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COMMISSION NOTICE

providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

(Text with EEA relevance)

(C/2025/6438)

1. INTRODUCTION

The recast Energy Performance of Buildings Directive (the recast EPBD) ([1]) sets a framework and a path for modernising and fully decarbonising the EU's building stock by 2050. It includes a range of measures to stimulate investment and structurally boost the energy performance of buildings. A specific emphasis is placed on renovating the worst-performing buildings.

The recast EPBD entered into force on 28 May 2024, with a transposition deadline of 29 May 2026 for all new or modified provisions (except for Article 17(15), which has an earlier transposition deadline of 1 January 2025 and on which the European Commission has already issued a separate notice ([2])). Article 35(1) requires the Member States to bring into force the laws, regulations and administrative provisions necessary to comply with the new or modified provisions by 29 May 2026; and to communicate the text of those measures and a correlation table to the Commission.

2. PURPOSE OF THE NOTICE

This notice provides interpretative and practical guidance on the new or substantially modified provisions of the recast EPBD that Member States need to transpose.

The recast EPBD explicitly requires the Commission to adopt guidance on specific topics, namely on what qualifies as a fossil fuel boiler; the development of one-stop shops; national roadmaps on limit values for the total global warming potential (GWP) of new buildings; the consideration of ambient heat in energy performance calculations; the energy performance of transparent building elements; and fire safety in car parks). This notice covers all these topics. In addition, this notice provides guidance on all other new or substantially modified provisions.

The purpose of this notice is to support and facilitate the effective and practical implementation of the recast EPBD, taking into account the needs for guidance expressed by Member States and the Commission's interpretation of the provisions. It is addressed mainly to the Member States but is also relevant for all other stakeholders involved in implementing the recast EPBD. The notice has been developed in close cooperation with Member States and takes into account the input received from stakeholders.

This notice is intended solely as a guidance document; only the text of the EU act itself has legal force. The binding interpretation of EU legislation is the exclusive competence of the Court of Justice of the European Union. The views expressed in this guidance have no bearing on the position that the Commission might take before the Court of Justice.

3. STRUCTURE OF THE NOTICE

This notice has 13 annexes. Each annex provides guidance on a specific topic:

1. Minimum energy performance standards for non-residential buildings and trajectories for progressive renovation of residential buildings (Article 9)
2. Financial incentives, skills and market barriers (Article 17) and one-stop shops (Article 18)
3. Energy performance certificates (Articles 19-21, Annex V) and independent control systems (Annex VI)

([1]) Directive (EU) 2024/1275.
([2]) Commission Notice on phasing out financial incentives for stand-alone boilers powered by fossil fuels under the recast Energy Performance of Buildings Directive, OJ C, C/2024/6206, 18.10.2024, ELI: http://data.europa.eu/eli/C/2024/6206/oj.

4. Renovation passports (Article 12, Annex VIII)
5. Databases for the energy performance of buildings (Article 22)
6. Data exchange (Article 16)
7. Zero-emission buildings (Articles 7 and 11)
8. Solar energy in buildings (Article 10)
9. Infrastructure for sustainable mobility (Article 14)
10. Technical building systems, indoor environmental quality and inspections (Articles 13, 23 and 24)
11. Fossil fuel boilers (Article 13, Annex II)
12. Common general framework for the calculation of the energy performance of buildings (Annex I)
13. Life-cycle global warming potential of new buildings (Article 7(2) and (5))

4. CONCLUDING REMARKS

Improving the energy performance of the EU's building stock is crucial to reducing energy consumption. It will contribute to more affordable energy bills; increased resilience against energy supply or price shocks; reduced EU dependence on imported fossil fuels; and the enhanced productivity and competitiveness of the EU's construction industry and cleantech companies. This notice and its annexes are intended to help the Member States transpose and implement the provisions that the European Parliament and Council agreed on as part of the recast EPBD.

ANNEX 1

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Minimum energy performance standards for non-residential buildings and trajectories for progressive renovation of residential buildings (Article 9)

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1. INTRODUCTION

Article 9 of the recast Energy Performance of Buildings Directive ('the recast EPBD') [1] introduces new requirements for Member States to improve the energy performance of their existing building stock. This text provides guidance to Member States on how to incorporate the requirements to establish minimum energy performance standards for non-residential buildings and to set-up a trajectory for the progressive renovation of the residential building stock into national law (Article 9).

This Annex does not alter the legal effects of the EPBD and has no bearing on the binding interpretation of the EPBD as provided by the Court of Justice.

2. MINIMUM ENERGY PERFORMANCE STANDARDS FOR NON-RESIDENTIAL BUILDINGS

2.1. Scope of the requirements

Minimum energy performance standards (MEPS) are a regulatory tool to stimulate the renovation of existing buildings on a large scale. They remove the main barriers to renovation such as split incentives and co-ownership structures, which cannot be overcome by economic incentives, as also indicated in Recital 25. The recital further states that the general purpose of MEPS is to gradually phase out the worst-performing buildings and thereby improve the energy performance of the building stock.

For non-residential buildings, Article 9(1) requires Member States to set up a national MEPS scheme based on the establishment of minimum energy performance standards for non-residential buildings. These ensure that the buildings do not exceed the specified maximum energy performance threshold. The scheme is designed to improve the energy performance of the worst-performing non-residential buildings by certain enforcement dates.

2.2. Relevant definitions

2.2.1. *Definition of non-residential buildings within the scope of Article 9*

There is no explicit definition of a non-residential building. A non-residential building is a building that is used for a purpose other than residential, e.g. office buildings, healthcare buildings, wholesale and retail trade buildings, educational buildings, sports facilities, hotels and restaurants. This is a non-exhaustive list of non-residential buildings according to their use, in accordance with Annex I, paragraph 6.

With regard to mixed-use buildings, i.e. buildings that include both residential and non-residential units (e.g. a residential building with shops on the ground floor), Member States may identify the most appropriate approach and, according to Recital 34, may continue to choose whether to treat them as residential or non-residential buildings, or a mix of the two.

If a mixed-use building is being renovated, double-counting of energy performance improvements must be avoided. The improvements must therefore be clearly attributed to the residential or non-residential part of the stock.

All non-residential buildings fall within the scope of Article 9(1) irrespective of whether or not the owner or user is a public or private body. Energy renovations of public buildings with a non-residential use could therefore contribute to both the achievement of the MEPS thresholds and to the annual renovation target established under Article 6 of the Energy Efficiency Directive (Directive (EU) 2023/1791) [2], provided that such renovations meet the requirements set in both pieces of legislation.

[1] Directive (EU) 2024/1275.

[2] For more details on the obligations for public buildings under the Energy Efficiency Directive, consult Guidelines on energy consumption in the public sector, renovation of public buildings and public procurement (Articles 5, 6 and 7).

2.2.2. *Definition of worst-performing non-residential buildings*

Article 9(1) states that worst-performing non-residential buildings are defined based on the national thresholds corresponding to the energy performance level of the worst 16% and worst 26% of the non-residential building stock in 2020 in terms of floor area or number of buildings. Member States shall establish additional thresholds for 2040 and 2050 with lower maximum energy performance thresholds to ensure the gradual phasing out of worst-performing buildings over time. Thresholds can be established for the entire non-residential building stock or by building type or category, based for instance on the building categories listed in Annex I. Categories of buildings could also be established according to their more specific use but also their size, typology, climate zone and a combination of these or other features.

2.3. **Stepwise approach to designing minimum energy performance standards for non-residential buildings**

The design of a MEPS scheme, including the selection of an indicator, the definition of thresholds and means of compliance, needs to be conducted in several steps. To make sure all design elements are considered and a proper enabling framework is set up, the following five steps are proposed to design and implement national MEPS schemes for non-residential buildings:

— identify data sources and characterise the non-residential building stock;

— define indicator(s), an energy performance baseline and set energy performance thresholds;

— design governance and rules of compliance;

— set up an enabling framework;

— set up a monitoring mechanism and penalty scheme.

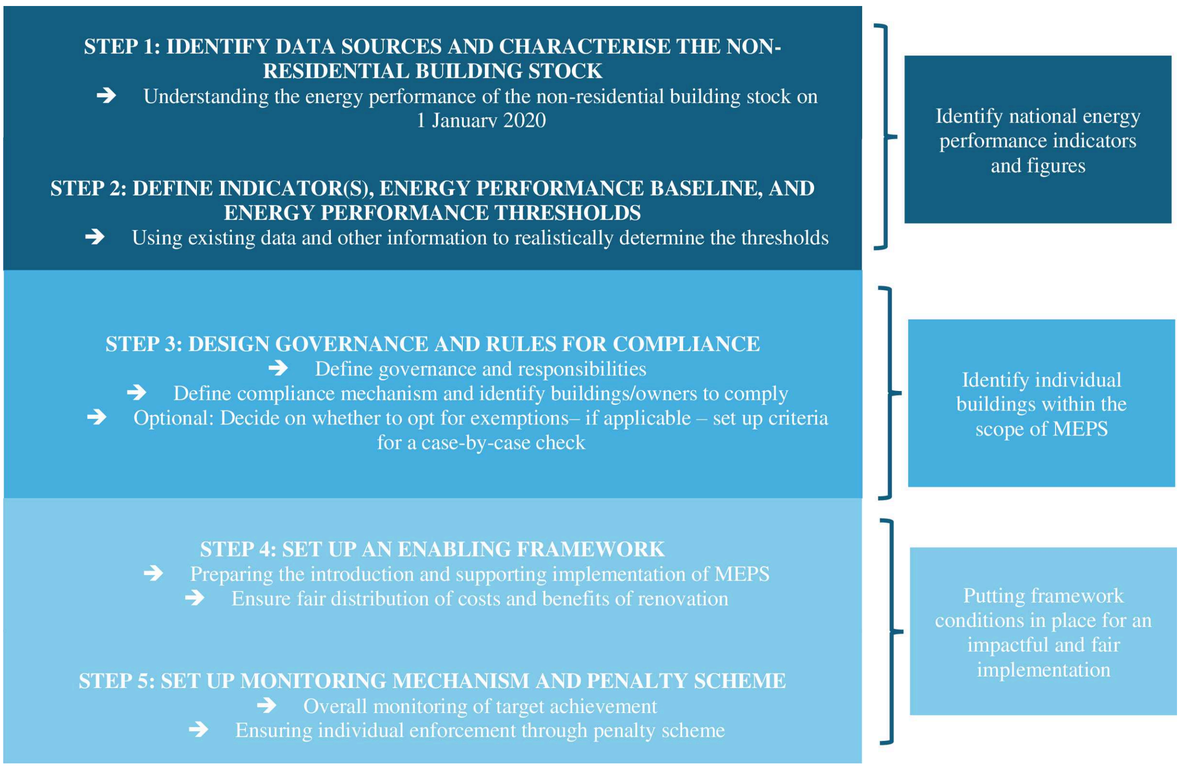

Figure 1. Recommended steps for the design of a MEPS scheme for non-residential buildings

In the sections below, examples and possible options for the different MEPS design features in accordance with Article 9 are presented based on the five steps in Figure 1. The elements for each of the steps can be recombined to match individual Member States' circumstances such as specificities of the existing building stock, prevalence of certain barriers and capacities to address them.

