ENSURING SAFE AND ENERGY EFFICIENT BUILDINGS

How to integrate seismic-safety with energy renovations in the EPBD

POLICY BRIEFING JULY **2022**

Purpose of this paper

The EPBD recast can strategically support the uptake of seismic renovations alongside energy efficiency in the EU. This means ensuring a robust policy framework that prioritises renovation of worst-performing buildings in terms of both energy performance and seismic safety. This framework should be combined together with reliable and accessible technical and financial solutions.

This paper suggests practical ways that the EPBD recast can strategically support the uptake of seismic renovations alongside energy efficiency in the EU, in order to ensure concrete implementation of seismic safety measures where it is needed most.

This paper is presented by the e-SAFE H2020 consortium. e-SAFE aims to develop a new deep renovation system for non- historical reinforced concrete (RC) framed buildings, which combines energy efficiency and anti- seismic retrofitting actions with a series of further advantages including affordability, improved architectural image and reduced implementation time, costs and occupants' disruption. e-SAFE will also address strategies to activate new value chains to boost the deep renovation market throughout Europe, including financial and social aspects.

Introduction

Fighting the climate crisis, lifting citizens out of energy poverty and achieving energy security requires full decarbonisation of the EU building stock. The challenge is great: almost 75% of the building stock is inefficient and the EU average rate for deep renovation – i.e. leading to at least 60% energy savings – is only at 0.2% annually[1]. According to BPIE, this number must increase to 3% annually of deep renovation (or scaled up by a factor of 15) to reach the EU's 2030 and 2050 climate targets[2].

Amidst this urgency to rapidly upscale deep energy renovations, the European building stock faces another significant challenge. About 50% of European territory is earthquake-prone. In the last 50 years, earthquakes in Europe have caused over 36,000 deaths and around 1.4 million people becoming homeless[3]. In highly seismic countries, such as Greece, Italy, Croatia and Romania, a destructive earthquake would render investments in energy-efficient renovations unsustainable from a social, economic and environmental point of view[4].

Seismic safety has traditionally been treated separately from energy performance and has not entered into the decarbonisation narrative. The revision of the Energy Performance of Buildings Directive (EPBD) provides an opportunity to consider how strategically integrating seismic safety measures can in fact support and even reinforce implementation of energy efficiency measures. The ability of a building to withstand earthquakes, specific to its geography is directly linked to safety, and the aim to protect vulnerable citizens. Ultimately, by not following an integrated approach to renovation in seismic countries, there is a risk of using neither seismic nor energy renovation as a trigger point to invest in both simultaneously, representing a significant opportunity loss.

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In the last **50 years,** earthquakes in Europe have caused over **36,000 deaths** and around **1.4 million** people becoming homeless

1 European Commission (2019) Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU. Available at: https://ec.europa.eu/energy/sites/ener/files/documents/1.final_report.pdf

2 BPIE (Buildings Performance Institute Europe) (2021). The road to climate-neutrality. Are national long-term renovation strategies fit for 2050? Available at: https://www.bpie.eu/publication/the-road-to-climate-neutrality-are-national-long-term-renovation-strategies-fit-for-2050/

3 Source: Bournas, D., Innovative Materials for Seismic and Energy Retrofitting of the Existing EU Buildings, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-81995-7, JCR10990

4 La Greca, P. and Margani, G., Seismic and energy renovation measures for sustainable cities: a critical analysis of the Italian scenario, Sustainability, vol. 10,254, 2018.

STATUS QUO OF SEISMIC RENOVATION IN THE EPBD

The EPBD first and foremost aims to improve the energy performance of buildings and reduce their greenhouse gas emissions. The Commission's recast proposal additionally aims to protect vulnerable households, alleviate energy poverty and ensure housing affordability.

Within this vein, the recast proposal introduces language addressing seismic and other safety measures. The concept is inserted a handful of times, notably in the introduction of the concept of deep renovation, in article 7 on new buildings, article 8 on existing buildings, and article 26 on guidance and training.

