation of PV panels bringing 38.2 MWh/year

5.5.2 Project description

5.5.2.1 Project initiation

Due to the poor condition of the buildings in Traneparken, the building association (its owner) considered they needed renovation, especially the concrete facades, that were already worn down.

The renovation works were carried out during 2011 and 2012, and they consisted of:

- The exterior walls and panel walls have been renovated: In the case of exterior walls, a U-Value of 0,15 W/m^{2}K was achieved by means of additional 190 mm of insulation plus 50 mm of standard bricks, and in the case of panel walls, a layer of 285 mm insulation plus 45 mm of standard bricks achieved a new U-Value of 0.11 W/m^{2}K. This external insulation was continued to the base of the buildings to reduce thermal bridges.
- The roofs were renovated and insulated. (New U-Value of 0.09 W/m^{2}K achieved by means of adding 250 mm of insulation)

- The windows and doors were replaced with 3-layer low-energy windows (final U-Value of 0.8 W/m^{2}K).
- Installation of a balanced mechanical ventilation system with heat recovery.
- Construction of new/larger balconies in every apartment.

5.5.2.2 Decision-making process (for different participants):

The decision-making process relied primarily in the agreement of at least a 51% of the tenants, according to Danish law. The administrator of the building was in charge of preparing everything needed to proceed with the renovation.

The tenants had to be part of the decision-making process because tenants' democracy is mandatory in Denmark. Therefore, the time schedule is important because the tenants need to know when something is going to happen in their dwelling.

5.5.2.3 Main barriers faced during the project planning and implementation and solutions

The fundraising process can be characterised as a normal one because a large part of the renovation project could be financed from funding available for improving the present situation. Also, considering a majority of the tenants have to agree on the decision according to Danish law, an overall focus on communication had to be provided, which supposed a challenge.

5.5.3 Impact

5.5.3.1 Analysis of different case study indicators

Category	Indicator	Result
Market	Number of dwellings involved (per building apartment)	66
	Decision-making process among participants	Normal[21]
Economic[22]	Project NPV	not available / not used
	Owner's NPV	not available / not used
	Financial institution's NPV	not available / not used
	Total investment per renovated area	1 249 EUR/m^2

[21] In social housing projects in Denmark, a majority of the tenants have to agree on the decision. This means providing information, holding several meetings, etc. In the case of this project, this was done properly, so there were not relevant misunderstandings or conflicts that led to a deadlock of the project. A social housing building makes the decision-making process more complex by nature, so in general terms, it was considered as normal in terms of speed.[21] Economic parameters such as NPV and IRR could not be estimated with high accuracy and were not used for analysing this case study.

Category	Indicator	Result
	Easiness of the fundraising process	Normal[23]
Technical	Percentage of final energy saved	18.56%
	Percentage of non-renewable primary energy savings	14.83%
	Percentage of final energy consumed from onsite RES	5.36%

5.5.4 Co-benefits

- New balconies
- New green surroundings
- Better air quality due to ventilation

5.5.5 Success factors and barriers

5.5.5.1 How the project objective was accomplished

The combination of the measures taken helped to improve indoor conditions while minimising thermal losses, increasing the performance of the building:

- Increasing the insulation levels while treating the thermal bridges
- Replacement of doors and windows for better insulated ones, tackling infiltrations and increasing the insulation.
- Installing a mechanical ventilation system with heat recovery, gaining control over the ventilation to guarantee adequate air quality levels.

5.5.5.2 Added value from the case study

- It is of the upmost importance to make sure expectations are adjusted to what can be met in practice.
- It takes longer to plan and carry out a renovation than a new construction, mainly because the apartments are inhabited. The inhabitants or tenants have to be part of the decision process to avoid misunderstandings, which can lead to potential new obstacles to the project.
- The time schedule is important—the tenants need to know when something is going to happen in their dwelling.
- Sometimes conditions in the individual dwellings are not known beforehand, so the project must adapt to these, and there has to be enough money for this flexibility.