2.3.1. *STEP 1: Identify data sources and characterise the non-residential building stock*

To establish a baseline for non-residential buildings, Member States need to have a clear understanding of the energy performance of their non-residential building stock on 1 January 2020. Member States therefore have to characterise their building stock, i.e. collect and process the relevant information to describe the building stock according to its main characteristics in order to derive its energy performance. This characterisation of non-residential building stock should allow Member States to rank all non-residential buildings by energy use in order to then determine the maximum energy performance thresholds, including 16 % of the non-residential building stock for 2030, 26 % for 2033, and the subsequent thresholds for 2040 and 2050. The worst-performing buildings with an energy use above the maximum thresholds identified for each year will then be obliged to comply with MEPS.

There are at least two general approaches to the characterisation of non-residential stock that can be implemented individually or in combination using a) existing building stock data and complementary data sources; and/or b) statistical sampling and ad hoc data collections. These are described in the following sub-sections.

For any approach selected by Member States, it is recommended to establish a clear plan in terms of time and resources.

The characterisation of non-residential building stock also relates to the development of the database described in Article 22. In the case of public buildings, Member States may take advantage of the data collected for the purpose of the public buildings inventory required by Article 6(5) of the Energy Efficiency Directive, which could be used for the characterisation of the stock of non-residential public buildings. During the initial characterisation of non-residential building stock, different existing databases will have to be identified and used. Some of these databases, such as energy performance certificate (EPC) databases, 3D urban models and cadastre or land registers, could potentially turn into permanent data sources to populate the national database for the energy performance of buildings as defined in Article 22.

Before characterising the non-residential building stock, it is recommended to select the indicator for the implementation of the MEPS scheme. Article 9(1) states that Member States can choose to establish the national thresholds in either final energy use or primary energy use. The choice of the preferred indicator has implications for the type and range of measures that can be implemented to improve the energy performance and therefore to comply with the MEPS obligation (see section 2.3.2.1). It is therefore recommended to characterise the non-residential building stock using the indicator that will be used for the MEPS scheme.

When already in place, the update and improvement of existing databases such as EPC repositories or cadastre registers may enable a faster and more cost-effective characterisation of the non-residential building stock in comparison to implementing an approach involving data collection from scratch. When selecting data sources for the characterisation of the non-residential building stock, Member States shall consider key data aspects such as ownership, rights of accessibility, privacy and security to ensure that the rights of building owners, tenants and any other relevant stakeholders are protected. These aspects are also relevant for other steps of the design of the MEPS scheme as discussed in other sections.

2.3.1.1. Use of existing building stock data and complementary data sources

2.3.1.1.1. Data sources

Member States may use a wide range of existing data sources to characterise non-residential building stock. Where available, information related to the energy performance of a subset or segments of the non-residential building stock can be obtained from sources such as EPCs, results from research, censuses, energy audits or aggregated measured energy data. It is possible to estimate the energy performance of a building by comparing it to buildings with similar characteristics – such as use, date of construction, typology and location – for which energy performance data is available.

Data on the physical characteristics and other features of the non-residential building stock such as use, date of construction, typology, location, geometric characteristics or data on technical building systems can be collected from sources such as 3D urban models, satellite images, digital building logbooks, cadastre data, construction and planning permission registers, interviews with architects or developers, and others.

It is recommended that Member States assess the quality, completeness and representativeness of the different datasets. It is also recommended to further pursue the automatic updating of these datasets and the interoperability between the databases.

2.3.1.1.2. Preliminary characterisation and building categories

For the characterisation of non-residential building stock, it is recommended to start with a preliminary estimate of the overall size of the building stock and the share of buildings in each use category, such as offices, healthcare, wholesale and retail trade, educational buildings, sports facilities, hotels and restaurants, as mentioned in Annex I of the EPBD. Member States are encouraged to use established use categories from existing policies, which may be more detailed. This will enable the identification of those segments where data collection may require higher efforts.

The non-residential building stock varies not only in terms of use but also in term of size, typology, facade materials and technical building systems. To obtain a better characterisation of the stock, it is therefore recommended to split it into more manageable portions based not only on their use, but also on some of these additional features. Results from research such as EPISCOPE ([3]) and TABULA or existing national categorisations can support this process. Also, patterns of common local or regional construction practices can be used as a criterion to define categories. Examples of other criteria include date of construction, climate zone, and heating system technology. This enables a breakdown of non-residential stock into segments of buildings with more similar characteristics (e.g. large hospitals (with floor area > x m^2), located in a certain climate zone). It can make it easier to develop assumptions for each segment when required and improve the results when estimating the energy performance of the buildings for which data is not available. Also, such categories may be used to develop different thresholds per building category that Member States may define.

The classification of buildings according to the construction period, location or climate zone can be linked to common construction practices. For instance, the implementation of previous building codes or energy performance standards, including requirements on the thermal characteristics of materials, can enable assumptions about the materials, thermal characteristics and systems of non-residential buildings. A building energy code implemented in the 1980s, including minimum requirements for the U-value of windows or a minimum level of insulation, can then be used to assume certain values for the material and other characteristics of buildings constructed during that period for which individual information is not available. Member States can also build on the classifications used for other purposes, for instance on the buildings' typologies used for the purpose of the cost-optimal calculation.

Interviews with architects, constructors and developers can help refine the assumptions about construction practices over the years. They may also help identify building typologies, their physical characteristics and distribution over time (e.g. typical school construction between 1960 and 1970).

In the case of different climate zones, the local climate conditions may impose certain requirements on construction practices, e.g. a higher level of insulation is expected in regions with cold climates compared to warmer regions. These kinds of analysis can also strengthen the assumptions for buildings without individual data.

([3]) https://episcope.eu/welcome/.

2.3.1.1.3. Using EPC data

It is important to ensure that the available EPCs are sufficiently representative of non-residential building stock. A representative dataset reflects the characteristics of the whole non-residential building stock, mirroring for instance the relative share of different building categories according to age, size, climate region etc. The coverage of EPCs of e.g. public buildings could be overrepresented due to the existing obligation to include the EPC information of public buildings in existing energy performance databases according to Article 10(6a) of Directive 2010/31/EU. Regions with a high density of non-residential buildings (e.g. capital cities or cities with large service sectors) may be overrepresented as well. It is important to assess whether these cases are in specific climate regions that do not represent the circumstances of the rest of the non-residential building stock. Similarly, other characteristics such as size and typologies should be assessed. The gaps identified in the EPC data available can be addressed by collecting additional information from the categories of buildings, regions or climatic zones that are underrepresented.

Besides coverage per use, size, typology, climate zone and other characteristics, the time of issuing is also relevant when using EPC data. EPCs are valid for 10 years and an EPC may not have been reissued after the building underwent renovation. Furthermore, the requirements to issue EPCs also introduce a bias in the database. EPCs are generally issued for new buildings or for buildings that are in the sales or rental market. These buildings may have a different performance compared to buildings that have been out of the market for a long time. Last but not least, many subsidy schemes require an EPC to demonstrate the improvement of the buildings' performance. This may include EPCs for both before and after, just before or just after.

To refine the data on the current status of the building, EPC data can be combined with additional information from construction and planning permission registers and digital building logbooks (when available). These can provide information on the date and scope of previous renovation activities carried out on the buildings.

2.3.1.1.4. Estimating the energy performance of non-residential buildings

Once there is assurance that EPC data or other data on the energy performance for a subset of buildings is representative of the whole (or parts) of the non-residential building stock and available, Member States may choose to combine this information with information on the physical characteristics and other features of the same buildings to create a reference set. A combination of data such as use, date of construction, location and size of the buildings for which the energy performance information is not available can be fed into statistical models such as multinomial logistic regression (based on the buildings in the reference set) to estimate their energy performance. This allows an energy performance value to be assigned to each building for which this data is not available and therefore complete the characterisation of the non-residential building stock.

When the energy performance information from subsets or segments of the non-residential sector is not representative or is not available, information for each individual building on its use, date of construction, typology, location, geometric characteristics or technical building systems can be fed into energy models to simulate the operation of the buildings and estimate their energy performance. Similar to the case described above, this allows an energy performance value to be assigned to the buildings for which this data is not available and therefore completes the characterisation of the non-residential building stock.

Coupling bottom-up data (buildings' physical characteristics, location, energy performance etc.) with top-down data (aggregated data for different energy carriers' consumption, final energy consumption, national statistics on building construction practices etc.) can strengthen the characterisation of non-residential building stock. The estimations based on bottom-up data can be cross-checked with the available top-down data to calibrate the assumptions and estimations made.

It is recommended that Member States describe the data sources and approach they use for the characterisation of non-residential building stock in their national building renovation plans (NBRPs).

2.3.1.2. Statistical sampling and ad hoc data collection

For the cases where there is no representative data on the energy performance of non-residential building stock or no data at all, statistical sampling and ad hoc data collection can support the characterisation of the building segments. The collection of data can be used to complement existing data and cover specific gaps, e.g. related to building types, geographical areas or climatic zones. This approach can be used on its own or alongside existing data to verify the findings and assess their plausibility.

When using statistical sampling, it is recommended to have a preliminary overview of non-residential building stock, breaking it down into different categories of buildings with similar characteristics in terms of use, typology, location, date of construction and/or others. The different categories of buildings should be represented in the final statistical sample.

A clear sampling procedure is required, e.g. by conducting a multi-stage survey that combines methods such as a screening for general information available from the sample buildings, followed by interviews with building owners and then on-site inspections ([4]). The information to be collected includes details on the operation of the building, energy demand, energy suppliers, construction materials, details on previous renovations and any other relevant data.