Mentions of seismic safety are currently framed as light suggestions. Seismic renovation is barely (or not at all) incorporated in mandated plans, such as national building renovation plans. Nor is it included in key information tools, such as the building renovation passport, digital building logbooks and in energy advice provided by one-stop-shops.

Adjustments to the above-mentioned elements of the EPBD could result in a stronger framework for building renovation which ensure seismic safety measures, where needed, are strategically integrated to energy renovations.

In earthquake-prone countries, the most strategic renovation should integrate seismic safety with energy efficiency measures:

- In Bulgaria, a total of 51 earthquakes in the period between 2010 and 2016 caused damage amounting to €31 million[5]. In the past year, the country has seen a total of 1,200 earthquakes, of which 9 registering above a magnitude of 4, and 1 registering a magnitude above 5[6].
- Greece is often tested by large-scale earthquakes, while a moderate or small-scale earthquake is felt every 2-3 days on average[7]. In the past year, Greece has experience 32,680 quakes of which 145 of Magnitude higher than 4, 14 with a magnitude higher than 5 and 2 quakes with a magnitude higher than 6[8].
- In Cyprus, the Cyprus Geological Survey records about 500 seismic tremors every year[9]. In the past year, Cyprus was shaken by 2 quakes of magnitude 4 or higher, and earthquakes 17 with a magnitude of between 3 and 4[10].
- In 2020 alone, 110 seismic movements with a magnitude of over 3.0 degrees, and 10 with a magnitude of over 4, took place in Romania[11].
- In the past year, Italy has experienced 11,039 earthquakes, with 143 of a magnitude of 3 or higher, and 18 with a magnitude above 4. Due to the geodynamics of its territory, Italy counts a large number of earthquakes annually and can cause heavy damage in a circle of dozens of kilometers.

5 https://www.moew.government.bg/static/media/ups/articles/attachments/DRM%20%20Full%20Report%20-%20First%20Draft%20(2018-04-27)%20-%20EN%20 %20for%20printing%20v2675c5b0db190d4aa5dae48daf147c909.pdf

6 https://www.volcanodiscovery.com/earthquakes/bulgaria.html

7 https://spark.liceodesio.edu.it/mod/book/view.php?id=1873&chapterid=53

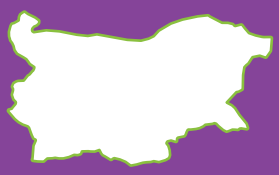
8 https://www.volcanodiscovery.com/earthquakes/greece.html

9 http://rochfordessex.com/informer/earthquakes-cyprus/

10 https://www.volcanodiscovery.com/earthquakes/cyprus/archive/2021.html

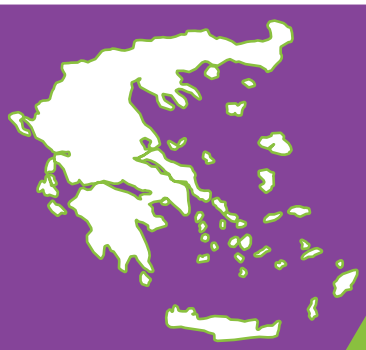
11 https://www.volcanodiscovery.com/earthquakes/romania/archive/2020.html

BULGARIA



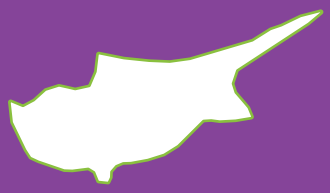
In the last year alone - **1,200 earthquakes**, of which 9 registered above a magnitude of 4, and 1 registered a magnitude above 5. A total of **51 earthquakes** between 2010 and 2016 caused damage amounting to €31 million.

