CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

(CT4) Renovation Strategies

Status in 2022

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1. Introduction

Article 4 of the Energy Efficiency Directive (EED, Directive 2012/27/EU) on long-term strategies for building renovation has been transferred to the Energy Performance of Buildings Directive (EPBD), Article 2a, as part of its amendment, Directive (EU) 844/2018. EPBD Article 2a, which is related to Long-Term Renovation Strategies (LTRS), shall accelerate a cost-effective renovation of existing buildings towards a highly energy efficient and decarbonised building stock by 2050. The article is complemented with new paragraphs, inter alia, regarding a roadmap for a decarbonised building stock with indictive milestones for 2030, 2040 and 2050, measurable progress indicators, requirements for the mobilisation of investment into renovation, and public consultation on the Long-Term Renovation Strategy. Beyond that, the EPBD requires that the Long-Term Renovation Strategies address energy poverty and wider benefits such as health, safety and air quality.

All Member States were obliged to submit their 3rd Long-Term Renovation Strategy in line with EPBD Article 2a by 10 March 2020. The CA EPBD central team for 'Renovation Strategies' supports the implementation of these Long-Term Renovation Strategies through the exchange of information and experience on national implementation processes among the individual Member States. The Renovation Strategies central team has strong links to the central teams for 'Existing buildings' and 'Smart finance'. An overview of all the components of 2a is presented in Figure 1.

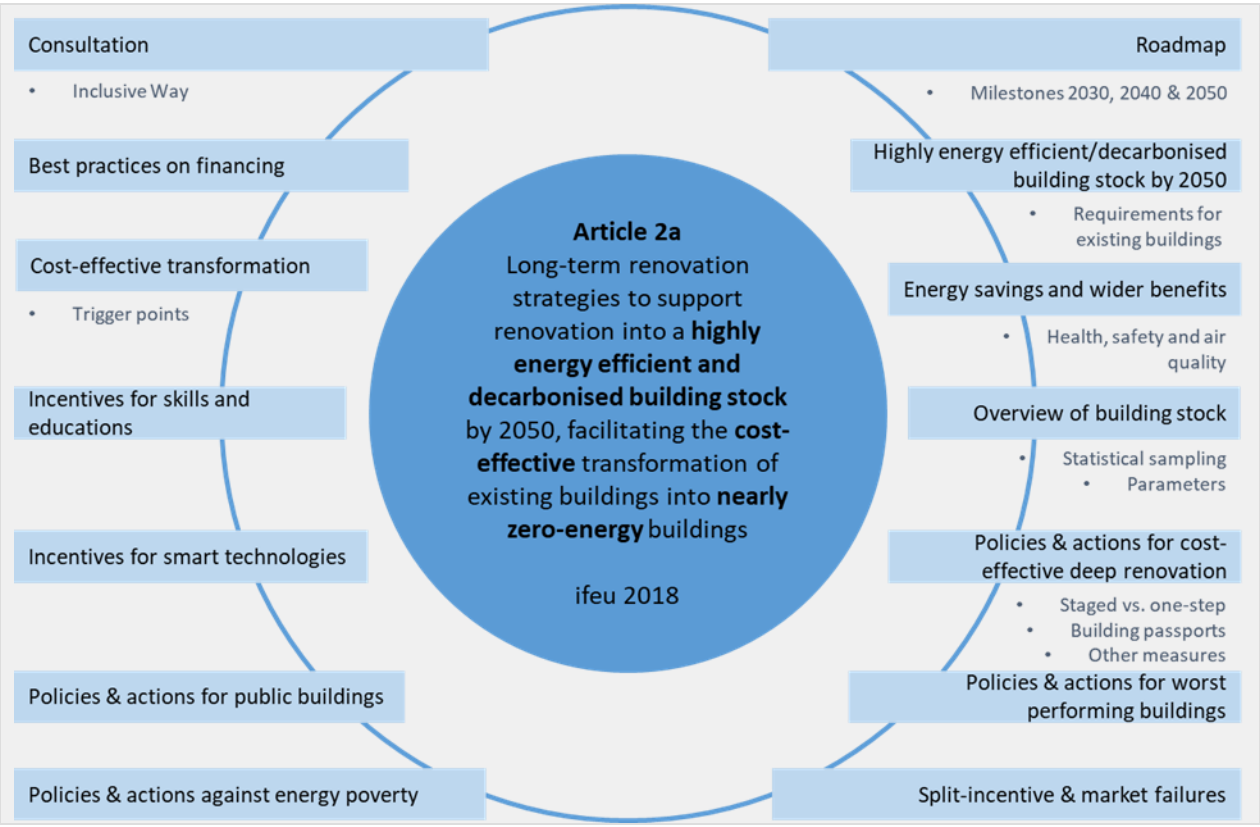

Figure 1: Overview of EPBD Article 2a components (source: ifeu according to EPBD).

The Commission published recommendation (EU) 2019/786 of 8 May 2019 on building renovation, where guidelines and good practices are presented to support Member States in transposing and implementing EPBD Article 2a[1].

2. Objectives

The aim of this central team's work is to support Member States in the preparation and implementation of their Long-Term Renovation Strategies as defined in the newly introduced EPBD Article 2a. Although all Member States had already submitted two Long-Term Renovation Strategies – one in 2014 and one in 2017 – the new paragraphs as well as adapting and updating the previous versions has been challenging for many Member States.

Thus, the main concern of the Member States is to improve on the existing LTRS, filling the (data) gaps and adequately addressing the new elements and components of the Directive.

In addition to the requirements of the previous Long-Term Renovation Strategy (LTRS), the new paragraph (EPBD Art. 2a) encourages the evolution of future policies and measures with the new obligation to set up roadmaps to 2050. This also encourages enhanced renovation targets, with indicative milestones for 2030, 2040 and 2050. Wider benefits, such as benefits related to health, safety and air quality are also mentioned explicitly in paragraph 1 (g).

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Major components of the new Article 2a concern:

- expectations regarding the **share of renovated buildings in 2020**;
- the additional consideration of **trigger points** in the life cycle of the building to support the identification of cost-effective approaches for renovation;
- the enrichment of policies and actions to stimulate cost-effective deep renovation;
- measures for renovation – for example by introducing an optional scheme for **building renovation passports**;
- the **alleviation of energy poverty** by outlining relevant national actions and summarising policies and actions to target the worst performing segments of the national building stock;
- the introduction of policies and actions targeting all **public buildings**;
- the promotion of **smart technologies** and **well-connected buildings and communities**, as well as **skills** and **education** in the construction and energy efficiency sectors;
- the focus on **wider benefits**, such as those related to health, safety and air quality;
- **a roadmap**, including measures and progress indicators up to **2050,** to contribute to a **highly energy efficient and decarbonised building stock** (i.e., reducing greenhouse gas emissions in the EU by 80-95 % compared to 1990). This requires indicative milestones for 2030, 2040 and 2050 and specific information on how Member States will contribute to achieving the energy efficiency targets in accordance with Directive 2012/27/EU;
- the mobilisation of investments in renovation according to Article 2a Paragraph 3;
- the inclusive **public consultation** on the Long-term Renovation Strategy prior to submission to the Commission, as well as during implementation;
- the documentation in an annex, of details on the implementation of the most recent Long-Term Renovation Strategy;
- the use of the Long-Term Renovation Strategy to address **fire safety** and risks related to intense **seismic activity** affecting energy efficiency renovations and the lifetime of buildings.

The above-mentioned components are discussed within the CA EPBD sessions of the central team for Renovation Strategies, CT4. This report reflects the discussions in the respective sessions and reports ideas and interpretations brought forward by the Member States and the experts invited to the sessions.

3. Analysis of Insights

Until March 2022, the CA EPBD central team for ‘Renovation Strategies’ (CT4) was in charge of ten sessions that centered around procedural, methodological, strategic and policy questions of EPBD Article 2a. Furthermore, CT4 contributed to several sessions led by other Core Teams, as well as a central team Working Group and participation in the Working Group Renovation Wave. The following paragraphs summarise the main outcomes of the sessions organised by the CA EPBD central team for ‘Renovation Strategies’.

3.1 Public participation

Public participation describing the interaction between government and the public is considered to result in **better outcomes and better governance**. It results in greater acceptance of decisions and implementation because public interests are better reflected, as well as bringing new ideas and approaches.

Thus, Article 2a Paragraph 5 requires, as part of the preparation of the Long-Term Renovation Strategy, **'a public consultation on their Long-Term Renovation Strategy prior to submission to the Commission**.'

3.1.1 Possible methodologies for public participations

Possible methods for public participation are widespread, ranging, for example, from face-to-face settings to electronic and internet technology-based approaches[2]. The level of interaction can extend from informing and listening through dialogue, debate and analysis to implementing jointly agreed solutions.

Concrete methodologies include very different formats, including:

- citizens' juries, summits or panels;
- user panels;
- open space;
- neighbourhood forums;
- focus groups;
- participatory appraisal or budgeting;
- e-petitions;
- wikis;
- world cafés;
- online forums;
- opinion polls;
- interviews;
- study groups;
- comply or explain principle;
- questionnaires and surveys;
- public meetings, information centers or open houses;
- electronic democracy;
- roundtables.

3.1.2 Public Participation in the Member States as presented in the 2018 meeting

Ireland

To enable the implementation of the Long-Term Renovation Strategy in Ireland, updates were required to the Irish Building Regulations, covered by two 'Part L' documents – one for residential buildings and the other for non-residential. It transpired that NZEB (nearly-zero energy building) was a term well known throughout the construction industry. To deliver the public consultation, the Department of Housing worked closely with the Department of Communications, Climate Action and Environment and the Sustainable Energy Authority of Ireland (SEAI).

The process was three-fold. Firstly, face-to-face meetings and presentations were arranged with relevant stakeholders, including members of the construction industry, NGOs and professional bodies. This was followed by a draft legislation publication with a request for online written feedback. There was then further consultation with stakeholders prior to publication.

The website that facilitated the online consultation included a template for comments to enable easy collation. It was found that most of the comments came in on the closing days. The further processing of the comments took a lot of time – 2-3 months – including responses and explanations provided for each comment.

The second round of stakeholder meetings and presentations was to document for the stakeholders that their concerns had been addressed and to ensure there were no surprises once the final legislation was published.

Advice would be to highlight the key changes to regulation and present the intention rather than give too many choices. Feedback can be incorporated where relevant. The main challenge was how to reach the right audience, including members of the general public.

Denmark

In 2013, the Danish LTRS Network was formed as part of the consultation process for the first LTRS. The Minister in charge wanted strategies to be based on knowledge and therefore wished to involve the whole sector. Acceptance of the strategy by stakeholders was seen as important, which is easier if the relevant stakeholders are involved at the consultation stage. The consultation was an open process, which relied on knowledgeable individuals, not necessarily members of specific organisations. Forty chosen stakeholders were invited to select four individuals each from the industry, allowing for a network of approximately 200 people. Six work groups were formed to focus on each building type (single-family houses, flats, public buildings, businesses), with two cross-cutting themes (financing and economic security, innovation and green businesses).

The consultation was a collaborative exercise with a common agenda, trying to focus on the common interests of all stakeholders. Each working group set their own rules for their decision-making process. Twenty-one initiatives were handed over to the Ministry, and a large number of them were included in the resulting government strategy.

Stakeholders were happy to be part of the process and felt that they had influenced the political process. The conference also triggered new partnerships within the construction sector. It was important for the government that the sector took ownership of the strategy.

The major challenge faced was finding the time and resources. Success factors included the co-creation of a common agenda and the commitment to joint decision-making whilst allowing for disagreement amongst participants, and new networks and partnerships that were formed in the sector.

Germany

Germany has launched several processes in the last four years to intensively discuss the strategy for buildings: the '*Energiewende-Plattform Gebäude*' was launched in 2014 to prepare the ground for the '*Effizienzstrategie Gebäude*', the efficiency strategy for buildings, which forms an essential part of the LTRS as well. This platform has continued to meet since then. In parallel, the '*Baukostensenkungskommission*' was formed to discuss the potential for reducing the cost of renovation while maximising the benefits. And finally, the stakeholder process of the '*Klimaschutzaktionsplan*' also discussed building measures.