The information collected can be put into a simulation model to estimate the energy performance of the sample buildings. The results can be extended to the rest of the building stock, taking the initial categorisation into consideration. The results can then be cross-checked with available aggregated data on the energy performance of the building stock as in the previous approach.

Table 1

Characterisation approaches to non-residential building stock

Approach	Key requirements and steps	Advantages/challenges
Building stock data and complementary data sources	— Sufficiently representative data across dimensions such as use categories, geographical and climatic coverage, years of construction, size, typologies, others. — Assess the quality of datasets and identify gaps. — Integrate the different datasets/sources available and fill the gaps. — Characterise the buildings for which the energy performance data is available in terms of use, typology, etc. Characterise in the same way the buildings without energy performance data. — Define the model to estimate the energy performance of buildings for which this data is not available based on their characteristics and the reference set of buildings.	**Advantages** Leverage existing data resources. If based on EPCs, it makes it easier to use EPCs as a compliance mechanism. Useful to identify gaps to be covered by dedicated data collection. **Challenges** Data across different databases is usually not consistent. If data triangulation is not possible, a simplified estimation of energy performance can lead to miscalculations. Ownership and accessibility to the data from different sources may be a barrier.

([4]) As proposed here based on a complete survey conducted in Germany.

Approach	Key requirements and steps	Advantages/challenges
Statistical sampling and ad hoc data collection	— Establish the characteristics of a sample of buildings representative of national non-residential building stock. — Conduct a survey to collect data from a representative sample of non-residential building stock. — Use a building model to estimate the energy performance of non-residential building stock.	**Advantages** Up to date and specific to the policy requirements for setting up and monitoring a MEPS scheme. The data could be used for other policy purposes. **Challenges** Sampling period can be long. Costs and responsiveness rate. Reliability of the building model.

2.3.2. *STEP 2: Define indicator(s), energy performance baseline, and set energy performance thresholds.*

The provisions in Article 9 allow Member States to make different decisions on certain features of the MEPS scheme for non-residential buildings, such as the choice of the indicator to deploy the MEPS scheme (final or primary energy use), whether to exclude certain building categories from the baseline, and whether to define a threshold for the entire non-residential building stock or by category (see Figure 2). This section presents different considerations that Member States should take into account while defining these features for their MEPS scheme.

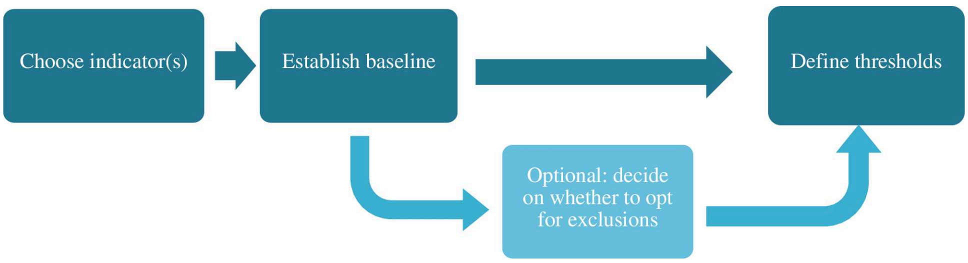

Figure 2. Definition of key features of the MEPS scheme for non-residential buildings

2.3.2.1. Indicator for the implementation of MEPS

Article 9(1) states that Member States can choose the indicator for the maximum energy performance thresholds to be either final energy use or primary energy use. The choice of the preferred indicator has implications for the type and range of measures to comply with the MEPS obligation (see Table 2).

Final energy use is the amount of energy that must be delivered to the building for space heating, space cooling, domestic hot water, ventilation, built-in lighting and other technical building systems to ensure the standardised operation of the building throughout the year. It describes the theoretical energy demand based on the physical properties of the building envelope and the systems technology. Primary energy use is energy from renewable and non-renewable sources that has not undergone any conversion or transformation process (see Article 2(9)). The use of **final energy use** as the main indicator encourages measures aimed at improving the efficient use of energy in buildings, such as the renovation of building envelopes and installation of more efficient heating systems, thereby tackling decarbonisation by reducing energy demand. However, it has limitations when it comes to comparing energy sources, introducing renewable energy sources in buildings or accounting for the improvements in the energy grid. The use of **primary energy use** would cover both energy efficiency measures described above and the use of renewable energy sources in buildings, thereby promoting also the decarbonisation of the building energy supply. It also makes it easier to compare multiple energy carriers.

If adjustments to primary energy factors or weighing factors per energy carrier lead to a better outcome of calculated energy performance, Member States need to justify the adjustments to the Commission and show that they reflect a real change in the mix of energy sources. The choices made and data sources shall be reported in accordance with EN 17423 or any superseding document (see Annex I.2).

The Commission recommends the use of primary energy given its use as the main indicator in the methodology for calculating energy performance (Annex I) and EPCs.

In accordance with Article 9(3), Member States can use complementary indicators of non-renewable and renewable primary energy use, and of operational greenhouse gas emissions expressed in $kgCO^2eq/(m^2.y)$. These indicators should be treated as additional ones, i.e. they can be used to establish a second requirement for non-residential buildings that are above the thresholds identified through the main indicator (final or primary energy use). This second requirement could help achieve higher levels of renewable energy use in buildings or further reductions in greenhouse gas emissions. The additional indicators cannot therefore substitute final or primary energy use as the main indicator for the setting of the energy performance threshold of the MEPS scheme.

A reference-building approach resulting in a ratio and displayed as a threshold expressed in final or primary energy use in $kWh/(m^2y)$ will also be eligible to establish the baseline and thresholds in accordance with Article 9(1).

Tabelle 2

Threshold indicator options

	Advantages	Disadvantages
Final energy use	Encourages measures to reduce the energy needs, including renovation of the building envelope, efficient heating systems, low-cost measures to reduce heat losses in heat distribution systems within the building. It may be easier to communicate as it relates directly to energy bills and is therefore directly related to consumers' decision-making.	The measures related to the decarbonisation of the building energy supply and the use of renewables on-site are not reflected by the indicator. Comparison between energy carriers is more complex.
Primary energy use	Encourages a larger set of measures, including both those that reduce energy needs and those related to the decarbonisation of the building energy supply and the use of renewables on-site. It allows for a direct comparison between different energy carriers. It is based on the same indicator used to identify energy classes in the EPCs. This could facilitate monitoring and compliance checks. Well-established indicator in the EPBD to express the energy performance of buildings across several provisions (e.g. Zero Emission Buildings, minimum energy performance requirements).	Primary energy use can change due to changes in the energy mix and primary factors, making monitoring difficult. Reduction of primary energy through measures in the supply side needs to be accounted for. More complex to communicate for non-specialists.

2.3.2.2. Baseline for the MEPS scheme

Article 9(1) states that the energy performance of non-residential buildings must be improved to ensure that their energy use is below the maximum energy performance thresholds, including 16% of non-residential building stock for 2030, 26 % for 2033, and the subsequent thresholds for 2040 and 2050. To determine these thresholds, Member States must set up a baseline reflecting their non-residential building stock on 1 January 2020. Member States may use data of a more recent year than 2020 along with the relevant assumptions (such as new construction rates and records of renovations or demolitions) to interpolate and achieve a realistic characterisation of the building stock in 2020. Member States should report data from 2020 in their NBRP as well as more recent data (2023 data for the submission of the first plan in 2025). This is reflected in the NBRP template.

The characterisation of non-residential building stock as described in STEP 1 is the main input to establish the baseline and define the energy performance thresholds.

The Directive allows Member States to exempt certain categories of buildings from MEPS according to Article 9(6) and exempt individual buildings according to Article 9(1). Both provisions are optional and have different effects on the application of MEPS.

The exemptions based on certain building categories as described in Article 9(6) lead to the exclusion of the selected buildings from the baseline. The considerations for them are explained in the following subsection.

Conversely, the individual buildings that may be exempted according to Article 9(1) cannot be removed from the baseline. They are discussed in Section 2.3.3.4.

2.3.2.2.1. Exemptions according to Article 9(6)

Member States may decide to exempt certain categories of buildings listed in Article 9(6) from the requirements under Article 9(1) as listed below:

(a) Officially protected buildings, e.g. due to their special architectural or historical merit, or other heritage buildings. This applies only if compliance with the standard would lead to an unacceptable alteration to the character or appearance of the building, or if the renovation is not feasible from a technical or economic point of view.

- There is technical feasibility when the technical characteristics of the technical building systems and the building (or building unit) make it possible to apply renovation measures to comply with the MEPS requirement. There is no technical feasibility when it is impossible to apply renovation measures to improve the energy performance of the building below the MEPS threshold due to technical limitations such as structural elements of the building, materials, aesthetics, space constraints, and others.

- Economic feasibility relates to the costs of applying the MEPS requirements and whether: (i) these costs are proportionate to the overall goal of the planned intervention (e.g. technical building system upgrade); (ii) the expected benefits outweigh the costs, taking into account the expected lifetime of the system or of the building, where appropriate.

(b) Buildings used as places of worship and for religious activities.

(c) Temporary use (two years or less), industrial sites, workshops and non-residential agricultural buildings with low energy demand and non-residential agricultural buildings that are used by a sector covered by a national sectoral agreement on energy performance.

(d) Residential buildings that are used or intended to be used for either less than four months of the year or, alternatively, for a limited annual time of use and with an expected energy consumption of less than 25 % of what would be the result of all-year use.

(e) Stand-alone buildings with a total useful floor area of less than 50 m^2.

(f) Buildings owned by the armed forces or central government and serving national defence purposes, apart from single living quarters or office buildings for the armed forces and other staff employed by national defence authorities.

If Member States decide not to include the buildings associated with some or several of these categories in their national MEPS scheme, these buildings must be removed from the baseline, i.e. they will not be counted as part of the non-residential building stock when defining the thresholds. The exclusion is therefore not automatic, the relevant national authorities must decide whether to apply exemptions and report such decisions in their national NBRPs. Member States shall also provide an estimation of the share of buildings excluded from the baseline in their NBRPs (see Annex II to the recast EPBD). The exclusion (for instance of historical buildings with non-residential use) has the disadvantage that it prevents such buildings and their owners from benefiting from access to tailored financial aid and specialised guidance that shall be provided on the basis of the recast EPBD Article 9(4), paragraphs a, b, d.