[23] Social housing renovation projects always face the handicap of the tenants' economic power, which supposes a larger risk in financial terms. However, in the case of this project, a large part of the renovation works and funding was from the very beginning provided by Landsbyggefonden, Taking into consideration these facts, the fundraising process was considered to be characterized as normal in terms of ease.

- The security at the building site has to be the best—it has to take into account the tenants, especially children, living at the building site.

5.6 Poland, Piaseczno – Refurbishment of four residential multifamily buildings

Summary:

- Heated area of 3,219 m^2 and 80 dwellings
- Final energy consumption was reduced by 22%
- Renovation costs of €56/m^2
- Financing scheme: 50.7% bank loan (around 7% of interest), 39.5% own equity, 9.8% grant

Figure 7. Building in Szkolna 10, the only that carried out works, before and after the refurbishment

Sources: Zrzeszenie Audytorów Energetycznych (before) and Google Street View (after)

5.6.1 Context and general information

The main national strategy documents on energy efficiency in Poland are the Energy Policy of Poland[24] until 2030 (EPP 2030) and the 2017 Fourth National Energy Efficiency Action Plan (NEEAP)[25].These policies are supported by legal acts, like the Law on support to thermal upgrade and refurbishment. Moreover, many Polish legal acts relevant to resource efficiency and sustainable construction are EU-driven, such as the Bill amending the Energy Efficiency Law (Ustawa o efektywnosci energetycznej), which implements the EED (2012/27/EU) and the Law on Energy Performance of Buildings, which transposes the EPBD (Directive 2010/31/UE). In addition to the legal framework, energy in buildings is supported by a significant number of instruments and measures.

The Polish broad construction sector is composed mostly of small companies and several large players, totalling 522,283 firms in 2018 (an increase of 22.7% over 2017). Production

[24] https://www.gov.pl/attachment/376a6254-2b6d-4406-a3a5-a0435d18be0f
[25] https://ec.europa.eu/energy/sites/default/files/documents/NEEAP_Poland_ENG_2014.pdf

in construction recorded a growth of 21.5% over the 2010-2018 period, after recording a drop of 10.8% in 2016 relative to 2010. Nonetheless, construction costs, including materials and workers' wages, have significantly increased. Hence, construction companies' income has largely suffered, as witnessed by the increasing number of bankruptcies. More generally, the issues of late payment and worker shortages have a significant impact on the sector's growth, preventing companies to develop further.

The housing market in Poland has performed well, primarily driven by the strong economic performance, rising wages, and declining unemployment. According to the Narodowy Bank Polski (Polish central bank) report, the average price of existing flats in Poland's seven big cities (Warsaw, Gdańsk, Gdynia, Kraków, Łódź, Poznań, and Wrocław) reported an increase of 7.11% during 2018 to an average of PLN 6,905 (€1,605) per square metre, 7.87% in 2017, 2.64% in 2016, 1.1% in 2015, representing an acceleration in price growth. This rise in prices was mainly driven by supply shortages, rise in construction costs, and favourable policy schemes. Despite the decrease in housing transactions, there was a significant increase in the number of new mortgages. According to the National Bank of Poland (NBP), the mortgage market in Poland rose from 1.3% of GDP in 2000, to 9.9% of GDP in 2007, and to almost 20% of GDP in 2018.

5.6.1.1 Project timespan

Late summer 2006-summer 2008.

5.6.1.2 Project location

Szkolna 10, Piaseczno, Poland

5.6.1.3 Project objectives

- Improve the indoor conditions in the apartments
- Reduce thermal losses from common parts of the building due to high levels of air infiltration
- Reduce heating consumption

5.6.1.4 Actors and their role in the project:

- **HOA:** Decision-making key figures and promoters of the project.
- **L&A Zarządzanie Nieruchomościami:** Manager of the building since April 2007; before that it was managed by the city of Piaseczno. The decision on undertaking the renovation of the building was made before the privatisation of the building's management.
- **Building contractors:** They performed the renovation works planned. There were two contractors on this project, as there were two calls for tenders comprising two packages of works.
- **Banks:** BISE bank (crediting bank) and Bank Gospodarstwa Krajowego (BGK) that evaluate the compliance of the requisites for getting the grant and informs the BISE bank on the decision to proceed to the concession of the loan to the HOA under the conditions previously agreed.