Other Examples

The Buildings Performance Institute Europe (BPIE) reviewed the strategies of selected countries (Croatia, Czech Republic, France, Greece, Hungary, Ireland, Italy, Poland, Spain) and also pointed out good examples of consultation with the ***Plan Bâtiment Durable*** in France and the **Rehabilitation Working Group (GTR)** in Spain. The French initiative was launched in 2009 and consists of a permanent team, an office and an assembly including in total between 200 and 300 persons from the building, energy and environment sectors as well as from insurance companies, engineering firms and banks[3]. The Spanish GTR is a group of industry and technical experts, and released a report in 2012 with an action plan for a new housing sector[4].

3.1.3 Critical Success Factors for public participation

Based on group discussion, the following would be considered useful suggestions:

- discussion on rules and a clear understanding of the organisation of the process;
- keep on track and avoid getting stuck on one issue, despite disturbances from lobbyists;
- a nominated lead to facilitate and move conversation along;
- professional facilitation from experts in the field;
- single communication for complex issues;
- promotion of thinking outside the box;
- continuity of the dialogue and process;
- focus on co-creation and acceptance;
- sufficient education and training;
- ensuring that results of discussions are gathered and summarised;
- limit responses by offering options;
- structured and controlled process with a stepped approach;
- strike a balance amongst the participating stakeholders;;
- hold a transparent discussion, with no hidden agenda
- responding to comments is rather time-consuming.

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Some barriers to successful public consultation were also raised in discussion. These included cost and administrative issues, language barriers, pressure from lobbying groups, large group sizes and a lack of interest of key stakeholders. The question was also raised about how to engage with less organised groups of stakeholders. It was suggested that running more targeted events may be a solution.

Highlights of 3.1	Broad selection of methodologies for public participation, allowing for co-creation and creativity.

Main Outcomes of 3.1

Public participation describing the interaction between government and the public is considered to result in better outcomes and better governance. The main benefits are a higher acceptance of decisions and implementation because public interests are better reflected, as well as the contribution of new ideas and approaches. A number of different methodologies were discussed, from world cafés and focus groups to opinion polls and roundtables.

Participation approaches differ according to particularities of the countries. While in Denmark 40 stakeholders were invited, who in turn were allowed to invite four others, a combination of invited web-based feedback and two stakeholder meetings were carried out in Ireland. Croatia leveraged synergies by planning the public consultation as a side-event to a conference. The individual approaches in the Outcomes also varied across the Member States: since the public consultation in Denmark started with discussion of potential measures, the outcome was a set of 21 proposals and measures. In Ireland, comments and feedback were sought on official documents; and in Croatia, the outcome was a signed joint charter.

The three presented public consultation processes all show different characteristics: One major advantage in the Danish process was that the minister gave positive impetus on the kick-off of the consultation process. In addition, the formation of subgroups defining their own rules allowed target-group oriented discussion. In Ireland, the public consultation was well structured with a clear timeline. Due to the open web-based feedback format, one of the major challenges was to reach the right audience. The organisation of the public consultation as a side-event to a conference in Croatia enabled the cooperation of a broad range of stakeholders.

Success factors include clear rules, professional moderation, and appropriate structures for lobby groups. Challenges are, amongst others, cost and administrative issues, language barriers, pressure from stakeholder groups, large group sizes, and a lack of interest among key stakeholders.

3.2 Indicators, milestones, scenarios and National Energy and Climate Plan (NECP)

As part of the Long-Term Renovation Strategies (LTRS) required under Article 2a of the revised EPBD, Member States are asked to develop a roadmap with measures, progress indicators, and indicative milestones to ensure compatibility with the long-term targets.

In its Long-Term Renovation Strategy, each Member State shall set out a roadmap with measures and domestically established measurable progress indicators, with a view to the long-term 2050 goal of reducing greenhouse gas emissions in the Union by 80-95% compared to 1990, in order to ensure a highly energy efficient and decarbonised national building stock and in order to facilitate the cost-effective

transformation of existing buildings into nearly-zero-energy buildings. The roadmap shall include indicative milestones for 2030, 2040 and 2050, and specify how they contribute to achieving the Union's energy efficiency targets in accordance with Directive 2012/27/EU.

In the context of the CA EPBD, different elements of the LTRS were discussed, including strategic approaches (chapter 3.2.1), links to NECPs (chapter 3.2.2), indicators and milestones (chapter 3.2.3) as well as trigger points (chapter 3.2.4).

3.2.1 Strategic routes towards decarbonisation in the LTRS

The inherent goals of the LTRS - i.e., the highly energy-efficient and decarbonised building stock - pose strategic challenges, but also methodological questions regarding the definition and quantification of milestones and indicators[5].

Each Member State has different strategic approaches and challenges to decarbonise its building stock, given the different points of departure with respect to the energy mix, the climate conditions, the traditions and preferences, as well as the building stock characteristics. These strategic aspects were collected in country posters.

The balance between heating and cooling with renewables and energy efficiency. One example for an energy-strategic decision is the contribution of renewables and energy efficiency to the overall decarbonisation target. The balance between the two approaches depends on, amongst other things, available RES potentials, the characteristics of the building stock, energy price levels, and implemented policies.

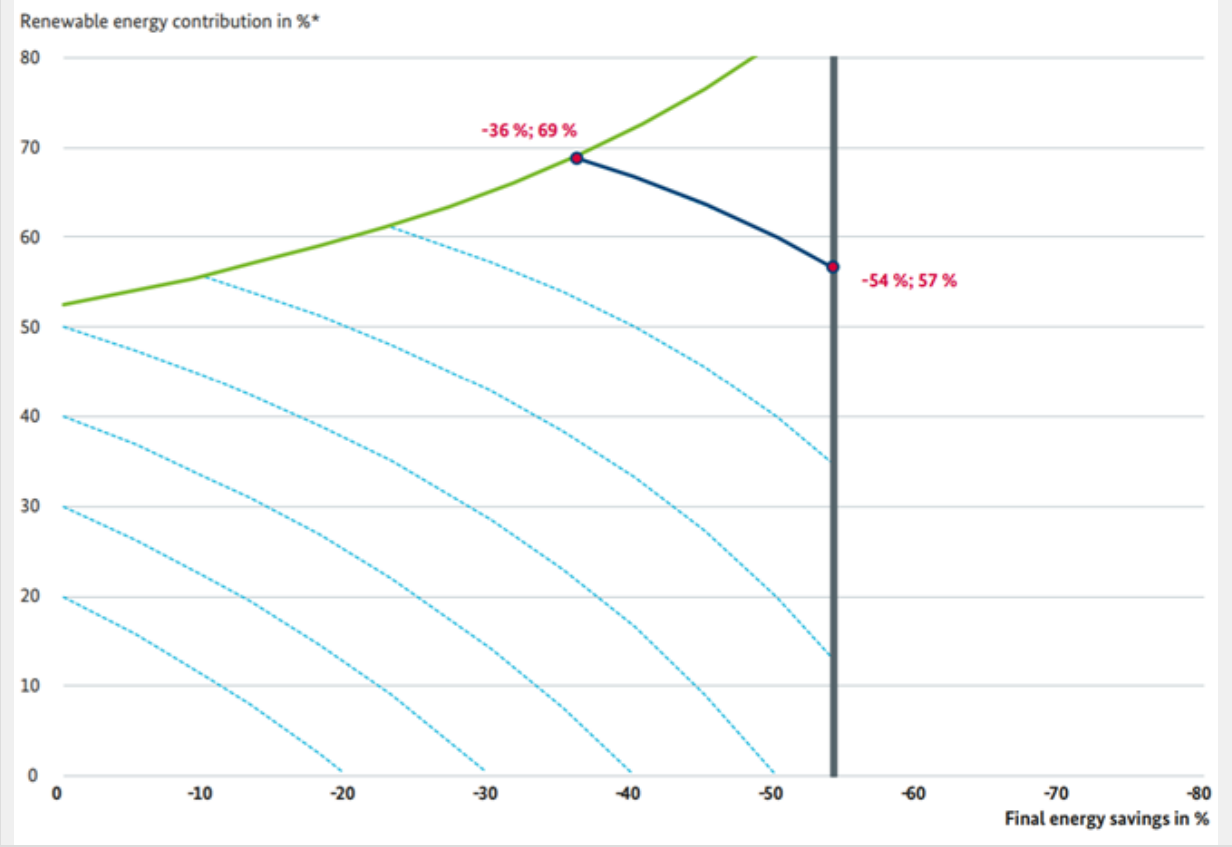

Figure 2: Corridor to achieve the -80 primary energy target: combining energy efficiency and RES (BMWi 2016).

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The figure shows how Member States' approaches vary with respect to the contribution of renewable energy versus efficiency to the overall savings targets. It should be noted that different Member States have different system boundaries, base years and methodologies, so the results presented are not directly comparable.

As an example of how to deal with the ratio between efficiency and renewables, the **German** Energy Efficiency Strategy for Buildings of the German Government (BMWi 2016) is based on a detailed investigation of insulation restrictions (e.g., protected houses and facades), RES potentials (GIS based calculations of geothermal, solar thermal, PV, biomass, and heat pump availability), and available district and waste heat potentials. It derives a roadmap for an optimal strategy to achieve the 2050 target of reducing non-renewable primary energy demand of buildings by 80% to 2050. The strategy recommends final energy savings between at least 36% (coupled with very high shares of RES of 69%) to energy savings of 54% (in combination with 57% RES share). Energy savings in the total building stock of more than 54% yield proportionally higher system costs. Based on this roadmap, two detailed scenarios were calculated (Prognos, ifeu, IWU 2016) and form the foundation for the NECP calculation. On top of that, a macroeconomic analysis determines the employment effects and wider benefits of these scenarios (Prognos 2017). An on-going debate concerns the degree to which heat pumps will be employed for heating. Different scenarios quantify up to 6 million heat pumps in the year 2030. Studies analyse optimal expansion paths for heat pumps, in combination and competition with the continued installation of gas boilers which would then increasingly employ green gas (power to gas, biomethane).

	Share of RES in total heating and cooling demand			*Savings in final energy demand for building stock*			Base year	Scale	not yet decided
Country	*2018*	*2030*	*2050*	*2018*	*2030*	*2050*			
Austria							1990	quantitative scale	
Belgium / Flanders							2007	qualitative scale	yes
Bulgaria								qualitative scale	yes
Croatia							2017	quantitative scale	
Cyprus							2010	quantitative scale	
Denmark							2005	quantitative scale	yes
Estonia								quantitative scale	yes
Finland							2012	quantitative scale	
France							2012	quantitative scale	
Italy							baseline	quantitative scale	
Luxemburg							1995	quantitative scale	
Slovakia							average of 2001-2005	quantitative scale	
Spain							2015	qualitative scale	yes

Figure 3: Contribution of RES and final energy demand reduction to the overall targets in selected countries (Status 2020).

As a way to determine cost-effective pathways towards decarbonisation, **Flanders** investigated the cost-optimal energy performance levels for the renovation of residential buildings in a 2015 study. The energy performance requirement was set at E90, which expresses the ratio of annual primary energy consumption divided by a reference consumption. The study showed that the macro-economic optimum, depending on the building type, was between E43 and E80.

These insights formed the basis for the long-term objective for 2050 for residential buildings, which was established in 2016 in consensus with 34 stakeholders. It consists of two equivalent tracks the owner can choose: a package of measures (U-values of building shell and heating system) and an energy performance indicator, offering more flexibility to reach the goal and aiming for an energy level equivalent to an energy score (EPC) of 100 kWh/m^2, or E60. With this scenario, a reduction of energy use of 76% compared to 2012 can be achieved in 2050.

In this approach, it was assumed that the long-term objective is achieved without the application of renewable energy sources: heating and production of domestic hot water are provided in the scenario through a condensing gas boiler. The Flemish Energy vision, however, states that the energy sources for heat and refrigeration will be various and increasingly renewable (ambient heat, geothermal, solar heat and so on) in the future. A follow-up study on cost-optimal renovation, taking into account the costs of the replacement of fossil-fuel-driven installations by renewables, is essential. Meanwhile, a decarbonisation plan is being prepared. To promote the use of heat pumps, the price for (renewable) electricity, which is very high due to various taxes and the incorporation of the cost of energy efficiency-grant schemes, should decrease. This could be obtained by shifting these extra costs to the tariff for gas.