If Member States decide to exempt one or more of the categories indicated above, they must develop clear and public/transparent criteria to determine which buildings will be exempted. This is important when communicating the scheme to building owners. For example, if a Member State decides to exempt historical or heritage buildings, the MEPS scheme must include a clear definition of what is considered a historical building and what types of historical buildings are exempted (e.g. by making reference to a historical building catalogue).

2.3.2.2.2. Differentiation by building category

The baseline and the thresholds for the MEPS scheme can be established for the entire non-residential building stock or by building type or category. Categories of buildings can be defined according to their use (examples in Annex I to the recast EPBD: offices, educational buildings, hospitals, hotels and restaurants, sport facilities, wholesale and retail trade services buildings, or others ([5])), but also their size, typology, climate zone and a combination of these or other features.

Predefined categories in existing data sources such as cadastre registers or censuses can support the categorisation process. If defined by category, the thresholds should be defined separately for each category.

The implementation of a single threshold for the entire non-residential building stock may simplify the characterisation and monitoring process. However, the classification of buildings by category is recommended to avoid treating certain building segments unfairly.

For instance, if the baseline is defined in terms of the entire non-residential building stock, the same threshold will apply to hospitals, office buildings and hotels. These types of buildings in practice have different energy use patterns and potential for energy use reduction. If a single threshold is defined for the entire non-residential stock, this would disadvantage buildings with inherently higher energy use per square metre due to their specific functions. For instance, hospitals use more energy due to increased ventilation requirements. This will put them in an unfavourable position to comply with the same threshold compared to office buildings, which typically consume less energy under similar conditions and will therefore meet the same threshold much more easily.

Another example can be related to buildings in different climate zones. There can be significant differences in the energy performance of buildings from the same use category (e.g. hotels) and with similar dimensions due to the climate zone where they are located. The characteristics of different climate zones (temperature, humidity, solar radiation etc.) may call for different construction practices in terms of materials, technical building systems etc. For instance, a hotel in a warm coastal climate may require sun shading systems and extensive cooling. In contrast, a similarly sized hotel in a cold, non-coastal city may not need shading systems but have high heating requirements.

([5]) Note that these are all categories describing service sector buildings – the non-residential building stock may have other categories with a lower number of buildings, including transport, industry and agriculture buildings.

It is therefore recommended to establish different categories to capture the particularities of different building segments according to the context of each Member State, considering different use, size, typology, climate zones etc. The classification will depend on aspects such as current categorisations that may exist in building databases such as cadastre registers, if there are pre-established climate regions identified within the country, whether there are clear time periods linked to previous building energy codes with specific requirements for materials and building systems, etc.

Applying the same threshold to all non-residential buildings without considering their specificities could result in suboptimal renovations that are not cost-efficient. Defining baselines by category also makes it easier to design better targeted renovation support and strategies to implement MEPS, taking into account differences in ownerships/renting practices, estimated renovation times, common features and typologies, etc. This can also trigger innovation developments for instance in devices and building systems specialised for each category (e.g. hospital and building offices).

2.3.2.2.3. Final baseline

Based on the characterisation of the non-residential building stock conducted in STEP 1, the data collected and estimated for the energy performance of non-residential buildings is used to rank the buildings according to the indicator selected, final energy use or primary energy use.

If Member States opt to exempt certain building categories indicated in Article 9(6), their data shall be removed from the characterisation and therefore be excluded from the baseline so they do not appear anymore in the ranking.

Based on the data collected and estimated during the characterisation of the building stock, the buildings can be ranked by creating a frequency distribution of the buildings or by using the data for each individual building. To create a frequency distribution, the data range (the difference between the minimum and maximum value of the energy use, e.g. 0-500 kWh/(m^2y)) is divided into the number of desired classes. The range for each class is defined accordingly, e.g. class 1 corresponds to 0-19 kWh/m^2/year, class 2 corresponds to 20-39 kWh/m^2/year, class 3 corresponds to 40-59 kWh/m^2/year and so on. The data points in each class are counted to define the frequency. This can be done by the number of buildings or by floor area. Figure 3 shows an example of frequency distribution. Each bar represents the number of buildings or the floor area of the buildings in each class. The buildings that belong to the classes at the top of the graph perform worse than the buildings in the classes at the bottom.

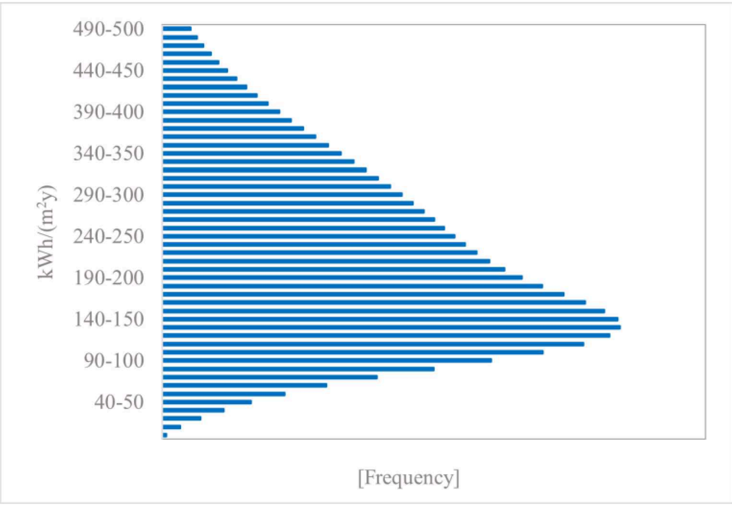

Figure 3. Non-residential building stock organised according to the energy use in a frequency distribution

To create the baseline using data for each individual building, the buildings are organised according to their energy use as illustrated in Figure 4. Each bar represents one building. Figure 4 is intended to be a representation of an entirely fictional non-residential building stock. The building stock is assumed to be composed of 25 buildings, therefore only 25 bars are presented to facilitate visualisation. The same approach to create a frequency distribution can be reproduced for a building stock of thousands of buildings. This approach and similar figures are used to illustrate other concepts and provisions in the following sections.

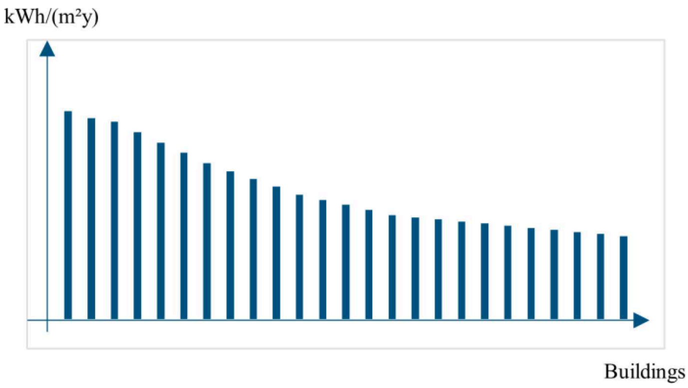

Figure 4. Illustration of the baseline for non-residential building stock

The baseline should include as a minimum the number of buildings (or floor area), type of buildings (i.e. office, healthcare, wholesale and retail trade, educational buildings, sports facilities, hotels and restaurants etc.), other building categories (if defined by the Member State) and their energy performance. The baseline should allow the subsets of worst-performing buildings to be identified (e.g. 16 %, 26 %) so that the maximum energy performance thresholds can be defined, as explained in the following subsection. Regardless of the number of categories or subcategories, the total portion of building stock that must undergo renovation remains the same (in number of buildings or area).

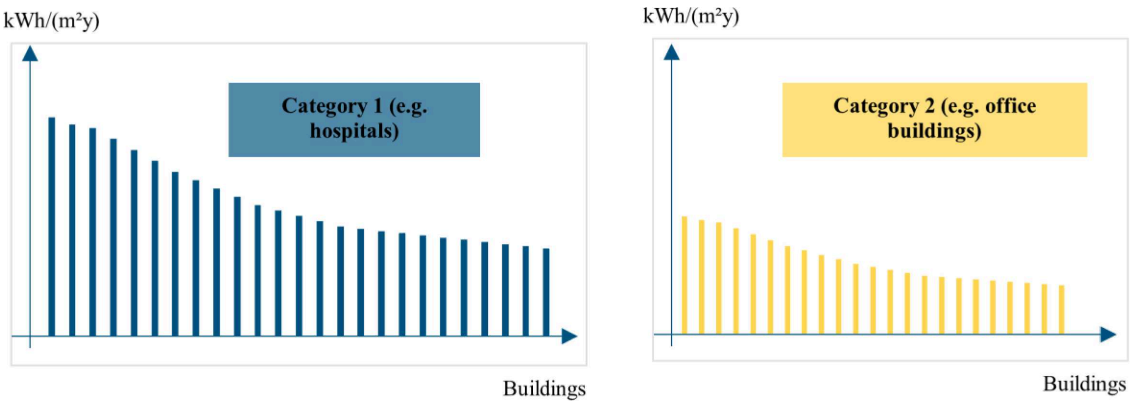

Figure 5. Illustration of baselines for different categories of non-residential building stock

If thresholds for several building categories are implemented, a specific baseline shall be established for each of the categories. The buildings in each category are organised according to their energy use. Figure 5 illustrates the case for two categories, each bar represents one building ([6]). Note that each category may have different number of buildings with a different range of energy performance.

([6]) The graphs are a representation of fictional non-residential building stock. Category 1 has 25 buildings, and category 2 has 20 buildings.

2.3.2.3. Energy performance thresholds for MEPS

Under Article 9, non-residential buildings must comply with specific energy performance thresholds that shall not be exceeded by the specified deadlines. The energy performance thresholds must be set in a way that at least 16 % and 26 % of the national non-residential building stock exceed these thresholds. These thresholds are expressed in kWh/(m^2y) and should represent either their final or primary energy use. Subsequent thresholds need to be established for 2040 and 2050, in line with the pathway for transforming the national building stock into a zero-emission building stock.

Member States shall ensure that all non-residential buildings are below the 16 % threshold by 2030 and below the 26 % threshold by 2033 unless they are exempted from the provision in accordance with Article 9(1) or Article 9(6).

To establish the thresholds, the number of buildings or the floor area can be used as explained below.