5.6.1.5 Main project results and how these were achieved

This case study includes renovation of multifamily buildings owned by the HOAs, with the incentive to improve indoor conditions and reduce energy consumption. Respective HOAs were dominant figures in the decision-making and managed to **change the initially low general interest of homeowners**.

There was **significant involvement of public authorities** that made **budget allocations**, provided **loan redemptions**, and successfully collaborated with and **involved commercial and development banks** and international projects.

Success factors: Significant involvement of public authorities, budget allocations and loan redemptions, collaboration with commercial and development banks, devoted HOAs.

5.6.1.6 Description of financing mechanisms:

The final project cost was €179,985, and the financing sources were the following:

- Own contribution: €71,171.16 (39.5%)
- BEEN grant: €17,721.84 (9.8%)
- Bank loan: €91,053 (50.7%); the bank loan had an altering interest rate of around 7%

5.6.1.7 Energy savings: nature and level

Energy savings come from better insulation of the external walls and the ceiling (the floor of the last story, which is uninhabited), reducing thermal losses and infiltration levels by means of replacing doors and windows on the common parts (such as staircases), and increasing the efficiency of the heating system by installing thermostatic valves and chemically cleaning up the whole piping network.

All this led to a reduction of 35% on heating consumption.

5.6.2 Project description

5.6.2.1 Project initiation

From December 2005 to January 2007, the HOAs of the four apartment buildings (all of them already aged and managed by Piaseczno municipality until April 2007, when the one located at Szkolna 10 switched to private management) that compose this case study decided to undertake energy renovation works by a majority of votes. After an energy audit was prepared in all of them (by spring 2007) and all bureaucratic procedures concerning grants and bonuses were ready, including loan concessions (summer-autumn 2007), only the building located at Szkolna 10 was able to find contractors during the tendering process to undertake the renovation; the other three buildings' management by the public administration set a series of conditions on its call for tenders that did not result in an attractive enough opportunity.

The renovation works of the sole building refurbished were carried out from late 2007 until summer 2008, and consisted of:

- Insulation of external walls using insulation of 14 cm thickness and $\lambda = 0.04$ W/mK.

- Insulation of the ceiling of the last story above the apartments of 16 cm thickness and λ = 0.04 W/mK
- Replacement of windows on staircases and of windows in the basement for new, tight windows of value of heat transmission coefficient not higher than U = 1.5 W/m^{2}K
- Replacement of external doors on staircases for new, tight doors of value of heat transmission coefficient no higher than U = 2.0 W/m^{2}K
- Replacement of pipes and radiators, and installation of thermostatic valves on radiators and automatic vents on risers, hydraulic regulation, with chemical rinsing
- Decision-making process (for different participants): The decision-making process for the different stages that led to the refurbishment was the responsibility of the HOA.

5.6.2.2 Decision-making process (for different participants)

The commercial banks, which are servicing the state financing scheme, require a set of internal decisions to be made by the HOA (listed below). Each of HOAs passed the process successfully and through different steps. Each step was subject to voting where decisions were taken with majority of HOA members.

5.6.2.3 Main barriers faced during the project planning and implementation and solutions

- The rules set by the public administration for the calls for tenders could potentially discourage potential contractors.

  Solution: Switch to private management to set up new rules freely and negotiate with contractors in a more flexible way.

- The fundraising process could be initially considered difficult due to significant reliance on owner contributions, low grant share provided, and the high interest rate of the bank loan compared to other projects. This implied different steps for the HOA, but also for the commercial bank (BISE) that had to keep frequent contact with BGK.