Non-cost-effective renovations. Cost-effective renovations have been determined in the 2014 and 2017 LTRS, but there is still a certain part of the building stock where the renovation actions are not cost-effective or hard to implement. This is another strategic challenge in the LTRS and is the case in many residential buildings in Mediterranean countries, where energy savings are less significant, meaning that payback periods would be so long that renovations would never take place. Also, in some energy-poor households, where heating is limited due to energy cost constraints, renovations are not cost-effective. The LTRS roadmap can also provide answers for this building segment.

Spain, for example, has a range of very different climatic zones: Atlantic, Continental, Mediterranean and the Canary Islands. In some of them, energy savings would be less significant, making payback periods so long that renovations would never take place if they had to be cost-effective. The 2017 LTRS started to explore this problem, which would probably mean that there is no need to renovate the building envelope of the whole Spanish housing stock, but only to define partial refurbishments (double glazing, bioclimatic and shading mechanisms, etc.) for Mediterranean areas. On the other hand, there are excellent opportunities for solar energy. Solar energy self-consumption has recently been regulated and it is expected that it will play an important role in the future. Energy poverty mitigation is another type of initiatives which can lead to non-cost- effective renovation, but in this case, there are other wider benefits that can be considered in macro-economic terms.

Role of heat supply options and energy carriers for heating. The role of the various fossil and renewable heating and cooling options varies significantly from country to country. For example, the role of capital cost-intensive and long-term infrastructures, such as gas and district heat pipelines, are discussed in the Member States, as well as the future share of power to gas, power to liquid, and electrification of the heating sector.

3.2.2 Links between LTRS and NECPs

The milestones to be reported in the LTRS, together with the indicators and the expected energy savings and wider benefits, will be based on the integrated NECP. In these NECPs, Member States must also describe the LTRS, including the policies, measures and actions required under Article 2a of the revised EPBD.

Some points and issues that were raised through the questionnaire included:

- Member States generally have a close link between NECP and LTRS;
- A problem can arise when the two are carried out by different ministries, which is the case in some Member States. In other Member States, there is a division between state and federal responsibility which can aggravate the problems.

For example, in **Belgium** (Flanders Region), in order to prepare the energy transition and draw the path towards a new energy model, starting in 2016 the Flemish Energy and Climate Agency worked on a long-term vision in consultation with citizens, the building sector and civil society. On the basis of five pillars (energy efficiency, renewable energy, flexibility, financing and governance), the vision of the Long-Term Renovation Strategy was designed and concrete proposals were made for policy and action on the ground. The outcome was largely incorporated in the LTRS and the NECP builds further upon this basis. In order to achieve the EU 2030 objective for energy efficiency of 32.5%, the existing policy from the LTRS (grants for energy efficiency measures, solar boilers and heat pumps, and energy performance standards for deep renovation) proved to be insufficient, and additional policy measures were formulated in the NECP. More recently, there was a shift from stimuli to specific obligations for renovation. As a result, they will be incorporated in the next version of the LTRS.

For the LTRS in **Croatia**, the country has established an 'Open partner dialogue' and 'Signing a Charter on cooperation aimed at decarbonisation of buildings by 2050'. The dialogue gathered representatives of state administration and local self-government units, the academic community and public experts, the construction and energy sector and their supporting industries. The aim is to foster through common dialogue the successful implementation of the nearly zero-energy buildings standard as well as the national long-term strategy of the energy renovation of buildings; this is to support the transformation, by 2050, of the existing building stock into a decarbonised and highly energy-efficient building stock. By signing the charter, the efforts for constructive, active and continuous action by all stakeholders will be reaffirmed. NECPs are organised in workshops and panel discussions with specialists and representatives of the state administration. The link between them is organised so that representatives from the energy and climate sector are participating in all workshops, discussions and consultations. The current version of NECPs include data from the LTRS 2014-2017 which will be updated in 2020 when the new LTRS is due to be finished. Also, the current version of NECPs refer to scenarios for building and energy strategy from previous years. Those scenarios will be reviewed in the new LTRS and aligned with all the strategic documents in the Republic of Croatia.

3.2.3 Indicators and milestones

EPBD Article 2a leaves a great degree of freedom for the Member States to define indicators and milestones. **Indicators** describe – quantitatively or qualitatively – the state and progress with respect to the decarbonised building stock and include, for instance, the number of buildings (per type, age, etc.), their energy demand, the annual share of renovated buildings, or the renovated area, etc. The indicators can also describe the various policies and measures as required in Article 2a, i.e., public incentives for deep renovation, public investments addressing energy poverty and split-incentives, the number of buildings equipped with building energy management systems, the number of skilled workers, etc.

The **milestones** describe set goals which contribute to the overall EU energy efficiency targets under the EED. This could, for instance, be the energy and CO_2 emission savings in the building sector, but also the percentage reduction of people affected by energy poverty, etc.

In 2019, the Commission published a Recommendations document[6] aimed at helping Member States apply the new and revised parts of the EPBD. This document is for guidance and does not alter the legal effects of the Directive. In terms of milestones and indicators, the document provides these as a way of measuring progress towards achieving goals and specifying how measures will contribute to the EU's targets. They are intended to provide useful information for Member States and are presented in a table alongside the paragraphs in Article 2a to which they relate. It is recommended that Member States use these early in the definition of LTRS – perhaps with some adjustments for local requirements – so that stakeholders have a

clear understanding of the roadmap. A section in the recommendations provides examples of good practice. Some of these are the 'Build Upon' project which brought together government, businesses, NGOs and householders.

Member States databases can provide useful background information but are not always up to date. For example, renovation works that are carried out privately are usually not recorded in any database until their next Energy Performance Certificate (EPC) assessment is carried out. Other Member States found that it is difficult to define assumptions over the long-term, which means that targets can shift over time. Also, due to different climatic conditions, there can be differences in targets across a country.

Figure 4 summarises the results from the questionnaire.

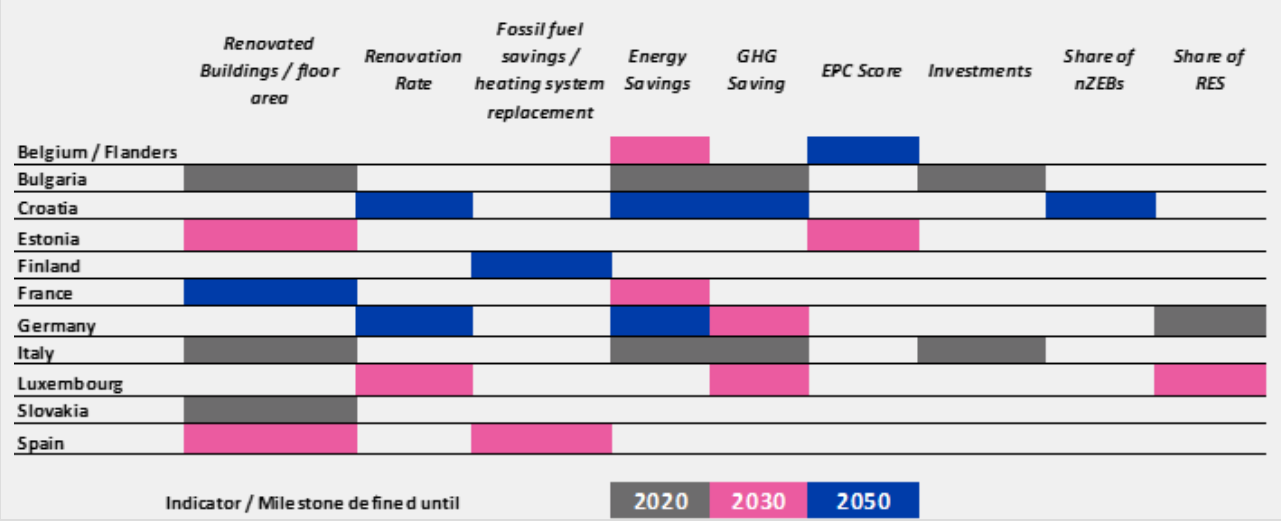

Figure 4. Indicators used in the respective LTRS of the countries[7].

In Flanders in December 2018, a free building passport tool was launched, offering the residential building owner insight into all information that is publicly available on the building as well as the energy performance, solar potential, soil contamination, building quality and so on. The EPC with the long-term renovation advice is also included. Additional functions are added on a regular basis, e.g., the possible upload of renovation evidence, the automated grant application, and the possibility of third parties (architects, contractors, potential buyers and so on) to add insight into all of this information. Eventually, it will be possible to use this tool to make more effective progress towards the 2050 long-term goal. In the meantime, the following set of indicators is used:

- average energy use per dwelling since 2012, both fossil and total;
- insulation rate (% of building stock) since 2011 and for each year relative speed in relation to 2011, enabling the extrapolation for which year that 100% will be reached at a given rate;
- heating: number of installations replaced by condensing boilers or heat pumps, replacement rate and distance to target;
- renovation activity: energy-efficiency grants, renovation loans, renovation permits.

This set of indicators is a work in progress, both for the content as well as the methodology. Flanders suggests documenting the indicators as a 'Dashboard of indicators'.

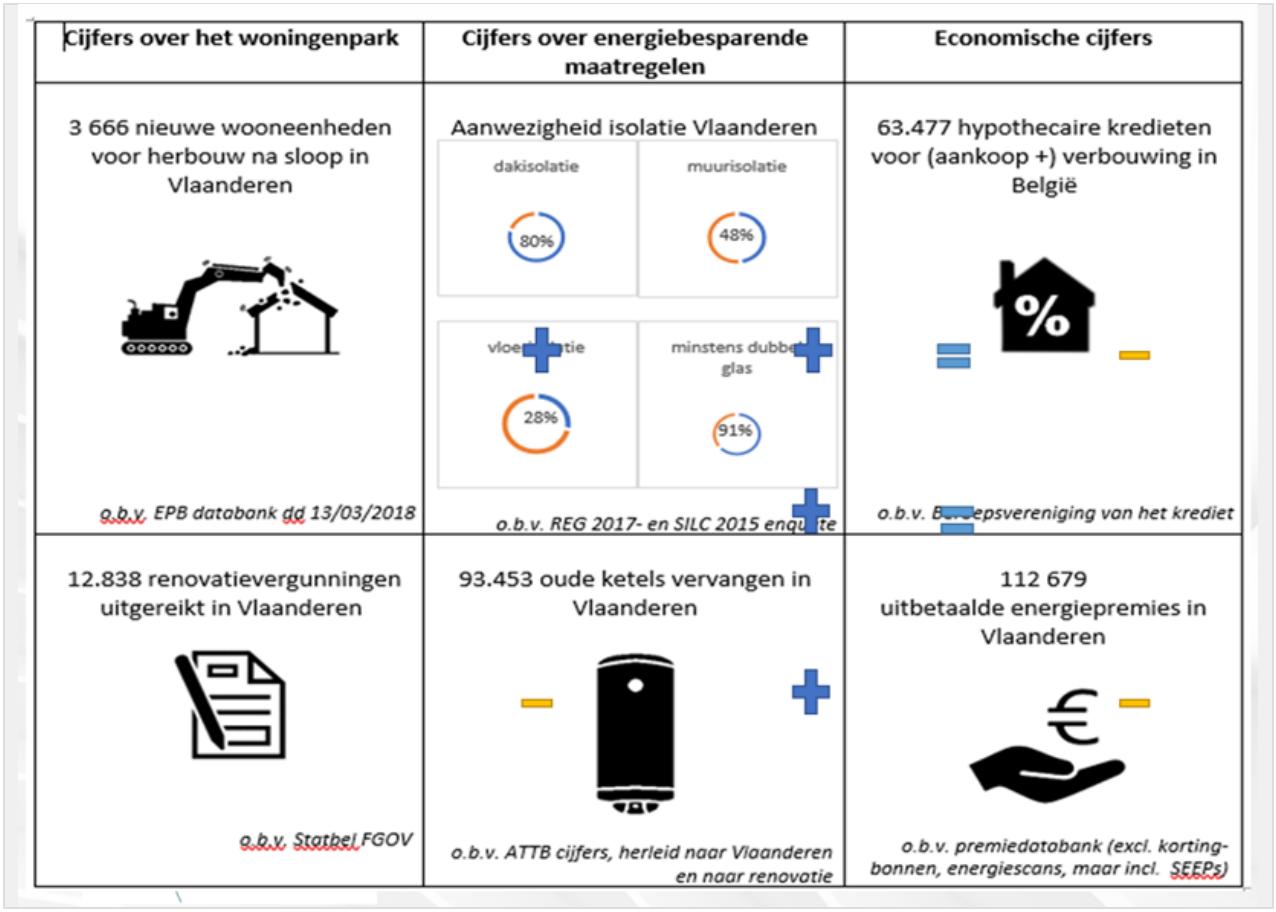

Figure 5: Flanders renovation dashboard.