GREECE



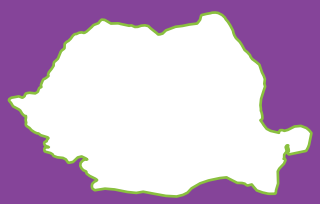
In the past year - **32,680 quakes** of which 145 of Magnitude higher than 4, 14 with a magnitude higher than 5, and 2 quakes with a magnitude higher than 6. A moderate or small-scale earthquake is felt every 2-3 days on average!

CYPRUS



In the past year - Cyprus was shaken by **2 quakes** of magnitude 4 or higher, and 17 earthquakes with a magnitude of between 3 and 4. Cyprus Geological Survey records about **500 seismic tremors** every year!

ROMANIA



In 2020 alone - **10 seismic movements** with a magnitude of over 4 took place in Romania and **110** with a magnitude of over 3.0 degrees.

ITALY

In the past year - Italy has experienced **11,039 earthquakes**, with 143 with a magnitude of 3 or higher, and 18 with a magnitude above 4. Italy counts a large number of earthquakes annually leading to heavy damage in a circle of dozens of kilometers.

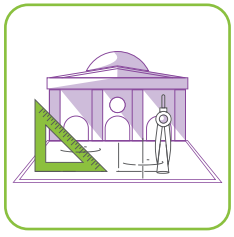
Is it safe to retrofit old homes and buildings with energy efficiency solutions in areas of seismic activity?

This question is at the heart of e-SAFE, an H2020 project working at the boundary where energy efficiency renovation blurs with building safety and risk management. e-SAFE has been developing three new systems for post-1950 concrete-framed buildings that can be used to improve a building's energy efficiency.

In the town of Catania, Sicily, Italy, a community of stakeholders was consulted during the co-design and implementation stages. In response, the consortium created customisable, prefabricated panels made from timber and locally sourced insulating bio-materials (such as hemp, cork, wood fibre, cellulose, or sheep wool). In earthquake-prone areas, these panels can be combined with novel structural systems that improve both the seismic and energy performance of buildings in sustainable ways.

SEISMIC RENOVATION AS PART OF A HOLISTIC, LONG-TERM, STEPWISE RENOVATION APPROACH: POSSIBLE SOLUTIONS TO STRENGTHEN SEISMIC SAFETY IN THE EPBD

This section identifies key elements in the EPBD where there is potential to better integrate seismic renovation with energy efficiency measures, in order to ensure a holistic, stepwise renovation approach. These include: National Building Renovation Plans, Minimum Energy Performance Standards, Building Renovation Passports and the Digital Building Logbook, Technical Assistance and Guidance and Training.



National Building Renovation Plans | Article 3, Annex II

The National Building Renovation Plan (NBRP) provides a clear opportunity to ensure that Member States prioritise renovation of their building stock, taking into consideration energy performance as well as seismic risk where applicable[12]. This would consequently affect how financial instruments and technical assistance are designed and deployed at the national and local level.

[12] Earthquake safety standards across Europe is mandated through a standard code (not binding regulation), Eurocode 8, which is applied in the context of the application of the Eurocodes for the design of Civil Engineering projects for public works. The Eurocodes essentially provide a 'recipe' to achieve earthquake safety but provide no political mandate and are entirely separate from private buildings and the wider narrative of building renovation, in view of reduction GHG emissions and protecting vulnerable citizens. Learn more about Eurocode 8 here: https://www.phd.eng.br/wp-content/uploads/2015/02/en.1998.1.2004.pdf

The EPBD has brought in national building renovation plans (NBRPs), replacing long-term renovation strategies (LTRS). NBRPs bring in a more ambitious vision for 2050, clear links to other planning tools, a better governance system, and a mandatory template for Member States. Article 3 lays down that each Member State shall establish a national building renovation plan to ensure the renovation of the national stock of residential and non-residential buildings, both public and private, into a highly energy efficient and decarbonised building stock by 2050, with the objective to transform existing buildings into zero-emission buildings.

However, aside from a soft suggestion in Annex II that national plans 'could include' policies and measures with regard to the increase of resilience against disaster risks, including risks related to intense seismic activity, anything more concrete on seismic safety is missing.