  However, the fast pace the whole project took considering this complex context suggests that the determination of the homeowners to execute the renovation of the building played an important role, acting as a driver for the process. This leads us to deem the fundraising process as normal.

5.6.3 Impact

5.6.3.1 Analysis of different case study indicators

An overview of all relevant indicators used to analyse the impact of this case study are presented below.

Category	Indicator	Result
Market	Number of dwellings involved (per building apartment)	80

Category	Indicator	Result
	Decision-making process among participants	Fast[26]
Economic[27]	Project NPV	not available / not used
	Owner's NPV	not available / not used
	Financial institution's NPV	not available / not used
	Total investment per renovated area	€ 56/m^2
	Easiness of the fundraising process	Normal[28]
Technical	Percentage of final energy saved	22.30%
	Percentage of non-renewable primary energy savings	19.72%
	Percentage of final energy consumed from onsite RES	0.00%

5.6.4 Co-benefits

- Better thermal comfort of the tenants
- More affordable housing expenses

5.6.5 Success factors and barriers

5.6.5.1 How the project objective was accomplished

The project objectives were accomplished, leading to a better performance of the building overall. This was achieved by:

- Reducing the thermal losses with the addition of a new layer of insulation on the external walls and the ceilings.
- Reducing the infiltration levels, which caused thermal losses, with the replacement of windows and doors in the common parts of the building.
- Enabling the control of the heating system with the installation of thermostatic valves.
- Increasing the efficiency of the heating system by thoroughly cleaning the piping network.

5.6.5.2 Added value from the case study

[26] The HOA of the building located at Szkolna 10 showed a high level of determination to materialise the energy renovation of the building by switching to private managing to increase their flexibility to find contractors willing to perform the renovation works. In less than a year since applying for the grant, the refurbishment works of the building kicked off. Therefore, the decision-making process could be deemed as fast.

[27] Economic parameters such as NPV and IRR could not be estimated with high accuracy and were not used for analysing this case study.

[28] The fundraising process could initially be considered difficult because of the share of owner equity, grant, and loan (whose interest rate is rather high). However, the important level of determination shown by homeowners towards the renovation helped to ease and speed up this process. This leads us to reframe this initial guess and deem the fundraising process as normal in terms of difficulty.

A renovation process can be severely hindered if the rules set for the call for tenders are too strict to the point potential contractors are discouraged. That was the case for three out of the four participants in this case study.

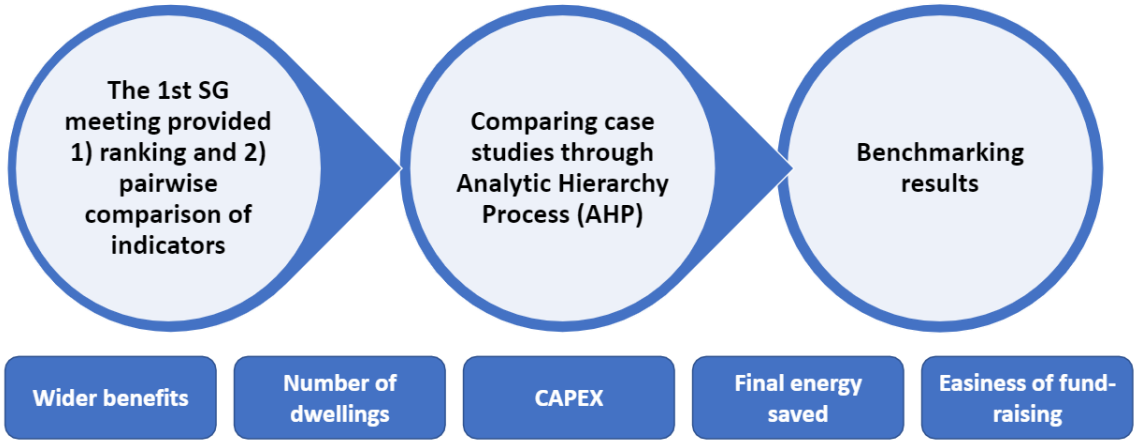
6. Benchmarking and key success factors

6.1 Benchmarking approach

The main takeaways from the analysed case studies were used as inputs for the benchmarking exercise that essentially started during the first Steering Group meeting, when the members provided a ranking and pairwise comparison of indicators.