3.2.4 Trigger points

Trigger points are a new element of EPBD Article 2a. These could include a change in ownership, damage or aesthetic work, children moving out, a need to change components, or the recognition of poor indoor quality. In the case of multi-family houses, it is required to involve the owner, e.g., with an obligation. Trigger points can be instigated by policy instruments such as a change in regulation, the need for obligatory auditing, or incentives from the state (promotional programmes, bonus systems). To identify trigger points and to trigger renovations, it is important to share best practices and promote communication and public consultation. Possible trigger points and associated policy responses based on the discussion and on further analysis performed by *ifeu* are summarised in Table 1.

Trigger point	Policy response	Examples
Change of ownership (sale or inheritance)	Mandatory requirements	Germany: Retrofit obligations to replace old boilers in single-family houses
	Obligation to carry out energy audit when building is sold	
Change of tenants	as above	Flanders: minimum requirements for roof insulation
Age of components transcended (e.g., boilers > 30 years)	Mandatory requirements	Germany: Retrofit obligations to replace old boilers in single-family houses
Technical building components are upgraded or replaced	Mandatory requirements	Germany: When a wall is upgraded or windows are replaced, new components have to fulfil efficiency requirements
Aesthetic building renovation and larger maintenance work	Mandatory requirements	as above
Conversion of building for accessibility, acoustic insulation, etc.	Coupled support schemes	Germany: Joint KfW support for barrier free and efficient buildings
Extension of the building, conversion of roof space	Mandatory requirements	
Chimney sweeping and control	Energy advice, control of top floor ceiling insulation	
Buildings with low energy performance	Renovation obligation	France: Obligation to renovate buildings >330 kWh/m^2.year primary energy
Personal circumstances changing (new children, children moving out, ….)	Support scheme for optimising building layout and energy performance	
Retirement	Support scheme for optimising building layout and energy performance	
Energy audits carried out	Improved financial support for subsequent implementation of recommended renovations	
Comprehensive thermography in village/city	Mailing with offer for free advice	
'Energy caravan'	Door-to-door campaign for energy advice	Germany: '*Energiekarawane*'
Taxes and change in regulation	Mandatory requirements	

Table 1: Possible trigger points and associated policy responses (examples).
Source: ifeu based on discussion during the CA EPBD London meeting.

Highlights of 3.2	• Flanders developed a 'renovation dashboard' to demonstrate indicators, milestones and the respective progress to achieve that, as well as an individual 'Woningpas', offering the residential building owner insight into all information that is publicly available on the building as well as the energy performance, solar potential, soil contamination, building quality and so on. • Spain developed a renovation strategy adapted to the climate, resulting in partial refurbishment requirements in Mediterranean countries.

Main Outcomes of 3.2

On a procedural level, the CA EPBD central team for 'Renovation Strategies' discussed, amongst others, indicators and milestones, the links between LTRS and NECPs, and data and modelling. Different timing and responsible ministries can present a challenge for establishing the LTRS. For many useful indicators, such as renovation works that are carried out privately, the activities are not usually recorded in any database until their next EPC assessment is carried out. Trigger points could include a change in ownership, damage or cosmetic work, children moving out, a need to change components, or recognition of poor indoor quality. In the case of multi-family houses, it's required to involve the owner, e.g., with an obligation for the owner. Trigger points can be instigated by policy instruments such as a change in regulation, the need for obligatory auditing or incentives from the state (promotion programmes, bonus systems).

3.3 Wider benefits

Wider benefits are related to energy efficiency measures and deep renovations that go beyond energy savings and cost reductions. Wider benefits range from an increase in property value to growth of employment and exports, to reduced fuel poverty or improved quality of life. Article 4 of the EED on building renovation had already included requirements for wider benefits. With the revision of the Energy Performance in Buildings Directive in 2018 (Directive (EU) 2018/844) the request is more specific, requiring that the Long-Term Renovation Strategy shall encompass 'an evidence-based estimate of expected energy savings and wider benefits, **such as those related to health, safety and air quality'**. Within the CA EPBD, three major parts of the topic were discussed:

- general advantages and figures on wider benefits;
- specific examples from the health and construction sector;
- communication of wider benefits.

3.3.1 General figures

In addition to the important benefit of GHG savings, Europe-wide studies point to additional co-benefits of the energy efficiency of the building stock, e.g.:

- For every €1 invested, at least €0.42 is saved in health care costs (EuroACE 2018)[8]. Holistic renovation works, where the right combination of materials, equipment and controls are installed together, can boost the comfort, health and well-being of occupants.
- Each € 1 million invested in energy efficiency creates eight to 27 job positions per year in the EU[9]; the IEA indicates 12 to 18 job positions per million.
- GDP growth rates ranging from 0.25% to 1.1% induced by energy efficiency (EmBuild 2017), tax income from the new jobs created and the VAT revenues on materials and equipment increase, social welfare payments decrease as unemployment is reduced, and overall healthcare costs fall as the well-being among occupants increases (EuroACE 2018)[8].
- Looking at EU-wide residential refurbishments, an annual investment of €23.5 billion per year was modelled within the COMBI-Project to deliver 23.5 TWh of energy savings per year. In addition, it was found that several other benefits could be achieved, including over 2,300 avoided premature deaths due to particulate matter, 139 Mt of material resource savings, 39 million additional

workdays and 29 TWh of power generation from combustibles avoided. It was found that although the energy savings alone would pay back the costs of refurbishment, the wider benefits make the work even more attractive. These wider benefit impacts have a value of around two-thirds of the energy savings based on lower bound estimates (COMBI 2018)[10].

Due to individual characteristics of each country regarding climatic conditions, composition of the building stock, or current economic situation, a generalisation of wider benefits is not possible. In addition, wider benefits are very context-specific and not linear. Thus, the above-mentioned figures should be interpreted as examples and a rough order of magnitude and can vary across the Member States.

3.3.2 Wider benefits in the health sector

Ian Hamilton from University College London pointed out the impacts of energy efficiency measures in the health sector. He aimed to design strategies based on the effects that energy efficiency and health have on each other. In the UK, fuel poverty is an issue in 11% of households and affects households in the worst performing buildings the most. It has been found that poor indoor environments can have a negative effect on health, which can increase the chances of developing cardiovascular diseases and cancer. Although energy efficiency measures may not always be cost-effective when energy savings is the only payback metric, if the savings to the health service are also included, then the measures become much more appealing.

There are three main ways in which energy efficiency measures improve health: improved ventilation rates, improved heat loss characteristics, and reducing the cost to heat buildings. It is important to ensure that whilst these works are carried out to gain desired outcomes, unintended consequences can be introduced, and these should be avoided through good design and workmanship. Through modelling improvements that achieve these aims, policies have been designed to ensure the most cost-effective solutions are carried out. An example of the work is that the cost of installing 1 million retrofits in fuel-poor households would cost around £2 billion. Energy savings in this case would be £1 billion. Personal health gain plus health service savings would total £220 million. Including other values such as air quality, carbon emissions, comfort taking value and utility to households, the total net present value could be £2.8 billion[11].

3.3.3 Wider benefits from the construction sector

Martin Bo Westh Hansen from Copenhagen Economics focused on the economic benefits of renovation with a focus on how the cost of energy efficiency measures are reflected in the increased value of houses. One of the key reasons a householder may pay more for a house with a higher energy rating is that the energy bills will be lower. However, this is just one of the benefits; others include aspects such as improved thermal comfort. Some of the problems identified are: buyers may be unsure of the quality of energy efficiency measures; they may be unsure of future fuel costs; and they may be unable to secure the larger finances needed for the typically more expensive homes that have higher energy efficiency ratings. Overall, it was found that energy ratings have an influence on selling prices. In a typical Danish house, moving up one rating band adds €7,000 to the selling price. However, this is not as big as the €10,000 of added cost that would be expected in order to address the problems mentioned earlier. One of the key solutions identified is to ensure buyers are given enough information on both the energy saving issues as well as the wider benefits such as health[12].

3.3.4 Communication of wider benefits

Based on group discussions, communication channels for wider benefits were collected in Table 2.

Wider benefit	Communication channel
Health	Health/social officer
Productivity	Employment reports
Property value increase	Real estate market
Fire protection	Fire protection authorities
Asbestos removal	Ministry of environment
Increased comfort	Surveys to ask people how they feel
Outdoor air quality	Air pollution reports

Table 2: Possible communication channels for wider benefits.

Highlights of 3.3	• In a British study, the interrelation between health and energy efficiency found that the cost of installing 1 million retrofits in fuel poor households would cost around £2 billion. Energy savings in this case would be £1 billion. Personal health gain plus health service savings would total £220 million. Including other values such as air quality, carbon emissions, comfort taking value and utility to households, the total net present value could be £2.8 billion. • A Danish study showed that energy ratings have an influence on selling prices and in a typical Danish house, moving up one rating band adds €7,000 to the selling price.

Main Outcomes of 3.3

Wider benefits are discussed in the Member States, especially benefits related to health and employment. In most of the Member States the final figures are still missing. It has been found that building improvements, such as improving insulation or ventilation, can enhance air quality and thermal comfort, which in turn can lead to better health for occupants with associated knock-on effects to national health services. By quantifying these benefits, payback periods for energy efficiency measures can be shortened. More work is likely to be financed and carried out.

In the Combi project, the effects of multiple impacts of energy efficiency measures were analysed. Looking at EU-wide residential refurbishments, an annual investment of €23.5bn per year was modelled to deliver 23.5TWh of energy savings per year. In addition, it was found that several other benefits could be achieved such as the avoidance of 2,300 premature deaths due to particulate matter, 139Mt of material resource savings, 39 million additional workdays and 29TWh of generation of power from combustibles avoided. These wider benefit impacts have a value of around two-thirds of the energy savings based on lower bound estimates.

One key aspect is ensuring people understand these benefits and how it will affect them so that they are more engaged. Wider benefits can be used in various communication channels to raise awareness of energy efficiency and deep renovation, e.g., between various ministries.

3.4 Capacity and skills of professionals in the building value chain

In many countries, a shortage of skilled workers in the construction and energy efficiency sectors presents a severe bottleneck for renovation activities and leads to rising renovation costs and quality issues. EPBD Article 2a (1) f) requires Member States to report on initiatives regarding 'skills and education in the construction and energy efficiency sectors'.

The capacity and skills of professionals in the building value chain were addressed in one of central team's Renovation Strategies sessions. Due to the COVID-19 pandemic, this session was prepared and then postponed to a later plenary meeting.

3.4.1 Current situation

In the EU, the technological revolution is causing significant changes in the working environment – some jobs are at risk of being lost to machines, others are being transformed and new ones are being created (Vazquez et al. 2019). Technological developments related to energy efficiency and digitalisation are pushing the current workforce to acquire new skills.

The financial crisis in Europe in the last decade also affected the construction sector by labour shortages. This is particularly the case in Germany and Luxembourg, where shortages are reported mainly for low- and medium-skilled jobs. Skill shortages are often affected by skill mismatch – the difference between the qualification level of jobseekers and the job requirements, and both over and under qualification can occur (European Construction Sector Observatory - Analytical Report, 2017).

According to the conclusions of the BUILD UP Skills projects (Pillar I), more than 3 million workers in Europe require up-skilling on energy efficiency or renewable energy sources by 2020 (Build Up Skills Pillar I, 2019).

Professionals in need of training on these topics range from on-site workers, craftspeople and technicians to architects, engineers and building managers. In addition, new digital related skills are required, e.g., through the use of Building Information Modeling (BIM).