2.3.2.3.1. Defining the thresholds according to the number of buildings

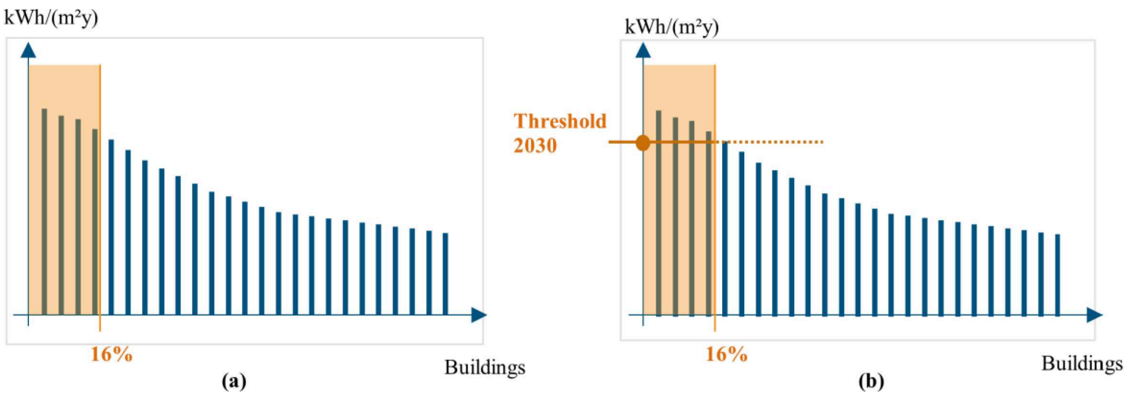

Figure 6. Establishing the 16 % threshold: (a) identifying the 16 % of buildings, (b) defining the threshold

If the thresholds are established based on the number of buildings, the number of buildings in the baseline are counted starting from the building with the worst energy performance until the percentage of buildings indicated for each milestone is reached. For instance, in 2030, the threshold shall be established by covering 16 % of the total number of buildings as illustrated in Figure 6(a). The energy use (in terms of final or primary energy use) of the next building after reaching 16 % of the buildings shall correspond to the maximum energy performance threshold for 2030 as shown in Figure 6(b). In the example, by 2030 all buildings belonging to the 16 % group must be renovated to improve their energy performance below the threshold in kWh/(m^2y) represented by the horizontal orange line.

The 26 % threshold for 2033 can be defined following the same approach, as shown in Figure 7. The subsequent thresholds for 2040 and 2050 can be defined following the same approach, see also Figure 9.

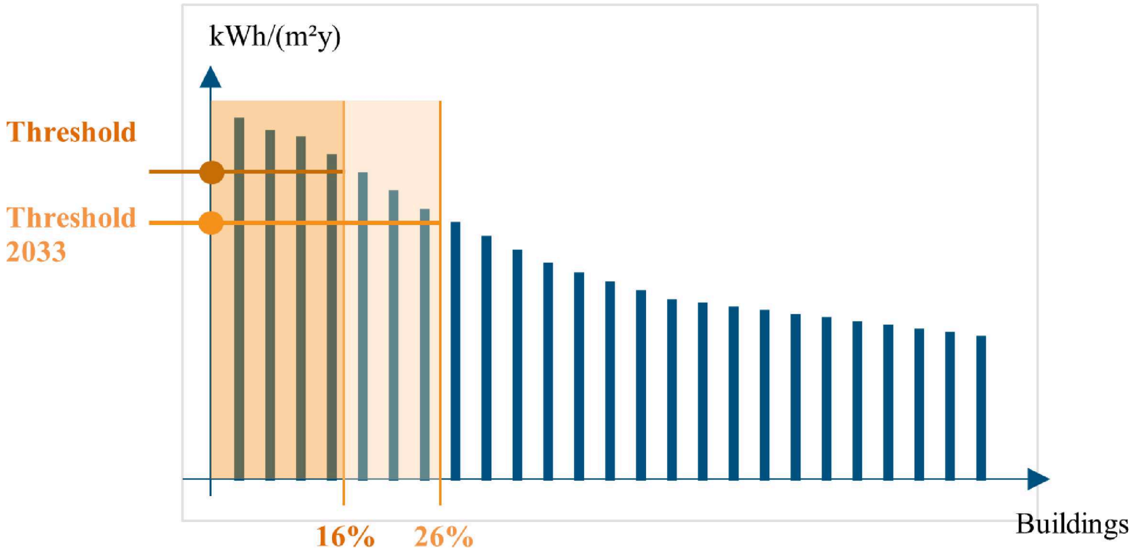

Figure 7. Illustration of 2030 and 2033 energy performance thresholds for MEPS

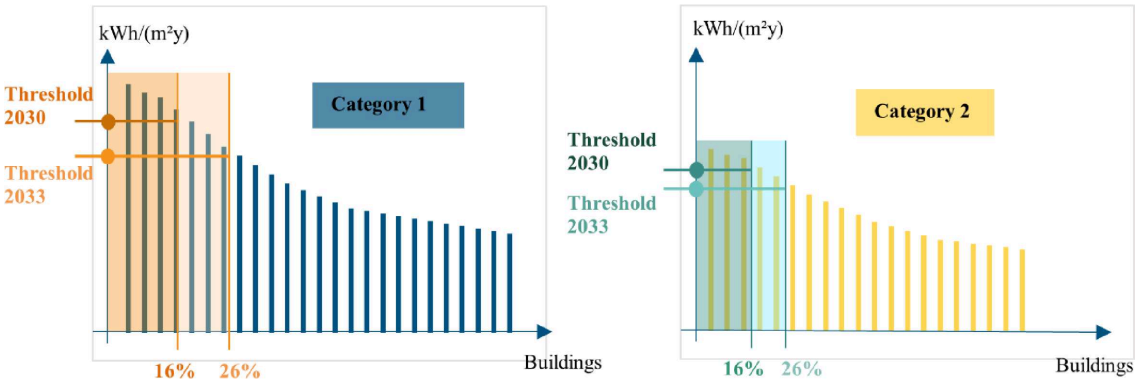

Figure 8. Illustration of 2030 and 2033 energy performance thresholds for MEPS when using multiple categories

If thresholds are defined for different building categories, the procedure previously described is applied to each of the baselines of the categories as illustrated in Figure 8. The 16 % and 26 % thresholds will represent a different number of buildings in each category, and the thresholds will be different values in kWh/(m²y) according to the energy use of the buildings in the category.

2.3.2.3.2. Defining the threshold according to the floor area

If the threshold is established in terms of the building floor area, the approach is similar to the method based on the number of buildings. The floor area of the buildings in the baseline is counted starting from the worst performing building until the percentage of floor area indicated for each milestone is reached. In 2030, this value shall correspond to 16 % of the total floor area of the buildings included in the baseline. The energy use of the next building after reaching 16 % of the floor area shall correspond to the maximum energy performance threshold for 2030.

In this case, it is important to note that even though the threshold is established based on the floor area, the number of buildings above the threshold shall also be established.

The 26 % threshold for 2033, and the subsequent thresholds for 2040 and 2050, can be defined following the same approach.

If thresholds are defined for different building categories, the procedure previously described is applied to each of the baselines of the categories.

2.3.2.3.3. Defining the threshold according to the energy performance class

Setting energy performance thresholds corresponding to the energy performance class is optional for Member States. It has the advantage that it improves the visibility of the MEPS scheme and makes communication and monitoring easier.

If the threshold is defined to correspond to a specific energy performance class in accordance with Article 19(2), the definition should still comply with Article 9(1), third subparagraph. The buildings above the threshold shall therefore at least cover the indicated portion of the worst-performing buildings, i.e. 16 % for 2030, 26 % for 2033, etc.

This can be done by defining the energy performance classes G and F of EPCs using the coverage indicated in Article 9(1), third subparagraph, i.e. 16 % threshold for G and 26 % threshold for F respectively. Alternatively, Member States could also define class G as the 26 % threshold for the building stock. While this would give more space to upper classes, it would make the differentiation between the 16 % and 26 % thresholds less visible. The buildings should be renovated to improve their energy performance and achieve a better energy performance class than the one defined in the threshold. Similarly, additional classes (e.g. D and E) could be used to represent the thresholds for 2040 and 2050.

2.3.2.4. Energy performance thresholds beyond 2033

In addition to the first two thresholds, Member States shall establish additional thresholds for 2040 and 2050 with values representing progressively lower energy consumption levels. These thresholds shall be reported in their national renovation plans as referred to in Article 3(1), point (b).

The maximum energy performance thresholds for 2040 and 2050 shall be in line with the pathway for transforming the national building stock into a zero-emission building stock. The threshold for 2040 can be defined as a midpoint threshold between the 26 % for 2033 and the threshold for 2050 (see Figure 10). The allocation of the threshold for 2040 closer to 26 % (threshold for 2033) or closer to the final threshold for 2050 will define the number of buildings or floor area to be renovated in 2033-2040 and in 2040-2050. A threshold for 2040 closer to the final threshold for 2050 will require most of the renovation efforts to occur in 2033-2040. However, a threshold for 2040 closer to 26 % can encourage non-residential buildings covered by the MEPS obligation for the 2033 threshold to implement adequate renovation measures to already meet the upcoming 2040 threshold. This will avoid a double intervention in the building to comply with the 2033 threshold and then with the 2040 threshold. It is recommended to consider these economies of scale when defining the 2040 and 2050 thresholds.

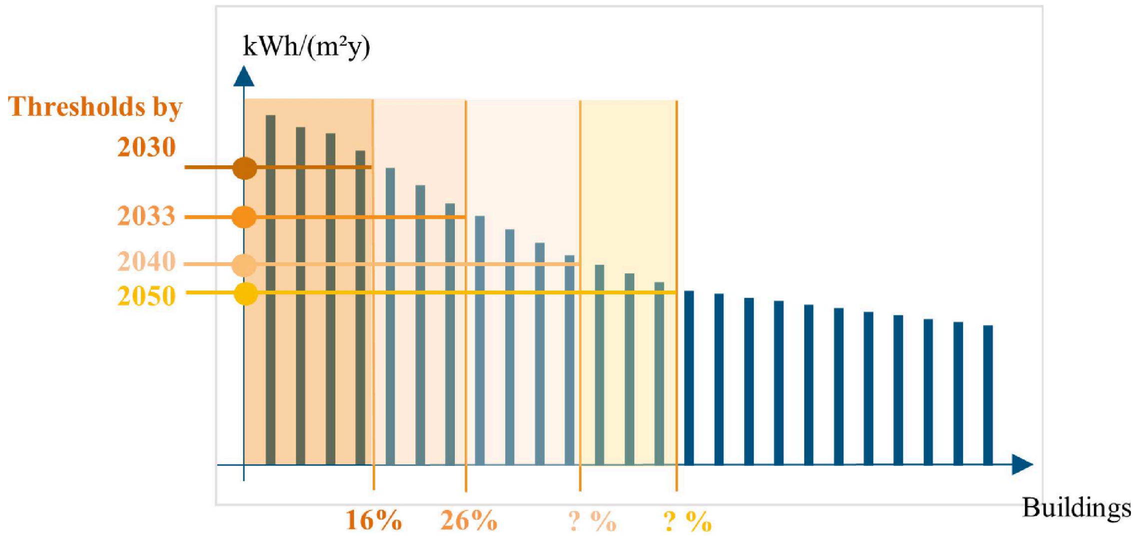

Figure 9. Illustration of 2040 and 2050 thresholds for minimum energy performance standards for non-residential building stock

It is recommended to make publicly available all the thresholds and timeline for all the relevant actors as soon as possible and in a clear way.