Benchmarking continued with a focus on what in each case study made the investment decision possible and the case study successful. In addition to these two, the focus was on case study components that could be replicated in and lead to the success of similar projects around the EU.

Figure 8: Benchmarking structure



Case studies were compared using an analytic hierarchy process (AHP), which allowed us to compare different case studies by analysing the set of criteria and indicators agreed on after the first Steering Group meeting. After taking indicators' values into account, it was possible to obtain the final ranking of the case studies and explain what made a case study successful.

Indicators used for benchmarking the case studies were as follows:

- Wider benefits
- Number of dwellings involved
- Level of CAPEX
- Final energy saved
- Ease of fundraising

6.2 AHP results and main conclusions

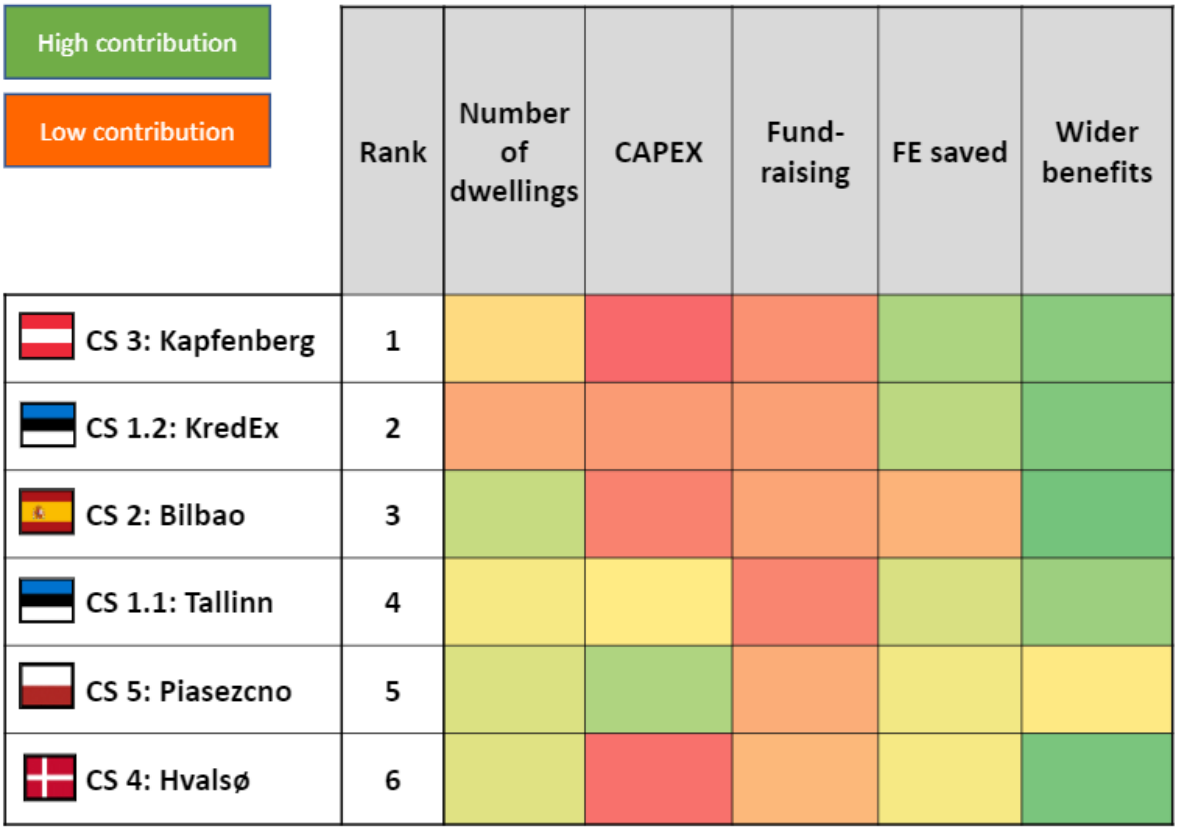
The most important results of the case study benchmarking are explained in the following matrix, where the importance of each indicator for success is indicated.