To address this situation, different approaches have been developed, notably in the framework of EU-funded projects, e.g., upgrading qualification schemes for blue collar workers to construct nearly zero-energy buildings (NEWCOM) and BIM on-site trainings for better airtightness and ventilation performance (BIMplement). The *Energiesprong*-approach developed in the Netherlands allows workers to work indoors during regular working time and independent of weather conditions thanks to the prefabrication of components.

3.4.2 Barriers

In Europe, several structural barriers exist that lead to skill shortages and mismatches in the construction sector. In the European Construction Sector Observatory - Analytical Report, (2017), the authors point out some elementary barriers in the construction sector that can also be transferred to other skill categories. One problem is the decrease in the number of young skilled workers in the sector due to the **bad image** of the construction sector, which has **low(er) wages** compared to other sectors. **Safety risks** and **unattractive working conditions** are also named as a hurdle. In Europe, the **migration** of highly skilled workers from countries with lower wages to countries with higher wages also causes problems, since it can create a shortage of highly skilled workers in the former.

As only few young skilled workers are attracted by the sector, the **ageing** of the construction sector is a second relevant obstacle: In Germany, the majority of construction workers are 35 to 50 years old. This also provides additional barriers for the integration for new skills in industry and needs to be addressed by suitable training and education programmes. In addition, a **misalignment** between training and the demand for skills on the construction labour market slows down the upgrade and the development of the sector, often leaving workers with outdated skills.

3.4.3 Training

The uptake and development of new qualifications and training programmes as well as the upgrade and the renewal of existing schemes is one of the main challenges to overcome the barriers and prevent or mitigate a shortage of skilled workers.

However, the development of training programmes for building workers is also facing some challenges: rapidly evolving regulations and also a lack of policy coordination makes target-oriented training more difficult. In addition, the lack of funds for training, especially for smaller companies, the lack of interest and time to enroll as well as uncertainties regarding training results are relevant economic and financial obstacles. Also, language barriers – especially for foreign workers due to migration – have to be addressed by the training programmes (Build Up Skills Pillar I, 2019).

BUILD UP Skills – a European initiative running since 2011 – addresses this gap by training building professionals and preparing them to meet the challenges posed by new energy efficiency regulations and a constantly evolving setting. The initiative aims to increase the number of building professionals across Europe who are qualified to deliver building renovations offering high-energy performance as well as new nearly zero energy buildings. Based on an analysis of 22 projects, the following conclusions regarding the training and education of skilled workers are drawn (Trinomics and Visionary Analytics, 2018):

1. Filling a market gap:

It is important that new courses cover new content and truly complement existing programmes, including existing in-company training or training developed by technology providers. Practical training and demonstrations should be given priority, as they allow discussion and communication amongst craftsmen from different professions, thus offering interdisciplinary learning. Although classroom work is needed, the practical component of training needs to represent at least half of the total hours taught.

2. Providing flexibility in the training design

Since every professional has different needs, flexibility is key to the design of training offers. This includes the offer of local training facilities to minimise long travel distances, the possibility of attending either daytime or evening classes as well as the wide variety of material in different formats, to ensure a wider adoption and acceptance for use.

3. Securing stakeholder involvement

The involvement of the relevant stakeholders, from industries, training providers or governmental institutions is key to creating synergies and facilitating a customer-orientated approach to the trainings provided.

4. Budgeting with care and securing long-term financing

Developing new curricula and high-quality training materials is time- and resource-intensive. In addition, to avoid one-off actions, projects need to secure long-term support from other available funding streams.

5. Providing recognition

Providing certification for trainees or the trainers is important in order to ensure the necessary visibility on the market and to increase the demand for skilled professionals

In this upcoming CA EPBD session, focus is on how to overcome the above-mentioned barriers and exchange ideas on policy instruments to tackle the challenge of continuously upskilling building professionals in energy efficiency and sustainability.

Based on a questionnaire, Member States status will be highlighted in order to get some deeper insight into the BUILD UP Skills initiative. The project pitches will serve as input for the interactive part, where the collection of measures for a better workforce is foreseen.

Highlights of 3.4	• The NEWCOM project develops a database for the transparency of qualifications for the mutual recognition of training schemes. • BIMplement aims to improve the quality of nZEB construction and renovation by training the value chain in a cross-trade and cross-level approach, strengthened with BIM enhanced workplace learning tools.

Main Outcomes of 3.4

The CA EPBD central team for 'Renovation Strategies' also addressed the issue of workforce and skills. In the EU, the technological revolution is causing significant changes in the working environment – some jobs are at risk of being lost to machines, others are being transformed and new ones are being created. Technological developments related to energy efficiency and digitalisation are pushing the current workforce to obtain new skills. The financial crisis in Europe in the last decade has also affected the construction sector by labour shortages. This is particularly the case in Germany and Luxembourg, where shortages are reported mainly for low- and medium-skilled jobs. Skill shortages are often affected by skill mismatches – the difference between the qualification level of jobseekers and the job requirements, and both over and under qualification can occur. More than 3 million workers in Europe require up-skilling on energy efficiency or renewable energy sources by 2020. Required skills in the building sector range from on-site workers, craftspeople, technicians, architects, engineers and building managers. Member States use different policy instruments to improve the skills situation, including certification schemes and registers of skilled professionals in more than 10 Member States, skills passports or professional skills cards, legislation on education, training, financial instruments and changes in migration law, for instance, for asylum seekers to receive training in craft/renovation.

3.5 Minimum Energy Performance Standards in Member States to trigger energy efficiency in existing buildings

A number of Member States have or plan to introduce mandatory measures or obligations for existing buildings to increase the renovation rate, create additional trigger points for renovation, target the worst-performing buildings or address split incentives.

A series of sessions in the CA EPBD investigates mandatory requirements for existing buildings. For selected examples, the process of introduction, the technical details, implementation issues, monitoring and verification, evaluated impacts as well as stakeholder acceptance of the measures are analysed. Building on the first session, a double session focused on all aspects of Minimum Energy Performance Standards (MEPS) in existing buildings, starting from the definition of building categories, needed data, monitoring and verification, as well as market impacts, the acceptance and the affordability.

3.5.1 Current situation and views of Member States on introducing MEPS

EPBD Article 7 requires Member States to take the necessary measures to 'ensure that when buildings undergo major renovations, the energy performance of the building or the renovated part thereof is upgraded in order to meet minimum energy performance requirements'. In addition, the paragraph requires necessary measures to ensure minimum energy performance in the case of the renovation of certain building elements.

The following figure presents the cases or building categories where countries already have introduced MEPS or are considering introducing them – Status 2020. The visualisation is the result of a conducted questionnaire in the session.

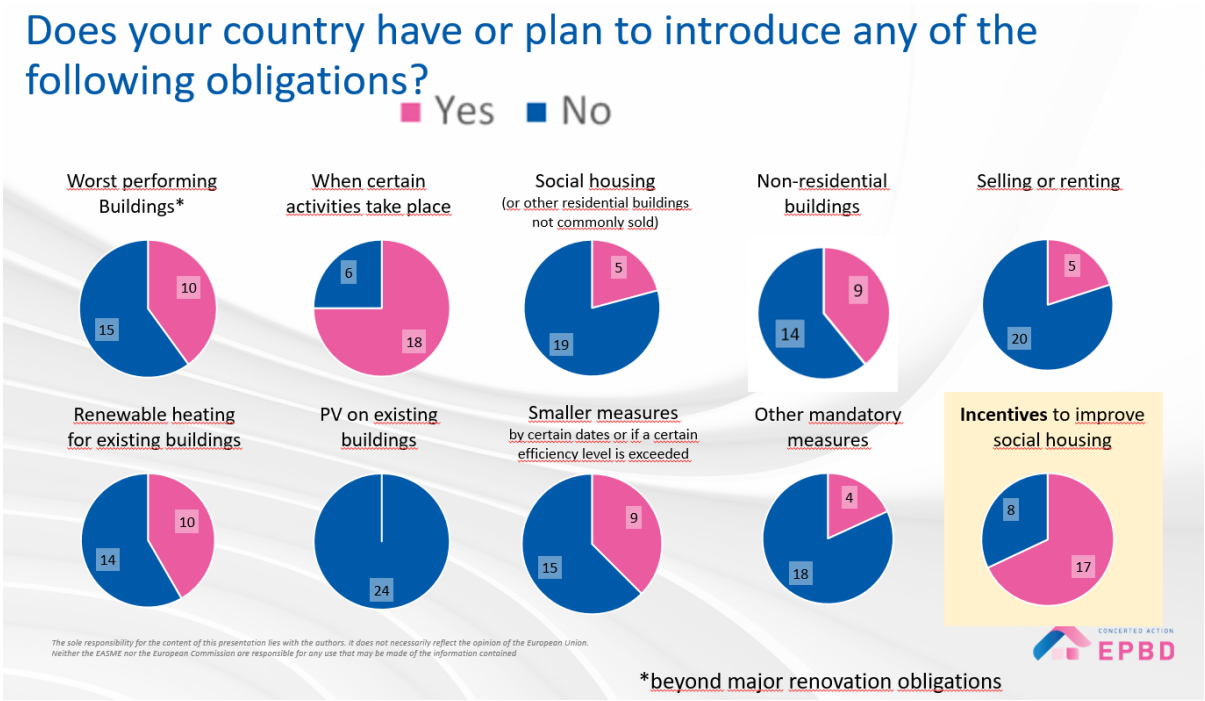

Figure 6: Use of mandatory measures based on a questionnaire of the Member States (source: ifeu)[1].

From the responses, it can be seen that Member States are addressing certain categories of buildings first - such as the worst performing buildings. At least half of the Member States have obligations associated with the worst performing buildings and also for non-residential buildings. Furthermore 10 out of 24 confirmed that they have mandatory requirements associated with renewable heating.

The prohibition of the installation of fossil fuel boilers is currently not a frequent measure. There are in fact other methods for reducing the number of fossil fuel boilers:

- Direct ban – selling is prohibited, and it must not appear on the building permit
- Indirect ban - it is not illegal to use fossil fuels but there are strong requirements for renewable energy as well as highly ambitious primary energy targets.

Of 24 questionnaires, only 6 Member States prohibit oil boilers in new residential buildings and the measure is under discussion in 5 states. For gas boilers, only 3 Member States ban installation in new residential and a ban is under discussion in 3 states. The requirements for existing buildings are even lower

and only 4 Member States ban oil boilers (5 states are discussing). There is no law that prohibits gas in existing residential buildings.

Serena Pontoglio from DG ENER presented an overview and insights from the **consultation of the EPBD revision and MEPS**. Within the EPBD revision public consultations, participants expressed their views on the (mandatory) introduction of MEPS, its design and the nature of MEPS. The results show that most participants (75%) of the public consultation call for the application of MEPS to boost the renovation rate and depth, but also stated that they must be accompanied by proper funding as well as EPCs and BRP. In addition, MEPS should focus on worst-performing buildings and promote deep renovation to avoid locking in effects. The challenge of EU-wide MEPS was mentioned by opponents as an obstacle, but also the fact that these are already partly addressed in the Member States. On the question of compulsory introduction, 79% were in favour, stating that they should be made compulsory on the basis of the timetable for a staged approach to achieve specific energy performance levels or linked to specific moments in the life cycle of buildings. A majority of the participants see residential and non-residential buildings as the category in which the introduction makes the most sense and indicated that the availability of financial support to building owners is one of the most important elements that could guarantee a successful roll-out of mandatory minimum energy performance standards.

3.5.2 Different Categories for requirements and examples

The focus of MEPS is on requirements that go beyond the compulsory requirements for major renovations. The requirements could be categorised as follows.

Requirements to renovate worst performing buildings

In this category, Member States require certain renovation activities if the buildings exceed a defined energy consumption, which can either be defined by the efficiency class, the value, or other similar building indicators.

Example: **England and Wales**: The Minimum Energy Efficiency Standards (MEES) came into effect in 2018 with the aim of improving privately rented housing to at least an E rating wherever possible. As included in the MEES for England and Wales[13]:

- From 1 April 2018, a landlord of a privately rented property with an EPC rating of F or G must not grant a new lease or renew an existing lease of that property until works have been carried out to improve the energy efficiency to a rating of E or above;
- From 1 April 2020, a landlord of a domestic privately rented property with an EPC rating of F or G must not continue to let the property until works have been carried out to improve the energy efficiency rating to an E or above;
- From 1 April 2023, a landlord of a non-domestic privately rented property with an EPC rating of F or G must not continue to let the property until works have been carried out to improve the energy efficiency rating to an E or above[14, 15].