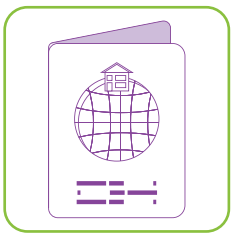
Given that NBRPs set the direction for the renovation of a national building stock with the objective of its decarbonisation by 2050, the NBRP is an important tool that can create the conditions for seismic damage prone Member States to integrate and prioritise energy and seismic renovations where needed.

Minimum Energy Performance Standards (MEPS) | Article 9

Minimum Energy Performance Standards (MEPS) have been introduced as a mandate policy. They require Member States to ensure that buildings owned by public bodies and non-residential buildings reach at least class F by 2027 and class E by 2030. For residential buildings, those requirements apply in 2030 and 2033. With the concurrent reform of the EPC system, class G will as of 2026 represent the 15% worst-performing buildings at national level.

The introduction of MEPS is a welcome addition to the policy framework that will likely trigger a series of interventions across Member States, identifying which buildings must be renovated as first priority.

By targeting from worst energy performing buildings, MEPS offer the opportunity to identify buildings that could use both energy and seismic renovation. In earthquake-prone countries, Member States, in addition to the EPC class, could also consider buildings with high seismic risk as worst-performing buildings. This would provide a more accurate picture of which buildings need to be renovated as priority and would go a longer way in protecting vulnerable citizens.



Building Renovation Passports and Digital Building Logbooks | Article 10

The EPBD recast proposal requires Member States to introduce a scheme for Building Renovation Passports (BRPs) by the end of 2024, based on a common EU framework established by the Commission by end of 2023. A BRP provides a customised renovation plan over a long-term period. It is used together with a Digital Building Logbook (DBL), a repository where all the building-related information can be stored and continuously updated.

BRPs should help overcome some of the biggest hurdles to home renovation, namely difficulty in the planning and decision-making process and risk of lock-in effect. Given this function, the tool represents a prime opportunity to ensure that energy efficiency and seismic renovation are considered and planned jointly in places where homes face high risk of earthquake damage (or even existing damage).

In these cases, failing to include seismic renovation measures from the energy renovation plan in the building passport could result in an uncoordinated renovation approach, not integrating energy saving measures with structural/foundational adjustments.

It also means that, where seismic renovation is an urgent need, these renovations may not be integrated into a holistic long-term plan with a view to achieving a zero emission building. In particular, two key risks must be considered: (1) excluding energy renovation for buildings in urgent need of seismic renovation, and (2) partial/insufficient consideration of energy elements when the focus is on anti-seismic renovation.

A Digital Building Logbook and Building Renovation Passport and would help address both of these risks by storing the necessary information (in the DBL), and providing a roadmap where seismic safety and energy efficiency measures could be integrated if needed (in the BRP).

> **In high seismic prone areas, Member States may even choose to promote the use of building renovation passports from an 'earthquake-first' approach, essentially using earthquake safety as a gateway to implementing energy savings, which may not be as high priority for building owners or occupants whose first preoccupation is earthquake safety**

Given that 50% of Europe is earthquake-prone, DBLs could include the seismic safety/risk profile of a building where applicable. Italy, for example, already has in place a separate seismic certification scheme which calculates both the expected economic losses from potential earthquake damage of a building, as well as a safety/risk index. To give a more complete and transparent picture of a building's overall performance and safety, the DBL could be designed to be interoperable with seismic certification databases, thereby indicating whether or not a given building already has a seismic certificate, and if so, what that label is. This information can be useful for the energy advisor to provide additional recommendations on seismic safety in the building renovation passport.

In this way, seismic resilience could then be integrated into the renovation roadmap to ensure that renovation plans take a 360 degree approach to building renovation, ensuring that opportunities to integrate other measures of high strategic importance for the building are not missed.

Example of existing tools: Italian Seismic Classification Certificate

Data from existing certification schemes such as the Italian Seismic Classification Certificate could be integrated into the digital building logbook.