The result matrix presented in Figure 9 uses the heat map approach—different colours are used to depict the contribution of each indicator to the case study's success. The heat map

is based on a scale where green indicates the high and orange/red indicates the low contribution of an indicator.

The ranking of case studies does not necessarily play a dominant role in the benchmarking exercise because each project is unique, and comparison is not always possible. What is more important here is understanding the role of indicators in the success of each case study, and based on this, derive the list of key success factors for analysed case studies.

Figure 9: Benchmarking result matrix



The following are the main conclusions from the benchmarking of case studies:

- Wider benefits played a particularly important role in all case studies, having a high share of success in each of them.
- Highly ranked case studies were successful because of the high level of energy savings achieved, as was in case in Austria (achieved through innovative solutions) and Estonia (as required per grant programme).
- Although reducing the level of CAPEX is always desired, successful projects highly depend on a proper distribution of CAPEX to different project participants and optimal balance in private and public capital (grants, loans, and residents' contribution).
- Very strong awareness raising, if properly executed, can make residents and other project participants interested in renovation and convert an unpopular project into a popular one. What is interesting here is that awareness raising is equally important for projects with either a small or large number of project participants.

6.3 Key success factors

Merging individual analysis of case studies with case study benchmarking provided the list of key success factors that made the analysed case studies successful. Although all listed key success factors are important for case studies' success, one can see that the first three success factors are found in majority of the case studies.

The key success factors from the case studies are:

1. **Optimal distribution of private and public financing**

   Finding the optimal share that grants, loans, and residents' contribution should have in total CAPEX is crucially important for positive decision-making. For example, in case of the KredEx fund, the proper design of grants, their share in total CAPEX, and its link to energy performance was crucial for the success of the program.

2. **Identified and promoted wider benefits**

   Wider benefits and their importance for positive decisions and successful implementation of projects was visible in all case studies. As an example, one can point to the KredEx case study where significant wider benefits were not only achieved but also monetised and clearly documented. Another example of practical value of wider benefits is the case study from Hvalso, Denmark, which shows that if accounted for and implemented well, wider benefits can even support higher rents accepted by tenants after the renovation.

3. **High project understanding among and awareness raising for all participants**

   All case studies emphasise the importance of raising awareness as one of the key success factors. For instance, the case study from Bilbao, Spain shows that making residents interested by taking into account any potential expectation they may have from the building renovation is important for getting them involved. In addition, case studies from Estonia and Poland showed that by using a strong awareness raising approach, a dedicated HOA can change the initially low general interest of homeowners towards renovation.

4. **Highly active and knowledgeable local and national authorities**

   Local and national authorities often have an important role in the success of the renovation projects. They can either promote the project among different participants or support the renovation by providing a significant share of CAPEX. In any case, local authorities will cover this role much easier if they are devoted to renovation and ready to use their power and skills as much as possible.

   An example of an active and capable local authority comes from the Spanish case study, where local authorities implemented and monitored the renovation successfully and managed to collaborate with other levels of public authorities, such as regional governments, to secure funding.

5. **High quality of project design, supervision, monitoring, and coordination**

   Many building renovation examples show the importance of a high quality project as a component for overall project success. Regarding the analysed studies, the KredEx grant program managed to keep the energy renovation rates high due to the required high quality audits that were used to select the renovation measures. In addition, it is clear that targeted high energy savings in Austria case study were possible, mostly

due to the involvement of highly skilled professionals who were required to implement innovative technologies to secure deep renovation.

6. **Higher rent applicable after the successful building renovation**

   Possibility to apply higher rents to tenants in the case of significant post-renovation reduction in energy bills would significantly support financing of the projects and ensure the adequate distribution of renovation benefits and costs.