Example: **Scotland**. In Scotland, the draft guidance for Energy Efficiency (Private Rented Property - PRS) (Scotland) Regulations 2019, published on 10 June 2019[16], is in the consultation process, due to be laid by the Scottish Parliament later this year. It requires:

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- From 1 April 2018, a landlord of a privately rented property with an EPC rating of F or G must not grant a new lease or renew an existing lease of that property until works have been carried out to improve the energy efficiency to a rating of E or above;

- From 1 April 2020, landlords of PRS properties may not grant a new tenancy for a property rated EPC F or G (unless an exemption applies). The landlord must improve the rating to minimum of EPC E (or register an exemption if one applies) before letting;

- By 31 March 2022, the minimum level of energy efficiency will apply to all domestic private rented properties, even if there has been no change in tenancy. From that date, landlords may not continue to let properties with an EPC rating of F or G, even to an existing tenant (unless an exemption applies). Landlords are encouraged to take action as soon as possible, bearing in mind that there is an additional target of EPC rating D, which will apply in a similar way, and may wish to ensure their properties meet or exceed EPC rating D by 31 March 2025, or indeed meet or exceed EPC rating C;

- From 1 April 2022, the landlord must not let the property unless the EPC is rated a minimum of D. By 31 March 2025, all PRS properties will need to have an EPC rating D.

Due to covid-19 and its impact on the sector, the April 2020 plans to set minimum energy efficiency standards for the EPC rating to rise from E to D were withdrawn. The Scottish 'Heat in Buildings Strategy' confirms the intention to introduce regulations requiring Scotland's homes to meet EPC rating C or equivalent, where that is technically feasible and cost effective, from 2025 onwards. The current proposal provides for a backstop date in 2028 for all privately rented properties and 2033 for all owner-occupied housing properties to comply. The strategy also proposes that a zero direct emissions heat source will be installed in homes in Scotland in a phased way at specified trigger points from 2025, with all homes using zero direct emissions heating by 2045.

Requirements for non-residential buildings

Certain Member States have specific renovation obligations for non-residential buildings.

Example: the **Netherlands**: In November 2018, the Dutch government adopted a new decree about the energy performance of office buildings in the Netherlands (*Besluit inhoudende wijziging van het Bouwbesluit* 2012, dated 2 November 2018). This decree specifically requires that each office building should have an energy performance label of C or higher as of 1 January 2023 (this is equal to an Energy Efficiency Index of at least 1.3) and a performance label A as of 1 January 2030[17].

Example: **France**. Due to the *décret tertiaire*, which became effective in October 2019, energy saving measures for existing non-residential buildings greater than 1,000 m^2 are required. These buildings must reduce their final energy consumption in 2030 by 40%, 2040 by 50% and 2050 by 60% compared to a reference year chosen after 2010, with few exceptions. The technical details are being regulated in separate delegated acts. Owners have to report their annual consumption data on an online platform. Fines up to €7,500 are foreseen if no action plan is submitted.

Requirements for social housing

Some Member States introduced obligations specifically for social housing.

Example: **France**. Since 2016, selling social housing dwellings is only allowed for apartments with an EPC class of E or better.

Requirements regarding renewable heating

The introduction of specific requirements regarding renewable heating is not very widespread. To our knowledge, on a national or state level, only the State of Baden-Württemberg in Germany has introduced a renewable heating obligation for existing buildings.

Example: **Baden-Württemberg**. In Baden-Württemberg, when replacing a heating system, the owner must use a minimum share of renewable energy that is 15% of the heat demand. The law also proposes alternative options: the building owner may choose efficiency measures, including insulation of the building or fulfil part of the obligation by carrying out an energy audit of the building based on an individual building renovation roadmap.

Requirements regarding small measures or individual components

Some countries have introduced regulation regarding obligations for smaller measures by certain dates or if a certain efficiency level is exceeded

Example: **Germany**. In Germany, boilers that are older than 30 years have to be replaced by new boilers. However, a number of exemptions are in place (e.g., single-family houses, low temperature boilers, etc., are exempted). Other obligations include the required insulation of heat distribution pipes and the mandatory insulation of the top floor ceiling.

Other requirements could include requirements for buildings that are sold, or photovoltaics.

3.5.3 Deep dive in selected Member States

The Dutch MEPS approach

In the Netherlands, MEPS have already been introduced for residential buildings and one of the aims made in the Dutch climate agreement of 2019 is that MEPS will be introduced for non-residential existing buildings, becoming obligatory by 2050. The goal is a 95% reduction in emissions in buildings by 2050.

For **residential buildings**, the focus is on the reduction of heat demand to prepare for the optimal use of renewable sources. The level of MEPS for these buildings is determined using a formula, whereas the ratio of the surface area of a dwelling (A_g) and the surface area of the facades and roof (A_{ls}) partly determines the level of the MEPS. The formula is presented in Table 3.

Table 3. The level of MEPS for residential buildings in the Netherlands.

Dwelling type	Als/Ag	Net Heat Demand [kWh/m^2]
Single family ≤ 1945	< 1,00	= 60
	≥ 1,00	= 60 + 105* (Als/Ag - 1,0)
Single family > 1945	< 1,00	= 43
	≥ 1,00	= 43 + 40* (Als/Ag - 1,0)
Multi family ≤ 1945	< 1,00	= 95
	≥ 1,00	= 95 + 70* (Als/Ag - 1,0)
Multi family > 1945	< 1,00	= 45
	≥ 1,00	= 45 + 45* (Als/Ag - 1,0)

Whether a dwelling meets the MEPS, can be determined with an energy label from 1 January 2021 or later. For now, MEPS are voluntary for owners and residents but it has been agreed to make them mandatory for rentals in 2050. The MEPS are due to be evaluated in 2025 on the basis of criteria to be determined in more detail, in conjunction with other instruments and the neighbourhood-oriented approach. After that, the MEPS can be tightened up, if necessary, better supported, or made more binding.

For **non-residential buildings**, the goal is to have the most ambitious yet cost effective standard possible. Unlike residential buildings, however, the indicator is intended to cover overall energy performance instead of heat demand only because of the variety of different building types. Separate standards based on different categories of buildings as well as a specific minimum EPC for each type of building are foreseen. The EPCs will also be used to check which buildings have met the MEPS and as such are no longer required to do large scale renovations. Industrial buildings (including logistics centres), monuments (historical buildings), buildings under 100 m² and new buildings constructed after 2015 are excluded from MEPS, but MEPS for industrial buildings and monuments are under development.

There are **concerns and challenges regarding MEPS**, including affordability and the required support from society and political acceptance. The question of mandatory introduction – which is not the case for residential buildings but plans are to make MEPS obligatory by 2050 for non-residential and rentals – as well as the question of whether intermediary goals are required need to be clarified. Moreover, primary energy factors are a challenge as well. The more sustainable a type of energy supply becomes the easier it is to reach the MEPS as the factor tends more towards zero. This is an issue because it means the longer you wait the easier it is to reach MEPS.

The Austrian discussion on banning fossil boilers

In Austria, the governmental working programme sets out a timeframe for replacing oil boilers with renewables, but it has not yet become a law. A federal law introduced in 2020 prohibits the installation of oil boilers in new buildings. Federal provinces must implement this law in the procedures concerning these installations.

Next steps (these are not enforced by law yet):

- 2023: installation of oil boilers is no longer permitted when changing heating systems;
- 2025: all oil boilers older than 45 years must be replaced from 2025 on;
- 2035: replacement of all oil boilers completed, regardless of the age of the system.

Oil traders oppose the phasing out of oil boilers. They argue that a ban may not be necessary because it is possible to produce climate neutral synthetic alternative fuels. Testing the operation of these alternative fuels is being promoted throughout Austria. They are expected to be marketable in around five years.

The use of oil boilers is considered by #mission2030 Climate and Energy Strategy. Currently, there are still around 700,000 oil-fired heating systems in use, with an average age of over 20 years. The goal is that in the next 20 to 30 years, oil-fired heating systems will be completely eliminated from the heating market. To this end, a funding campaign called '*raus aus Öl und Gas*' has been introduced to make it easier for the relevant parties to switch from fossil fuel boilers to a sustainable heating system. It is worth €650 million and will be available in 2021 and 2022. This funding is mainly provided for the connection to a highly efficient district heating system. If this is not possible, the switch to a climate-friendly district heating connection (less efficient than the first option), a wood-fired central heating system, or a heat pump is subsidised. Eligible costs include the cost of materials, installation and planning, and disposal and dismantling.

Low-income households will receive support to switch from a fossil-fueled oil or gas heating system to a modern and more climate-friendly heating system. The Ministry for Environment is providing €100 million for this purpose over the next two years. Households in the lowest income quintile can receive subsidies of up to 100% of new climate-friendly boilers.

Highlights of 3.5	• The Netherlands requires office building to have an energy performance label of C or higher as of 1 January 2023. • In the German State of Baden-Württemberg, when replacing a heating system, owners must use a minimum share of renewable energy which is 15% of the heat demand. • Austria is planning to ban the installation of oil boilers when changing heating systems from 2021 onwards, and replacement for boilers older than 25 years is required from 2025 on with the aim of completing the replacement of all oil boilers in 2035, regardless of the age of the system.

Main Outcomes of 3.5

To date, a number of Member States have introduced, or are planning to introduce mandatory regulatory measures for existing buildings to increase the renovation rate. In a study, 30 relevant cases of MEPS implementation were identified, 4 of which are currently being enforced. As an example, in the United Kingdom, MEPS are enforced through meeting a specified EPC rating. There were also incentives to avoid shallow renovation undertaken just meet the standard. In Flanders, for residential buildings specifically, MEPS are enforced through a package of stimuli and the meeting of a specified EPC rating. For non-residential buildings, a minimum label will be introduced for all large buildings. In case of sales, MEPS are met either by reaching a specified EPC rating or by carrying out a number of specific renovation measures. It was noted that acceptance of meeting these obligations has been relatively difficult for existing buildings, although this tension could be alleviated if targets and obligations were implemented gradually.

3.6 LTRS – Monitoring Building Stock & Policy Implementation

The Long-Term Renovation Strategies require Member States to set a number of milestones and indicators to monitor the progress of implementation. Monitoring the success of the LTRS is crucial for developing a customised and successful strategy and policy packages. The milestones should be evidence-based and rely, whenever possible, on data and information that is widely available.

Against this background, one of the sessions of the central team for Renovation Strategies focused on the exploration of various monitoring strategies and how EPCs can play a role in monitoring the evolution and strategy effectiveness of building stocks. Based on a questionnaire, the status on monitoring strategies across Member States were presented, the actions and tools of the European Commission were highlighted as well as the status of the EPC Database for monitoring the building stock among EU Member States was discussed. Finally, two Best Practice examples – the Scoreboard in Flanders and the French National Energy Renovation Observatory - were presented. All presentations served as input for a final discussion.

3.6.1 Results of questionnaire

A questionnaire was sent to the Member States in advance of the session, some points and issues that were raised through the questionnaire included:

- existence of monitoring strategy;
- indicators that are already monitored in the country in different categories, e.g., overview of national building stock, cost-effective approaches to renovation, or promotion of skills and education in the construction and energy efficiency sectors;
- role of EPC to develop policy measures;
- responsible bodies for monitoring.

(CT4) Renovation Strategies

The analysis of the 24 completed questionnaires from Member States showed, that most states (15 out of 23) include monitoring as part of their LTRS. Furthermore, Member States mainly focus on monitoring an overview of the building stock and there is less monitoring for other articles and measures.