The Seismic Classification is a certification scheme through which a qualified technician evaluates the seismic risk to which a given building is subjected.

It is expressed with a two indicators:

- **The Expected Average Annual Loss (PAM),** which takes into account the economic losses resulting from damage to structural and non-structural elements, with reference to the costs of reconstruction / renovation of the building. The PAM can be compared to the **cost of repairing the damage caused by seismic events that will occur during the life of the building, broken down annually and expressed as a percentage of the reconstruction cost.** For the calculation of these parameters it is necessary to calculate, referring to the point where the house stands, the peak accelerations to the ground upon reaching certain points of interest in the structure;

- The **Safety index (IS-V) of the structure** determines the achievement of the **Life Protection Limit State (SLV)**. The safety index (IS-V) of the structure is also commonly called the **"Risk Index"**.

The certificate is borne by the owner of the property and must be filed with the Civil Engineering Office competent for that territory and must be drawn up by qualified technicians, with proven specific skills in the sector.

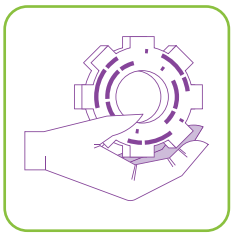
The Certificate comprises of 8 risk classes: A +, A, B, C, D, E, F, and G. Buildings in class G are in the maximum expected seismic risk conditions, while a property classified with risk A + is in the lower risk conditions foreseen.

The EPBD should require that, in Member States where this is applicable, national certification schemes on seismic resilience should be developed and this data should be fed into the digital building logbook and building renovation passport. In Member States where seismic labelling is available, it can be considered in other policies aiming the renovation of the worst-performing buildings.

Sources:

https://mtricci.it/news/certificazione-sismica-edifici

https://www.casewonderwall.com/blog/certificato-sismico-2020-tutto-da-sapere



Technical Assistance | Article 15

Technical assistance can cover how available funding can be accessed and spent, including advisory support for the identification, preparation, development, structuring, procurement, and implementation of investment projects. Article 15 of the EPBD recast includes stronger provisions on the removal of obstacles and barriers to renovation, and on the mobilisation of financial incentives with one-stop-shops accessible to the full range of stakeholders across the building ecosystem (ie, building owners, tenants, financiers, project promotors, manufacturers and those who design and implement the works), so that all barriers to building renovation, not only the costs, are addressed, and Member States promote appropriate training.

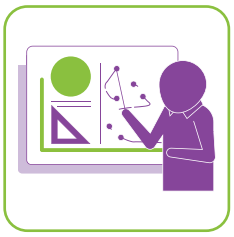
However, two key elements must be addressed: Firstly, deep renovation as an overall objective of technical assistance is missing, which should without question be an absolute priority. Without the clear objective to achieve deep renovation, there is a risk of a sub-optimal use of financial and advisory resources. For example, the proposal requires Member States to link their financial measures for energy performance improvements to the targeted or achieved energy savings, but there is no clear requirement to have a proportional link between the two[13].

Secondly, the set-up of Technical Assistance programmes represents an important opportunity to ensure an integrated approach to financing energy and seismic (where appropriate) renovations, which is currently missing. Where suitable, Technical Assistance designed with the objective of an integrated approach to renovation would help optimise use of funds and avoid complex management of different funding streams (ie, energy and seismic). Interventions should therefore be streamlined in order to make it easier for Member States to take advantage of the support offered by the EU via Technical Assistance by allowing them to aggregate use of funds directed to 'essential interventions' (structural, safety, seismic and energy) - of course under the conditions that the renovations carried out deliver the required improvements on all of them.