   An example from the Denmark case study showed that by applying higher post-renovation rents part of the CAPEX was indirectly distributed to tenants. This covered part of the renovation costs and significantly supported the positive investment decision by the building owner.

7. **High level of achieved energy savings**

   Always check if a higher level of energy savings is possible and opt for it, as visible in case of Austria where deep renovation led to project success, or in the case of Estonia where KredEx managed to influence the level of energy savings with higher level of grant.

7. Policy recommendations and complementary measures

Analysis of the case studies and the benchmarking exercise carried out under topic 1 suggest the following policy recommendations and complementary measures for facilitating the renovation of EU apartment blocks. The recommendations listed here are applicable either at the EU or Member State levels.

Additional extremely valuable contribution to the policy recommendations came from the Steering Group members who discussed and provided feedback on the benchmarking results. At the same time, they suggested some of the policy improvements, which are grounded in their recent experience from the building renovation field. The order of the recommendations mirrors the importance given by Steering Group members.

7.1 EU level

The European Commission could reform the cost-optimal methodology set by EPBD as leverage **for including different environmental, health, and climate benefits to MEP requirements**. In this way, Member States would be guided towards understanding and including wider benefits to their renovation policies, which would potentially lead to energy performance requirements more relevant to building owners and occupants.

In addition, European Commission would be advised to **develop a set of guidelines that would explain to FIs (Financial Institutions) how to take into account climate-related factors when addressing financial risks**. For example, in addition to existing techniques, a credit risk assessment of HOAs or building owners could include the reduction of energy bills or even wider benefits as an additional income source, therefore increasing the credit capacity of these clients.

New regulations should support the development of standardised methods for recognising the increase in property value as the result of the building renovation. These would **help FIs to include the property value increase in their investment decision-making**, which could drive the decision of undertaking a renovation project and effectively compensate low payback based only on energy savings. The increase in property value is not recognised by

FIs due to a lack of available data and a lack of standardised procedures, which could be one of the focuses when updating existing policies.

Renovation of apartment buildings could be significantly eased if financial institutions were able to combine technical expertise with financial expertise, which would then allow them to effectively identify and understand the performance of environmentally sustainable buildings. In this sense, **developing and regularly updating a set of guidelines for FIs covering the technical and financial issues of building renovation** is recommended.

Stronger involvement of FIs would be supported by **updating regulatory standards for banks and allowing reduced capital requirements for investing in building renovation**, which would be justified by reduced financial risks of these investments. In addition to better involvement of FIs, this would result in increased private investments in energy renovation and effective financial markets.

When designing its policies, EU could **require that every LTRS, NECP, or similar heavily relies on a dialogue between relevant stakeholders** who should provide an important input for these documents. For example, EPBD requires that when preparing their LTRS, Member States carry out a public consultation, but strong emphasis on equal involvement of all relevant project participants (such as HOA or FI) and an expected increase in renovation understanding is strongly advised.

The European Commission could **require Member States to implement dedicated funds for renovating multi-apartment buildings by using the momentum of the current EU budget, Recovery Funds, and the Renovation Wave**. For example, a Member State could be required to use the Just Transition Fund for training workers, use Structural and Cohesion funds and Recovery Funds for building renovation, and to constantly monitor and report on the impacts these programmes may have on the renovation of apartment blocks.

7.2 Country level

Local and national authorities could **introduce MEP requirements stricter than those defined in national building codes**, which would push for higher energy savings and show energy efficiency leadership at the local level.

Wider benefits should be heavily promoted in local and national policies, with authorities making sure these are recognised and considered by all participants, especially when energy savings alone do not ensure proper investment return. Wider benefits could be endorsed by:

- In the case funding is provided by national governments, participating **FIs could be required to recognise and include wider benefits** when evaluating the financial strength of projects and customers.
- National governments could **update their existing EPC schemes with an assessment of wider benefits** and require that EPCs reflect on the effects wider benefits may have on the technical and financial performance of renovated buildings.
- National governments can lead the way by **recognising and monetising wider benefits**, such as tax returns and different avoided costs, when preparing their annual budgets and when making decisions about energy renovation investments.