2.3.2.5. Temporary adjustment of the threshold in case of serious damage due to natural disaster

Article 9(1) last subparagraph states that in the case of serious damage to a portion of non-residential building stock by a natural disaster, a Member State may temporarily adjust the maximum energy performance threshold. This way, renovation activities can focus on the renovation of damaged buildings. The adjustment of the threshold should correspond to a proportionate share of worst-performing buildings, equivalent to the damaged buildings. By adjusting the threshold, those worst-performing buildings are temporarily not required to comply with the threshold. If this provision is used, Member States will have to report on the adjustments and estimated duration in their NBRP (Article 3).

Example: If shortly before the first threshold in 2030 (corresponding to 16 % of the worst-performing buildings) 1 % of the non-residential building stock is seriously damaged by a natural disaster and the Member State intends to prioritise the energy renovation of the damaged buildings, the maximum threshold can be adjusted to the effect that 15 % (16 %-1 %) of the non-residential building stock is above the new threshold. Member States should ensure that a similar number of buildings undergo energy renovation. In this example, the 1 % of the building stock that was damaged should be renovated. The threshold should be adjusted once prioritisation of the renovation of the damaged buildings ends. The use of this option should be accompanied by a relevant disaster declaration.

2.3.3. *STEP 3: Design MEPS governance and rules of compliance*

Once the calculations have been completed and the values for the thresholds have been determined, the legal framework and rules of compliance have to be laid down. This includes appointing the relevant authorities, defining the means to show compliance, the compliance procedure, criteria for exemptions, process to apply for exemptions, etc. Figure 10 presents the recommended general steps to design the legal architecture of the MEPS scheme. These steps are not exhaustive and additional elements may be needed according to the particularities and specificities of each Member State. Even though the steps are presented in a linear flow, the process will include iterations, feedback and adjustments across the different elements defined in each step. The following sections present recommendations for each of the steps presented, except for the last step on monitoring and penalties. For details on that step, see STEP 5: Set up monitoring mechanism and penalty scheme.

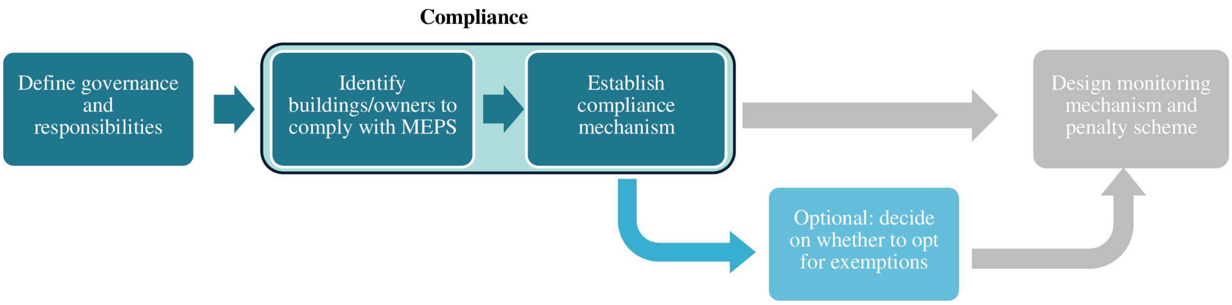

Figure 10. Steps to design the legal architecture of the MEPS scheme

All these choices need to be integrated into a clear plan and timeline for compliance during the different stages (i.e. before 2030, between 2030-2033, 2033-2040 and 2040-2050). This will allow building owners and tenants to better prepare and react on time to the MEPS requirements. It is recommended to design the legal architecture for the MEPS scheme and the compliance mechanism at an early stage and communicate them clearly to the building owners, authorities, construction associations and any other key actors to reduce uncertainties, disinformation and incomplete assumptions from the different groups of key stakeholders.

2.3.3.1. Governance and responsibilities

Member States must incorporate Article 9(1) and the resulting thresholds into national law and put in place a MEPS scheme that can be enforced at the level of the building owner. Assigning relevant authorities, defining their responsibilities and setting up a compliance scheme are crucial parts of the architecture of a MEPS scheme. The MEPS architecture has to ensure that owners of non-residential buildings above the threshold are adequately informed well in advance about key aspects of the scheme, including available technical and financial support (as required under Article 9(4)) and information on how to show compliance.

2.3.3.1.1. Appointing the relevant authorities

Member States may design a **centrally** organised MEPS scheme e.g. by creating a central register for all non-residential building owners administered by a central public authority that would also be responsible for compliance checks.

Alternatively, they could decide to organise a **decentralised** MEPS scheme, assigning responsibilities e.g. to local authorities or municipalities or public one-stop shops, or commission the implementation to energy agencies to enact the scheme on a regional or local scale. In both cases, Member States must clearly set out the mandate to the respective implementing authority and provide sufficient resources to ensure smooth implementation. Revenues could be used from the penalty scheme to (partly) finance the administrative costs of the MEPS scheme (see STEP 5: Set up monitoring mechanism and penalty scheme).

Roles and responsibilities need to be defined for activities such as notifying and contacting building owners who must comply with the MEPS obligation, managing and checking the quality of the compliance evidence, managing the monitoring and penalty scheme, designing the technical and financial support tools etc. Actors that are already in regular contact with building owners, such as facility or building energy management companies or those carrying out inspections, may also be suited to taking over a role in MEPS governance.

The clear identification of implementing authorities, roles and responsibilities and communicating this to building owners is particularly important. This allows building owners to be able to better understand the scheme and, critically, be able to direct enquiries or submit necessary documentation to the relevant authorities.

An important task for the implementing authority is to identify owners of those buildings with energy use above the different applicable thresholds. The architecture of the scheme must clarify how to access owners of buildings that are likely to be part of the MEPS obligation. Implementing MEPS at a regional/local level may be advantageous as local actors, in particular municipalities, may make use of locally available data and information, such as registries of landlords, local homeowner associations, business registers and others.

A centrally administered scheme may however allow for a more consistent enforcement of the scheme.

2.3.3.1.2. Engaging with building owners

It is recommended to make publicly available all the thresholds, timeline, compliance mechanism, penalty schemes and other elements of the enforcement procedure for all the relevant actors as soon as possible and in a clear way.

When informing the building owners/tenants about the compliance requirements, it is recommended to emphasise the subsequent thresholds and the timeline that may apply to their buildings. This way, the owners of the worst-performing 16 % and 26 % of non-residential buildings are able to plan a renovation in view of the energy performance thresholds for 2030, 2033, 2040 and 2050. This will maximise benefits, minimise costs, avoid lock-in effects and encourage building owners to align the level of ambition of the renovation and planning of their individual renovation projects with the NBRP (Article 3).

Outreach to specific building owners should be accompanied by information provided to building owners on details of the requirements, subsequent thresholds, timeline, general benefits of renovation, available one-stop shops and other available technical assistance, financing instruments, the post-renovation compliance mechanism and any other relevant information (see also STEP 4: Set up an enabling framework).

Engagement with building owners can occur at different stages of the compliance mechanism designed by the relevant authorities. Examples include:

— Informal support to help understand the MEPS scheme, e.g. through workshops, information through owner associations, stakeholder associations, communication in media, flyers, etc.

— Technical support, e.g. from one-stop shops, to help identify the most appropriate renovation measures for improving energy performance.

— Formal compliance actions by relevant authorities such as a formal notice for compliance.

— Timing (procedure and deadlines) and means to provide evidence for compliance if building owners consider the energy use of their building to not be above the applicable threshold. If, for example, the building owner registers a valid EPC proving that the building is performing better than the threshold, they can free themselves from the requirement to renovate the building.

— Timing (procedure and deadlines) and means to provide evidence when a building falls under a building category exemption or under an individual exemption (case of hardship).

— Timing (procedure and deadlines) and means to provide evidence for compliance after renovating the building due to MEPS.

— In the case of failure to comply, a formal action according to Article 9(7), taken by relevant authorities and if necessary, by courts can be the following stage.

2.3.3.2. Compliance: identifying buildings/owners to comply with MEPS

The relevant authorities need to develop a method to identify the buildings that must meet the thresholds of the MEPS scheme. The EPBD recast does not specify how this should be done, giving Member States flexibility on this point.

A starting point can be the characterisation of non-residential building stock as explained in STEP 1: Identify data sources and characterise the non-residential building stock. Estimates on final or primary energy use based on certain technical characteristics of buildings can be used to identify the buildings that are likely to have energy use above the applicable threshold. This method alone might however not be sufficient and it is recommended to combine it with other strategies to identify the buildings and their owners that need to comply with the MEPS scheme.

For buildings with an EPC, authorities can use the data in the EPC database to assess whether the building meets the threshold. Owners of these buildings can then be notified in advance about the need to comply with the MEPS obligation. Adjustments to the values in the EPC might be necessary if the assumptions for calculating energy performance have changed, such as changes in primary energy or weighting factors. In addition, the data in the EPCs might be outdated if a renovation occurred since the EPC was issued.

Another option is to use building owner registers or landlord licensing systems ([7]). These can be put in place at local or national level to promote self-registration of building owners and supply information on the energy performance of their building. Landlord licensing systems that require minimum information about the properties and owners can also make it easier to identify buildings in the rental market that are above the maximum energy performance threshold.

([7]) A licensing system for landlords requires building owners who let non-residential properties to apply for a licence to be allowed to rent out a building.