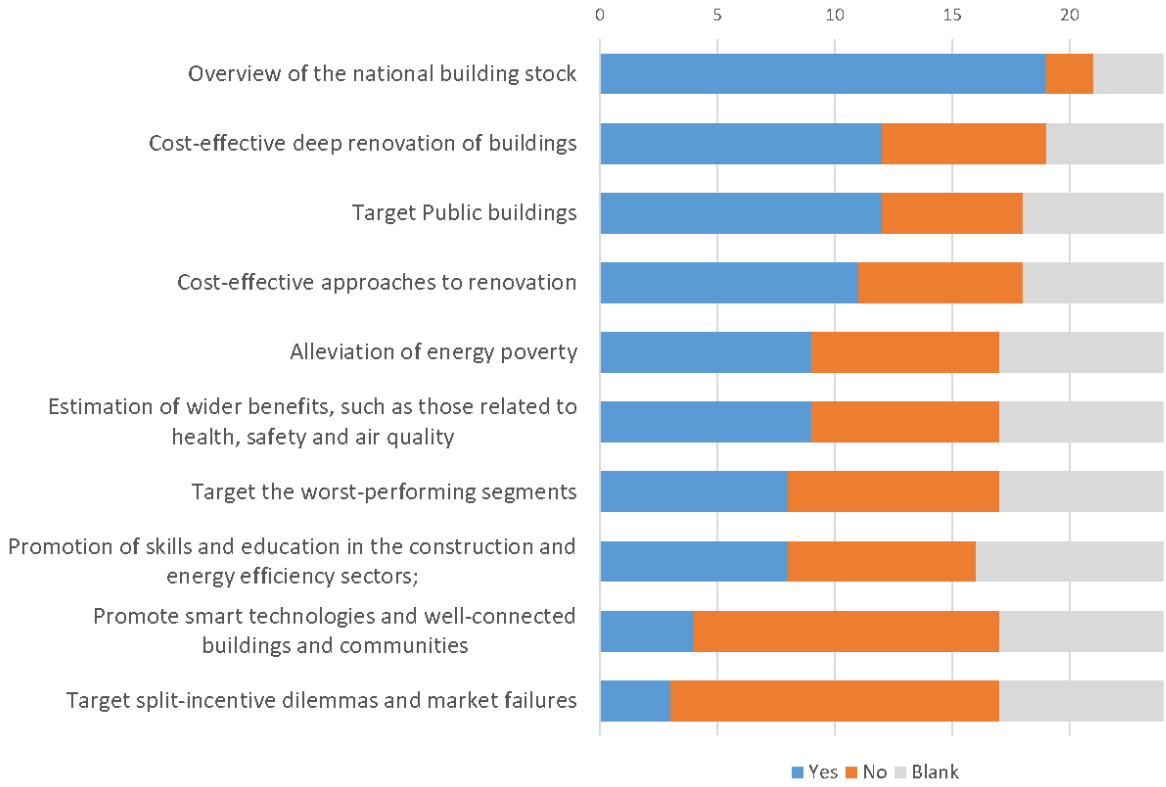

Figure 7: Overview of categories where indicators are monitored in Member States (source: Adene).

Three questions were asked to understand how building stock is monitored. In 13 Member States, an EPC database is used to monitor the LTRS. 14 Member States indicated that the EPC database is used to derive policy measures such as access to tax reductions and to financial benefits, the definition of priorities and phasing in the LTRS, and the reduction of administrative burden related to the new green investment scheme.

Finally, more than half of participants think that a uniform indicator for the renovation rate could be relevant and could be developed and applied across the whole EU. However, it is considered challenging to be able to make a comparison across countries due to the range of climatic conditions and the different starting point for each Member State. They sought a simple and uniform indicator.

Various external working groups and experts and/or agencies are responsible for monitoring the building stock and policies, inter alia, the ministry of energy, the ministry for economics/industry, the ministry for construction / urban planning agency or energy authorities.

3.6.2 Actions and tools for data collection

Three presentations focused on actions and tools for monitoring the building stock and on data collection: Dimitrios Athanasiou from DG ENER described the actions and tools of the European Commission; Ulrich Filippi Oberegger from EURAC Research presented the BuiltHub Project, where a roadmap for data collection and knowledge creation on Europe's building stock is created; and Rui Fragoso/Adene discussed the current status of EPC databases for monitoring the building stock.

Dimitrios Athanasiou/DG ENER stressed, that the lack of comparable, reliable and consistent data for monitoring the energy performance of the building stock and relevant policies is known and clearly addressed by the EPBD. As part of the Renovation Wave and the Commission's proposal to revise the EPBD, there is a strong emphasis on gathering data for the building stock, for example via:

- strengthening EPCs databases;
- encouraging BIMS, digital logbooks, Building Renovation Passports;
- implementing a Smart Readiness Indicator;
- promoting the use of smart meters;
- promoting the EU Building Stock Observatory, including through national observatories.

Member States' Long-Term Renovation Strategies (to become Building Renovation Plans according to the Commission's proposal to revise the EPBD) are another significant data source, as they contain a wealth of information, which relates directly to each Member State. The strategies provide an overview of the building stock, indicative milestones for 2030, 2040 and 2050, relevant policies and measures, and other useful information describing the efforts of Member States towards the decarbonisation of the building stock by 2050.

The EU Building Stock Observatory (BSO), established in 2016, is a web tool that monitors the energy performance of buildings across Europe aiming to provide a better understanding of the energy performance of the building sector through reliable, consistent and comparable data. The Observatory is currently being revamped, due to be launched early in 2023. At the moment, most data rely on H2020 projects, but the aim is to build a network of data providers, including the CA EPBD.

The aim of the **BuiltHub** project, funded under the Horizon 2020 programme, is to **establish a roadmap for collecting EU building stock data** through a cloud-based platform. To build the most helpful platform and populate it with reliable and relevant data, BuiltHub is working on building a community of stakeholders to collect data and feedback throughout the development process. This will help to understand their needs and requirements, gather feedback during the development of the platform and understand how to collect and harmonise datasets. The BuiltHub platform will then feed back into the BSO. Additionally, through networking and outreach, BuiltHub aims to provide information on the value of data sharing, partly through workshops, training and webinars.

Lessons learned show that data can be collected through web platforms, databases, reports, building-related documentation, surveys, smart meters, monitoring systems, audits and drones. BuiltHub also emphasised the importance of metadata as it is crucial to record the methodology of data collection and the approach used for processing the data.

Some barriers to data collection were identified. For example, there are some gaps in the data, so the question is whether to reduce the number of indicators as they are impractical, or to include them in case they become more achievable in the future. To overcome barriers, they consider examples of best practice.

Within the project, the BuiltHub Platform architecture is designed to centralise access to datasets. It creates links to other platforms, considering requirements for cloud-based implementation following EC data strategy, flexibility, scalability and reduction of development time and cost. According to EC data strategy, all datasets will be in a shared repository and it will be possible to store all types of structured and unstructured data, preserving the data in its original form. Furthermore, the data catalogue includes metadata.

(CT4) Renovation Strategies

Two categories of possible insights will be proposed within the project:

- basic services including data export, data visualisation, aggregation and descriptive statistics as well as KPIs;
- advanced services will include queries for other data platforms, advanced single-variable projections based on models matched with historic data and other projections, as well as spatial up and downscaling.

Other projects in the field of data collaboration are BEYOND, BIGG, MATRYCS.

In a previous session, the CA EPBD conducted a questionnaire to understand the current status of **EPC Databases for monitoring the building stock**. The objective was to understand which Member States currently have EPC databases, what kind of information is stored, and how this fulfills EPBD 2020 requirements. Rui Fragoso from Adene presented the outcomes. To set up EPC databases, different approaches in Member States were followed.

- 28 Member States collected different inputs of data related to the building/EPC;
- 19 states generate the EPC with the inputs of data collected;
- 11 states perform the EPC calculation inside the register / database with collected inputs.

Various types of data are collected in almost all EPCs, including the unique identifier of the EPC, the expert who issued the EPC, the calculated energy consumption, as well as the building address. Information on heating, cooling and domestic hot water systems is also collected in most EPCS, as well as recommendations of information on the building envelope (opaque, windows). The following figure shows the number of EPCs issued across Member States. In total, 54 million EPCs have been issued in the EU.

Country/ Region	# of EPC	Reference date	Country/ Region	# of EPC	Reference date
The UK	20 094 859		Belgium - WL	576 990	23/04/2019
France	7 593 763	16/05/2019	Lithuania	233 536	19/04/2019
Netherlands	6 600 000	11/04/2019	Croatia	232 403	12/04/2019
Spain	3 600 000		Belgium - BR	230 171	10/04/2019
Germany	2 302 307	31/10/2018	Czech Rep.	152 911	
Belgium - FL	1 810 000	01/01/2019	Slovakia	128 439	03/04/2019
Portugal *	1 675 155	31/03/2019	Finland	115 700	
Greece	1 574 316	31/03/2019	Austria	100 000	31/12/2019
Italy *	1 100 000	01/04/2019	Slovenia	70 000	31/03/2019
Romania *	1 000 000		Malta	51 300	
Hungary	951 436	21/05/2019	Rep. of Cyprus	51 172	24/04/2019
Norway	898 620	10/04/2019	Estonia	30 255	
Ireland	864 253		Luxembourg	17 000	
Sweden	700 000	31/12/2018	Latvia	9 219	26/04/2019
Poland *	667 307	01/01/2017	Bulgaria	7 804	02/04/2019
Denmark	631 260				

Figure 8: Number of EPCs issued in the EU, estimations based on partial information (source: Adene).

Using the example of Portugal, there was a discussion of how EPCs can contribute to the LTRS monitoring: EPC databases can provide information on the percentage of renovated buildings and the total renovated area (m^2). It can enable tracking of energy class trends, number and m^2 of NZEB buildings. It is also possible to track the impact of renovation on annual energy savings and GHG emissions. EPC databases also allow tracking of the number of buildings equipped with energy and water management systems or similar intelligent systems, and the percentage reduction in hours of discomfort in the home, and finally the improvement of the thermal comfort index.

3.6.3 Best practice

Portugal – Overview of EPC Database

Portugal had, by 31 March 2019, an EPC database with approximately 1.7 million of energy certificates issued and around 300 variables ranging from detailed building characteristics (e.g., walls, windows, roof) to technical systems descriptions (e.g., heating, cooling and domestic hot water equipment), the building energy balance (e.g., energy needs, energy class, etc.) or improvement measures (e.g., costs, impact, payback period, new energy class, etc.). Therefore, this database has the potential to permanently monitor several energy related actions, namely:

1) the building stock characterisation and evolution; and
2) the identification of improvement measures.

Furthermore, the interoperability of this database with other data sources (such as energy consumption, CENSUS data, financing schemes, etc.) will allow the creation of other important indicators towards policy monitoring.

Flanders Scoreboard

In Flanders, there are more than 3 million buildings, 60% of which are over 50 years old. Most of them have an EPC rating D, 30% are rated F while less than 7% are rated A. The goal is to shift the trend, for all residential buildings to reach an EPC label A by 2050. This implies increasing the deep renovation rate from 1% to 3%.

The indicators used to monitor the renovation rate are insulation rate, heating upgrades and aggregated indicators, including an overall 'renovation indicator'.

They noticed a decrease in insulation rate. To combat this, they introduced a dashboard as a user-friendly medium for sharing information and the evolution of selected indicators: demolition rates, renovation permits, insulation rates, loans, heating replacements, energy efficiency grants.

It was noted that a lot of work remains to be done, especially in gathering data from many sources. The data are often incomplete, available at different moments in time and are often more intuitive than scientifically validated.

They are building an online integrated platform (see screenshot in Figure 9), providing highly disaggregated data on renovation activities and grants, and in the near future they hope to see an evolution of EPC label distribution.