The EPBD therefore offers the opportunity to ensure one-stop-shops are designed according to local needs of by clearly requiring that one-stop-shops provide the following:

- technical advice, information about suppliers/construction companies, assistance in elaborating the renovation project focusing on both energy performance, seismic safety and any other elements directly impacting the structural safety and comfort of the building where applicable;
- information regarding funding for energy renovation and integrated energy (or seismic and other structural safety measures, where applicable) renovation at a low-interest rate and assistance in the application;
- information about subsidies and assistance in the application for energy renovation and integrated seismic/energy renovation;
- no upfront costs, nor repayments for homeowners until the works are finished and dwellers start saving on the bills;
- quality assurance of the works.

[13] BPIE (Buildings Performance Institute Europe) (2022). EPBD Recast: New provisions need sharpening to hit climate targets; Available at: https://www.bpie.eu/publication/epbd-recast-new-provisions-needsharpening-to-hit-climate-targets/



Guidance and Training | Article 26

With regard to training and guidance in Article 26, Member States are obliged to ensure that training addresses the importance of improving energy performance. The texts adds that Member States 'may also address' structural improvements, adaptation to climate change, fire safety, and risks related to seismic activity, among others. To ensure buildings in highest need of renovation receive adequate support, implementation of seismic safety measures (and their integration into an energy efficiency renovation) should be included as mandatory components of training and guidance programmes offered in seismic-prone countries rather than be treated as an option.

All in all, training and guidance programmes should be understood by Member States and local authorities as an opportunity to provide value to communities by taking a 360 degree approach to buildings' renovation needs, with both deep renovation and safety as the goal.

Conclusions

About 50% of European territory is seismic prone. Seismic safety has traditionally been considered separately from energy performance. However, maintaining this separation can lead to wasted investments and even more serious consequences. It may even multiply the number of renovations and interventions over time, by increasing and replicating the well-known difficulties and barriers to renovation for owners and occupants (ex: dust, noise, limited access/use of one's dwelling and costs) and the shortage of skilled labour to deliver the €35M renovations by 2030 foreseen in the Renovation Wave.

This approach can be now rectified and the EPBD can be used to promote an integrated approach. As a cornerstone legislation regulating building renovation, it can be used to maximise the benefits of renovation by allowing Member States to adopt - where suitable - an integrated approach to decarbonise, protect citizens and lift them out of poverty.

This paper thus suggests a number of practical ways that the EPBD could foster concrete implementation measures to promote investments in integrated seismic safety and energy efficiency measures in high-seismic zones where they are most needed:

- Given that NBRPs set the direction for the renovation of a national building stock with the objective of its decarbonisation by 2050, the NBRP should lay out the conditions for seismic prone Member States to integrate energy and seismic renovations.
- In addition to the EPC class, in earthquake-prone countries, Member States could also consider buildings with high seismic risk as *worst-performing buildings*.
- The Digital Building Logbook and Building Renovation Passport should jointly ensure that seismic renovation measures are integrated into a building's energy renovation plan. The DBL could be interoperable with existing seismic certification databases, thereby indicating whether or not a given building already has a seismic certificate, and if so, what that label is. This information can be used by the energy advisor to provide additional recommendations on seismic safety in the building renovation passport.
- In high seismic prone areas, Member States could choose to promote the use of building renovation passports from an 'earthquake-first' approach, essentially using earthquake safety as a gateway to implementing energy savings, which may not be as high priority for building owners or occupants whose first preoccupation is earthquake safety.
- Technical and financial interventions for seismic and energy renovations should be streamlined in order to make it easier for Member States to take advantage of the support offered by the EU via technical assistance by allowing them to cluster/aggregate use of funds directed to 'essential interventions' (structural, safety, seismic and energy).
- Implementation of seismic safety measures (and their integration into an energy efficiency renovation) should be included in training and guidance programmes offered in seismic-prone countries.

Authors	Caroline Milne, BPIE Victoria Taranu, BPIE
Reviewed by	Mariangiola Fabbri, BPIE Oliver Rapf, BPIE Hélène Sibileau, BPIE Vivian Dorizas, BPIE Jo Junkel, BPIE Giuseppe Margani, UNICT Laura Vivani, Moverim
Graphic design	Penrose-CDB

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