Coordination across public institutions and offices that issue different licences or permits may enable the identification of targeted buildings. If e.g. a building owner applies for a rental licence or other permits (e.g. hotel operating permit), this can be an opportunity to check/request evidence on the energy performance of the property. Whenever a new EPC is issued due to the building being sold, rented out to a new tenant or when a rental contract is renewed, this represents an opportunity to identify the energy performance of the building as well. The relevant authority responsible for compliance with the MEPS scheme could be automatically notified when a new EPC above the current applicable threshold is registered in the national EPC database. Similarly, an update to an EPC that brings the performance below the threshold could be used to exclude the relevant building from the category of non-compliant buildings.

2.3.3.3. Compliance: Establishing a compliance mechanism

To meet the MEPS obligation, buildings with energy use above the thresholds shall be renovated to improve their performance to levels below the respective thresholds. Renovation measures shall improve the performance of the building in terms of energy use directly considered when determining the energy performance of the buildings according to Annex I (1). The eligible measures to improve the energy performance of the building and comply with the MEPS obligation therefore include the energy renovation of the building envelope and replacement of technical building systems, including the technical equipment for space heating, space cooling, ventilation, domestic hot water, built-in lighting, building automation and control, on-site generated renewable energy, or a combination of them.

Evidence that the threshold has been met should be derived from a consistent approach, with a clear methodology and timeline to avoid ambiguity. The compliance mechanism should consist of three key elements:

— established mechanism recognised at national level;

— evidence to be supplied;

— subject to quality assurance.

Examples of a compliance mechanism include EPCs, a checklist with predefined measures, existing national benchmarking schemes (e.g. BREEAM, DGNB), and others. If such benchmarking schemes do not exist or require modifications, it is necessary to develop them early within the timeline of the enforcement period.

Evidence could be issued by a third-party provider (e.g. a registered independent expert for an EPC). This is both to exclude conflicts of interest and to ensure that the assessment has been done according to the recognised methodology.

The evidence must go through a quality assessment procedure carried out by an independent party. It is recommended to involve the relevant authorities to validate the quality.

The EPC scheme, available in all Member States, is a recognised evaluation tool and complies with all the criteria above. It is therefore recommended to use EPC as the basis for the compliance mechanism.

The following subsections provide more information on the timing of compliance, together with two examples of compliance mechanisms: EPCs and a list of renovation measures.

2.3.3.3.1. Compliance timing

It is necessary to clearly define which compliance mechanism will be applicable and the rules in terms of the issuing, quality and characteristics of each of them. It is recommended to establish these elements early enough so they can be communicated explicitly and on time to the building owners that must comply with the MEPS obligation.

The timeline should be aligned with the provisions in Article 9(1), i.e. the first applicable threshold by 2030, second applicable threshold by 2033 etc. It is recommended to include regular reminders of the MEPS obligation and compliance deadlines. Consequences and penalties for non-compliant building owners should be communicated as well (see STEP 5: Set up monitoring mechanism and penalty scheme).

Compliance checks are relevant in two points in time: a) for cases where building owners consider that their property is already compliant at the time of notification of the MEPS obligation, therefore well before the threshold dates as defined in Article 9(1); b) for regular cases where building owners conduct renovation activities after the notification of the MEPS obligation to improve the energy performance of the building below the applicable threshold. In both cases, the quality and control requirements (clear methodology, issued by a third party, subject to quality checks) of the compliance mechanism must be applied.

Since the identification of buildings and building owners that must comply with the MEPS obligation may rely in some cases on data collected before the implementation of the MEPS scheme and estimations, there may be cases where buildings identified as buildings with energy use above the maximum threshold are in reality already compliant with the MEPS obligation as their energy use is indeed lower than the threshold.

Where the identified buildings have an energy performance above the applicable threshold, the compliance timeline can be aligned with the timeline described in Article 9(1), i.e. 2030 for the first threshold, 2033 for the second threshold, etc. In these cases, building owners must conduct renovation activities to bring the building's energy performance below the applicable threshold by the specified dates. Member States could also establish earlier timelines for building owners to show compliance.

2.3.3.3.2. Evidence of compliance by EPCs

Proving compliance by EPC requires the building owners to provide a valid EPC of their property to show the energy performance of the building calculated according to Annex I (1).

To be valid as a compliance mechanism, an EPC shall include the information on the indicator selected for the MEPS scheme, i.e. the information on final energy use or primary energy use. If the EPC does not include the data about the main indicator (e.g. final energy consumption) or is not up to date (e.g. the building underwent renovation measures after the EPC was obtained), other compliance mechanisms shall be applied.

If the renovation triggered by the MEPS is a major renovation, an EPC must be issued according to Article 20. Member States should make use of this trigger and leverage the EPC as a compliance mechanism. The relevant authority responsible for compliance with the MEPS scheme could be automatically notified when a new EPC for buildings under the MEPS scheme is registered in the national EPC database. This can be linked to the monitoring mechanism and the national database for the energy performance of buildings that needs to be set up in accordance with Article 22.

2.3.3.3.3. Evidence of compliance based on a list of renovation measures

Another compliance mechanism could require building owners to provide evidence on the implementation of renovation activities taken from a list of measures linked to minimum technical requirements and resulting estimations of energy performance improvements.

This compliance mechanism can be implemented in two ways: a) based on a predefined list of minimum measures with requirements for the building components; b) based on the list of renovation measures recommended in the individual building EPC or renovation passport (if available). In both cases, Member States shall establish a clear methodology, including a definition of the evidence that must be provided, who must provide it (self-disclosure, third party), and a methodology to assess whether the energy performance of the building was improved to levels below the maximum energy performance threshold applicable. This approach must in any case ensure that the energy performance of the building is well established, and that the energy performance threshold established at national level is met.

For the first approach, Member States define a list of minimum measures that would improve the energy performance of the building so it complies with the MEPS obligation. The list would for example provide a default value for the replacement of windows with a maximum U-value (lower than the previous windows) or an increase in wall insulation by a few centimetres. These values can be estimated based on current renovation practices and technological developments, common measures implemented in different non-residential building segments, or energy modelling of multiple representative buildings.

The measures shall improve the performance of the building in terms of energy use for space heating, space cooling, domestic hot water, ventilation, built-in lighting or other technical building systems as these are the elements that have an impact on the calculation of the energy performance of the buildings according to Annex I (1). Examples of measures include:

(a) improving external wall insulation, roofs and other envelope elements such as windows and doors:

(b) replacing the heating system by a more energy-efficient one;

(c) installing building automation and control systems to monitor, control and optimise energy performance;

(d) installing a renewable energy system on site.

Building owners or a designated third party (e.g. contractor, external assessor) shall provide evidence (e.g. proof of payment) of the renovation measures from the predefined list of minimum measures that were implemented in the building. The energy performance of the building after applying the estimated energy improvements shall be below the maximum energy performance threshold applicable. The energy improvements achieved can be estimated by adding up the energy improvement potential [8] of the renovation measures implemented. Member States shall ensure that a suitable methodology is implemented. The choice of indicator may have implications on the choice of renovation measures (see Table 2).

The second approach for compliance based on a list of renovation measures is linked to buildings with a valid EPC (including renovation recommendations) or a renovation passport. In this case, building owners or a designated third party shall provide evidence to demonstrate that the renovation measures recommended in the EPC or renovation passport of the building were implemented.

Like in the previous approach, the energy performance of the building after applying the overall energy improvements achieved through the renovation measures implemented must be lower than the maximum energy performance threshold applicable. The overall energy improvements can be estimated based on the energy savings projected in the EPC or renovation passport (if included). Alternatively, they can be based on predefined default values for energy improvements associated with each measure, as discussed for the previous approach.

2.3.3.3.4. Other considerations regarding compliance

Member States shall ensure the quality of compliance evidence. If compliance is based on EPCs, EPCs issued after the recast EPBD has been transposed must fulfil the relevant provisions introduced in Articles 19 and 20, and in Annexes I and V.

If Member States implement any of the two approaches based on a list of renovation measures, it could be established that the evidence provided and the estimations for the energy performance improvements are subject to third-party quality checks and control. Also, the relevant authority shall validate the quality based on random sampling at least.

If building owners provide the evidence themselves, the checks and control shall be stricter to ensure adequate quality of the evidence provided and ensure equal treatment.

Allowing different ways to prove compliance may offer more flexibility to building owners to fulfil the requirement and encourage reporting from building owners.

Member States may use different compliance mechanisms for different building categories.

Compliance mechanisms can be linked to additional benefits or incentives, such as receiving certification for the improvement achieved or registering the property in a public list of compliant buildings, which building owners/tenants can use to promote their properties.

Financial institutions can play a key role not only in providing information on benefits and opportunities for renovation, but also in facilitating loans to cover renovation investments necessary to comply with MEPS.

(8) Member States can develop a predefined list of measures, including the potential energy improvement achieved if each individual measure is implemented. For instance, it is estimated that by replacing single-glazed windows with triple-glazed windows, the energy savings would be x %.

2.3.3.4. Optional: allowing for exemptions of individual buildings

The recast EPBD allows Member States to exempt certain categories of buildings under Article 9(6) and to exempt individual buildings under Article 9(1). Both provisions are optional and have different effects on the application of MEPS. For the exemption of building categories under Article 9(6), please see Section 2.3.2.2.1. This section covers the exemptions for individually identified buildings under Article 9, paragraph 1, subparagraph 8.

The buildings exempted on an individual basis through the criteria established by the Member States shall not be removed from the baseline for the MEPS scheme. Instead, the sum of the unrealised energy performance improvements must be compensated by achieving equivalent energy performance improvements in other parts of the non-residential building stock (see section 2.3.3.4.3.2 'Quantifying equivalent energy improvements').

If Member States decide to implement the option of exempting individual buildings, they shall establish a set of criteria that is clear, precise and stringent. These criteria must be reported in the NBRPs as per Article 3 of the recast EPBD. The criteria to exempt individual buildings may reflect three reasons: a) expected future use of the building; b) serious hardship; c) unfavourable cost-benefit assessment (see 'Criteria for exemptions for more details').

They must be selected in such a way that exemptions are allowed only in exceptional cases and on the condition that evidence shows that compliance with the requirements is impossible for a specific building. Such conclusions can only be made on a case-by-case basis, and Member States should not introduce systematic exemptions for any category of building. Building owners must prove that a specific criterion applies to request an individual exemption.

The conditions under which the application of exemption criteria is evaluated should be defined at Member State level or, where regional conditions affect only part of a Member State's territory, at regional level. However, in the latter case, regional conditions should be described in the NBRPs. In all cases, these conditions should be documented (e.g. as part of technical guidelines) and should apply uniformly to the national, or, where applicable, regional territory. Exemption criteria should be clearly communicated to building owners as part of the overall MEPS scheme. Finally, the non-application of requirements should be assessed using clear procedures established and supervised by public authorities.