Local and national governments should be encouraged to **invest in line with an adopted national LTRS and NECP and keep the high renovation targets** specified there and to make building renovation a part of an integrated planning approach that takes into consideration RES and urban and district-based strategies.

Local authorities should **engage in gathering data on local building stock**, energy consumption, building typologies, age, and other aspects important for planning and implementing renovation. For example, utility companies, real estate developers, or designers may be required to keep a record of their projects and report relevant building related data back to local or national governments. Such actions would significantly support building renovation by promoting leading practices, recognising wider benefits, and allowing the design of effective financial schemes. The data gathered should be shared and fed back into higher level (national and EU) datasets.

Due to specific GDPR requirements, access to and exchange of renovation and building-related data is difficult, leading to expensive project planning. National governments could consider relevant GDPR requirements and **develop clear guidelines on how renovation and building-related data can be collected and used in compliance with GDPR**. Such adjustments would allow financial institutions, municipalities, one-stop shop providers, and similar organisations to share their data more easily, which would help the pre-investment project screening and significantly reduce the cost of finding the right building to retrofit.

Improving skills in the building renovation sector should be one of the priorities of local and national governments. In particular, updated policies could put emphasis on:

- Organising trainings or accreditation related to different fields such as nearly zero energy buildings, efficiency of energy supply systems, digitalisation, and innovation.
- Introducing a requirement that public financial support can be obtained only if renovation design and construction works are carried out by certified installers.

National and local governments should concentrate on **raising public awareness through extensive awareness-raising campaigns**. These campaigns should be customised to the needs of different project participants, such as residents, financiers, or construction companies, and should be delivered by highly experienced professionals from respective fields, and could be linked to advisory services such as one-stop shops to translate words into actions.

When supporting renovation, governments should **link grant funding with the higher level of energy savings** required. This should be done by keeping in mind that the optimal share of grant in total CAPEX, which would ensure financially attractive investment, is essential.

Updates to national regulations that would **put a significant focus on HOAs and their role and involvement in the renovation process** are highly recommended. Local and national governments could establish different programs for educating HOAs and raising their awareness and capacities about their role in project design, coordination, and execution. Simplifying and standardising HOAs' involvement through technical assistance and project promotion is also advised.

It is advised that policy updates for grants linked to energy performance and for putting additional focus on HOAs are introduced simultaneously because it is the synergy of these two what would provide a strong incentive to undertaking the building renovation.

Governments could consider **adding building renovation passports (BRP) or passport-like documents to existing** EPCs or transform EPCs into BRPs. It would help defining a long-term (15-20 years) step-by-step renovation roadmap for buildings. Such a document would support an increase in final energy savings and tailored deep renovations, while establishing clear communication, better understanding of renovation projects, and more effective awareness raising.

Updated policies should allow a **rent increase after the building renovation** in cases where this increase is lower than the reduction in energy bills. Such a policy update would

help proper distribution of both renovation costs and benefits, which would hopefully push building owners and other investors towards positive investment decisions.

Updated policies should make sure that if a national government is involved in financing building renovation, **project-related data is systematically monitored, collected, and reported into the EPC databases, for example**. For instance, different project participants, such as HOAs, FIs, or energy auditors, should be required to keep record of different project information and report these back to local or national databases. Such efforts would be extremely helpful for promoting leading practices, recognising wider benefits or designing efficient financial schemes. Collection and management of renovation-related data and regular reporting could be a task for dedicated national bodies, such as energy agencies or similar.

In addition, residential policies and housing laws could be revised by **lowering the share of positive votes in a multifamily building required for a positive decision** on building renovation. In this way, HOAs would be allowed to make renovation decisions in their respective buildings without requiring consent from a large majority of residents, which would enable a fast decision-making process. However, special care should be paid to votes and rights of vulnerable residents.

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