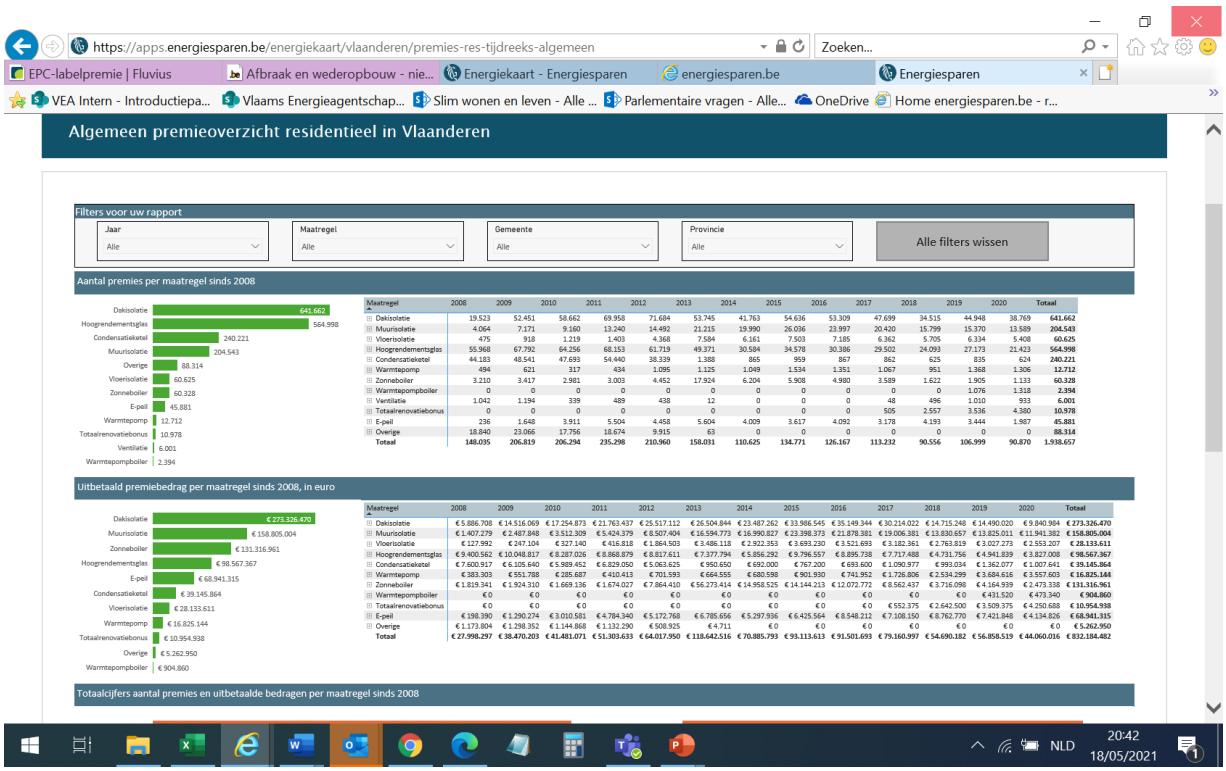

Figure 9: Screenshot of the Flanders online dataplatform (source: Roel Vermeiren).

French National Energy Renovation Observatory

The French national energy renovation observatory launched in September 2019. The objectives of the observatory are:

- to characterise the current state of the housing stock in terms of energy classes and to analyse the evolution of energy consumption;
- to monitor the renovation dynamics of all residential and non-residential buildings (measures and associated energy savings, etc.), with regards to the public policy objectives;
- to monitor renovation support schemes and study their effectiveness.

The project was developed by the statistical department of the Ministry of Ecological Transition along with a strategic committee (composed of civil servants from ministries and national agencies), a partners committee involving 25 stakeholders, and multiple working groups on dedicated topics.

In September 2020 the observatory produced its first publication[2] on the state of the principal residence stock on 1 January 2018 in terms of EPC classes. The study was mainly based on the EPC database, but since EPCs are only produced at certain points in time (when selling or renting and for all new constructions), not all dwellings are represented. To bridge the gap, they extrapolate the data in the EPC database to all dwellings using statistical methods. The results are available from national to department level, disaggregated by type of housing, year of construction, characteristics of households etc.

In July 2022, the observatory published a new study on the state of the housing stock, on 1 January 2022. This study is based on the EPC realised with the new EPC methodology that came into force in July 2021. This time, all housing stock is represented: principal and secondary residences as well as vacant homes.

A study summarising the state of renovation works and subsidies between 2016 and 2019 was first published in May 2021, and updated in March 2022. The study was based on data from support schemes (tax rebate, subsidies, white certificates) and a statistical survey on renovations in single-family houses. One result showed that in 2019, renovations of single-family houses, and subsidised renovations, enabled savings of 2.5 % on the conventional energy consumption of all principal residences. The study provides a complete review, based on statistical analyses, of the use and efficiency of support schemes, and the quality of renovations made in single-family houses.

The observatory is now looking into three future projects:

- a statistical survey on renovations in all dwellings;
- estimation of the effect on the *real* energy consumption (taking into account the rebound effect);
- renovations of non-residential buildings.

Highlights of 3.6	Member States think that a uniform indicator for the renovation rate could be relevant and could be developed and applied in the whole EU. However, it should be simple and uniform, as the cross-national comparison could still be difficult and the starting point for each of the Member State is very different Almost all Member States have EPC databases.

Main Outcomes of 3.6

Although most Member States do include monitoring as part of their LTRS, the detailed answers showed that they mainly focus on monitoring an overview of the building stock and there is less monitoring for other articles and measures. The lack of reliable data is known and stressed in the EPBD. The EU Building Stock Observatory (BSO) should serve as a data source for monitoring the building stock so that different data sources can be used for the BSO, e.g., data from the LTRS, as data come directly from the Member States. Currently, the data are primarily from H2020 projects, including the BuiltHub project. This project aims to bring together relevant actors, projects, initiatives, data holders and users, as well as other interested stakeholders in order to understand their needs and requirements, gather feedback during the development of the platform, and understand how to collect and harmonise datasets.

As of now, almost all Member States have implemented EPC databases. EPCs can contribute to the LTRS monitoring: they can provide information of the percentage of renovated buildings and the total renovated area (m2). EPCs can enable tracking of energy class trends, number and m2 of NZEB buildings. It is also possible to track the impact of renovation on annual energy savings and GHG emissions. EPC databases also allow to track the number of buildings equipped with energy and water management systems or similar intelligent systems, and the percentage of reduction in hours of discomfort in the home, and finally improve the thermal comfort index.

4. Lessons Learned and Recommendations

The aim of the CA EPBD central team for 'Renovation Strategies' work is to support Member States in the preparation and implementation of their Long-Term Renovation Strategies as defined in the newly introduced EPBD Article 2a. Toward this end, a number of different elements, established as well as those newly introduced into EPBD Art. 2a, are analysed and discussed. Through to March 2022, ten sessions were mainly organised by the team and centered around procedural, methodological, strategic and policy questions of EPBD Article 2a.

As part of the Long-Term Renovation Strategies (LTRS) required under Article 2a of the revised EPBD, Member States are requested to develop a roadmap with measures, progress indicators, and indicative milestones to ensure compatibility with the long-term targets.

Each Member State has different **strategic approaches** and challenges to decarbonise its building stock, given the different points of departure with respect to the energy mix, the climate conditions, the traditions and preferences as well as the building stock characteristics. These strategic aspects were collected in country posters. One example of an energy-strategic decision is the contribution of **renewables and energy efficiency** to the overall decarbonisation target. The balance between the two approaches depends on, amongst other things, available RES potentials, the characteristics of the building stock, energy price levels and implemented policies.

Wider benefits are discussed in the Member States, especially benefits related to health and employment. In most of the Member States the final figures are still missing. It has been found that building improvements, such as improving insulation or ventilation, can enhance air quality and thermal comfort, which in turn can lead to better health for occupants with associated knock-on effects to national health services. By quantifying these benefits, payback periods for energy efficiency measures can be shortened, thus more work is likely to be financed and carried out.

In the Combi project, the effects of multiple impacts of energy efficiency measures were analysed. Looking at EU wide residential refurbishments, an annual investment of €23.5bn per year was modelled to deliver 23.5TWh of energy savings per year. In addition, it was found that several other benefits could be achieved including over 2,300 avoided premature deaths due to particulate matter, 139Mt of material resource savings, 39 million additional workdays and 29TWh of generation of power from combustibles avoided. These wider benefit impacts have a value of around two thirds of the energy savings based on lower bound estimates.

One of the key aspects is ensuring people understand these benefits and how it will affect them so that they are more engaged. Wider benefits can be used in various communication channels to raise awareness of energy efficiency and deep renovation, e.g., between various ministries.

On a policy level, a special focus was put on **Minimum Energy Performance Standards** (MEPS) and other requirements for existing buildings. To date, a number of Member States have introduced, or are planning to introduce mandatory regulatory measures for existing buildings to increase the renovation rate. In a study, 30 relevant cases of MEPS implementation were identified, 4 of which are currently being enforced. As an example, in the United Kingdom, MEPS are enforced through meeting a specified EPC rating. To ensure that renovations were not performed to simply meet the standard, and thereby result in a shallow renovation, incentives were also used. In Flanders, for residential buildings specifically, MEPS are enforced through a package of stimuli and the meeting of a specified EPC rating. For non-residential buildings, MEPS are met by reaching a specified EPC rating or by carrying out a number of renovation measures that have been explicitly outlined. It was noted that acceptance of meeting these obligations has been relatively

difficult for existing buildings, although this tension could be alleviated if targets and obligations were implemented gradually.

The CA EPBD central team for 'Renovation Strategies' also addressed the issue of **workforce and skills**. In the EU, the technological revolution is causing significant changes in the working environment – some jobs are at risk of being lost to machines, others are being transformed and new ones are being created. Technological developments related to energy efficiency and digitalisation are pushing the current workforce to acquire new skills. The financial crisis in Europe in the last decade also affected the construction sector by labour shortages. This is particularly the case in Germany and Luxembourg, where shortages are reported mainly for low- and medium-skilled jobs. Skill shortages are often affected by skill mismatches – the difference between the qualification level of jobseekers and the job requirements, and both over and under qualification can occur. More than 3 million workers in Europe require up-skilling on energy efficiency or renewable energy sources by 2020. Required skills in the building sector range from on-site workers, craftspeople, technicians, architects, engineers and building managers. Member States use different policy instruments to improve the skills situation, including certification schemes and registers of skilled professionals in more than 10 Member States, skills passports or professional skills cards, legislation on education, training, financial instruments and changes in migration law, for instance, for asylum seekers to receive training in craft/renovation.

On a procedural level, the CA EPBD central team for 'Renovation Strategies' discussed, amongst others, **indicators and milestones**, the links between LTRS and NECPs, data and modelling, as well as public participation. Different timing and responsible ministries can present a challenge for establishing the LTRS. For many useful indicators, such as renovation works that are carried out privately, the activities are not usually recorded in any database until their next EPC assessment is carried out. **Trigger points** could include a change in ownership, damage or cosmetic work, children moving out, a need to change components, or recognition of poor indoor quality. In the case of multi-family houses, the owner must be involved, e.g., with an obligation for the owner. Trigger points can be instigated by policy instruments such as a change in regulation, the need for obligatory auditing or incentives from the state (promotion programmes, bonus systems).

Public participation is required and is considered to result in better outcomes and better governance. The main benefits are a higher acceptance of decisions and implementation as public interests are better reflected, but also the creation of new ideas and approaches. A number of different methodologies were discussed, from world cafés and focus groups to opinion polls and roundtables.

Participation approaches differ according to the particularities of the countries. While in Denmark 40 stakeholders were invited, who in turn were allowed to invite four others, in Ireland, a combination of invited web-based feedback and two stakeholder meetings were undertaken. In Croatia, the public consultation took place as side-event to a conference and thus synergies are used. The individual approaches in the Member States can also be differentiated with regard to the outcomes: Since the public consultation in Denmark started with the discussion of potential measures, the outcome was a set of 21 proposals and measures. In Ireland, the comments and feedback on official documents were sought and in Croatia, the outcome was a signed joint charter.

The three public consultation processes that were presented all show different characteristics: One major advantage in the Danish process was that the minister gave positive impetus on the kick-off of the consultation process. In addition, the formation of subgroups defining their own rules allowed target-group oriented discussion. In Ireland, the public consultation was well structured with a clear timeline. Due to the open web-based feedback format, one of the major challenges was to reach the right audience. Due to the

organization of the public consultation as side-event to a conference in Croatia, the cooperation of a broad range of stakeholders was enabled.

Success factors include clear rules, professional moderation and appropriate structures for lobby groups. Challenges are, amongst others, cost and administrative issues, language barriers, pressure from stakeholder groups, large group sizes and a lack of interest of key stakeholders.

Almost all Member States do include monitoring as part of their LTRS, with a focus on **monitoring** an overview of the building stock and less monitoring for other articles and measures. However, the **monitoring of the building stock** lacks reliable and consistent data. This issue is stressed by the EPBD and the EU Building Stock Observatory has tried to fill this data gap. For the moment, data have mainly been provided by H2020 research projects, such as BuiltHub, but there are plans to exploit other data sources, such as the LTRS submitted by the Member States.

Endnotes

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