It is recommended to publish the criteria early on and set up a clear timeline and procedure for building owners to notify exemptions. The applicable evidence (e.g. demolition certificate, unfavourable cost-benefit assessment carried out by a third party) must be unambiguous and clear for each of the three exemption categories.

2.3.3.4.1. *Ex ante* report on estimated individual exemptions

If Member States allow for individual exemptions based on criteria in accordance with Article 9(1), subparagraph 8, they must carry out an *ex ante* assessment of the potential share of buildings covered by these exemptions. This assessment must be reported in the NBRPs as referred to in Article 3. Member States must ensure that they do not exempt a disproportionate number of non-residential buildings. Factors influencing whether the number of exempted buildings is disproportionate include the additional administrative effort to monitor exemptions and plan for alternative measures.

There are different ways to carry out the *ex ante* assessment of the potential share of individually exempted buildings. Member States could make estimates based on the typical use and characteristics of the building stock and their occupants. Alternatively, they could require building owners to apply for an exemption upfront by registering it in a central register by a specific date and proving that they meet the criteria established by the Member States. The second approach is more precise and may increase building owners' awareness of their buildings' energy performance. It also allows for better planning of renovation measures to be implemented elsewhere. Member States may also opt for a combination of those approaches.

It is recommended that Member States check the number and floor area of exempted buildings *ex post* to verify if the number aligns with the *ex ante* estimates.

2.3.3.4.2. Criteria for exemptions

Under Article 9(1), the criteria to exempt individual buildings may reflect three reasons: (a) expected future use of the building; (b) serious hardship; and (c) unfavourable cost-benefit assessment.

The criteria must be defined as specifically and clearly as possible and be underpinned with indicators to demonstrate eligibility. It is recommended that the building owner applies for an exemption before the enforcement date and provides proof of eligibility that can be verified by a third party or relevant authority. Evidence for the exemption application shall be defined according to the applicable criteria. Examples of criteria are presented in the following subsections.

2.3.3.4.2.1. Expected future use of the building

The criterion related to the expected future use of the building addresses situations where, due to a change in usage pattern, renovating the building would not be beneficial or the building would no longer fall within the scope of the requirement. Examples of this:

Plans to convert the building into a residential building: If a building owner plans to convert an existing non-residential building into a residential building, it may be exempted from the MEPS obligation. The building will then fall under Article 9(2). Adequate proof must be provided, e.g. a valid building permit, contracts to prove that construction work has been commissioned etc.

Plans to convert the building into another category of non-residential building within the scope of Article 9(1): The conversion of a non-residential building from one category to another (e.g. from hotel to office building) does not qualify for an exemption to comply with the MEPS obligation. The threshold for the future use category of the building would apply in this case.

Plans to convert a non-residential building into another category of non-residential building that would fall within the scope of Article 9(6): The conversion of a non-residential building under Article 9(1) to a building that would be eligible for exclusion from the MEPS scheme under Article 9(6), e.g. buildings used for worship, conversion to a non-residential agricultural building or a building to serve national defence purposes, may be exempted from compliance with the MEPS obligation. Another example can be buildings within the process of becoming officially protected as part of a designated environment or because of their special architectural or historical merit. If exempted, the building needs to be removed from the baseline, or energy performance improvements must be achieved in other parts of the building stock. Adequate proof must be provided, e.g. a valid building permit, contracts to prove that construction work has been commissioned, or a certificate proving the status of a protected building.

Plans to demolish the building: Planned demolitions are explicitly mentioned as a special situation that qualifies for individual exemptions under Recital 26 of the recast EPBD. When individual buildings to be demolished are exempted from the MEPS obligation, Article 9 states that equivalent savings must take place in other parts of the non-residential building stock. A demolition permit can serve as proof of the intended future use of a building.

If the future use of a building qualifies for an exemption from the MEPS obligation, the building owner must provide appropriate evidence. It is recommended to establish a clear timeline for the application process, aligned with the enforcement procedure of the MEPS scheme.

It is also recommended to establish a clear timeline in terms of fulfilling the change of use. For example, if a building owner plans to change the use of the building, but does not do so within a given timeframe, then the obligation to renovate should apply.

2.3.3.4.2.2. Serious hardship

The criterion of serious hardship is intended to reflect a severe but temporary situation and needs to be justified by the individual situation of a building owner or tenant. As indicated in Recital 26, ‘cases of serious hardship justify an exemption for as long as the hardship persists’. Serious hardship exists, for example, if the building’s owner or tenant faces liquidity problems, is threatened with bankruptcy or made a certain percentage of staff redundant within the past year.

Liquidity problems: These could be proven e.g. by financial statements, bank statements, tax returns, credits reports, audit reports and others. Clear conditions and rules should be defined to make sure that exemptions based on this criterion are applied fairly.

Threatened with bankruptcy: If threatened with bankruptcy, the building owner has to provide similar evidence as for liquidity problems. In addition, the owner needs to indicate future profit projections for the upcoming year that should be based on previous years and compared to the investment costs or rent increases due to renovation work. These costs must be substantiated, e.g. by three independent advisors' offers. Additionally, actual profits should be submitted annually to demonstrate that the assumptions were reasonable. If the profits are higher than projected, the criterion does not apply and the exemption may be lifted, and the obligation to comply with MEPS will apply.

Sickness: Serious individual situations (such as sickness) may be considered as serious hardship if the building owner is a small or medium-size company or private building owner. The building owner then has to provide a medical certificate and show that there is no alternative person who can be responsible for fulfilling the MEPS obligation.

Recently becoming a building owner: There are circumstances whereby a person suddenly became a building owner (e.g. by inheriting a leased building) that would make it very difficult to carry out required renovation work immediately. This case may qualify for a short exemption from the requirement to comply with the MEPS obligation.

2.3.3.4.2.3. Unfavourable cost-benefit assessment

For the criterion based on c) (unfavourable cost-benefit assessment), Member States' criteria need to be able to assess whether the costs to conduct the renovation measures in order to comply with the MEPS obligation are proportionate, and whether the expected benefits outweigh the costs, allowing for a comparison of alternatives. They shall do this by carrying out a cost-benefit assessment for planned renovation measures at individual building level.

A cost-benefit assessment is a tool used to evaluate the costs and benefits of various renovation measures for a building. This evaluation is conducted in monetary terms and considers factors such as construction costs, energy savings, increased property value and maintenance savings. The calculation should also include the costs and benefits of environmental and health externalities, aligning with the aim of the recast EPBD of increasingly take environmental and health externalities into consideration (see e.g. Articles 2(32 iv) and 13). A thorough cost-benefit assessment needs to consider the lifespan of the building and each renovated component, as different elements will have varying durations of effectiveness and costs over time.

If Member States allow for individual exemptions due to unfavourable cost-benefit assessments, they need to provide a clear and publicly available framework to carry out the assessment. This involves defining the calculation steps and parameters to be considered in the assessment, including average values for the lifetime of building components, discount rates to determine the net present value, reference values of costs for certain measures, etc. Member States should set up a scheme to verify the calculations, e.g. checklists to be verified by the relevant authority or requiring independent experts to provide calculations to validate the findings. Member States may reject applications if the cost-benefit assessment is not carried out according to the pre-established framework.

A cost-benefit assessment is considered unfavourable if the resulting net present value, including its externalities, is negative throughout the remaining lifetime of the building. Alternatively, the return on investment could be calculated, i.e. the net benefits (i.e. total present value of the benefits minus total present value of costs) divided by the total costs, and be used as an indicator.

The calculation must detail the costs and benefits associated with single measures to evaluate which measures would still result in a favourable cost-benefit assessment. Article 9(1) subparagraph 10 states that Member States must require, in the event of an unfavourable cost-benefit assessment, that at least those individual renovation measures with a favourable cost-benefit assessment are implemented. The calculation should therefore allow for a comparison of the alternatives. For example, for the replacement of an old and depreciated boiler the assessment of economic costs should e.g. consider alternatives such as a gas boiler and a heat pump and compare the costs for the gas boiler with the costs of the heat pump, taking the lower operating costs and environmental benefits of the latter into account.

The renovation passport (Article 19, Annex XIII) could be a useful tool to help Member States and building owners carry out a cost-benefit analysis if the passport is available. It provides details on the different renovation steps and the costs associated with those measures, taking the individual buildings renovation roadmap into account over time.

2.3.3.4.3. Equivalent improvement in other parts of the building stock due to exemptions

2.3.3.4.3.1. Quantifying unrealised energy improvements

The sum of the unrealised energy improvements due to the exemption of individual buildings must be compensated by achieving equivalent improvements in other parts of the non-residential building stock. Member States shall monitor the renovation activities for these equivalent improvements. An estimation of equivalent energy performance improvements shall be reported in the NBRPs as referred to in Article 3.

The total unrealised energy improvements correspond to the sum of the unrealised improvements of all the buildings exempted. The unrealised energy improvements for a single exempted building can be estimated based on the difference between the current energy performance and the threshold to be reached as described by the equation below. For instance, if an exempted building with a floor area of 500 m^2 and an energy performance of 350 kWh/(m^2y) was expected to comply with the MEPS obligation of a threshold of 280 kWh/(m^2y), the unrealised energy improvements would correspond to 35 000 kWh/y. The floor area must be the same floor area that was used to determine the energy performance of the building to ensure consistency in the calculation.

$$Unrealised\ improvements_j = (EPerformance_j * A_j) - (Threshold * A_j)$$

— Unrealised improvements$_j$: unrealised improvements of building j, in kWh/y

— EPerformance$_j$: current energy performance of building j, in kWh/(m^2y)

— A_j: floor area of building j

The unrealised energy improvements shall be calculated for every single building that is exempted. The total unrealised improvements are then calculated by adding up the unrealised improvements of all exempted buildings:

$$Total\ unrealised\ improvements = \sum Unrealised\ improvements_j$$

The unrealised energy improvements can also be estimated based on the effect of a list of minimum measures that would be necessary to improve the energy performance of the building so it goes below the threshold. The allocation of standard energy savings to these measures will allow for an estimate of their impact on the overall energy performance. The implementation of the measures in the list should improve the building's energy performance in terms of energy use for space heating, space cooling, domestic hot water, ventilation, built-in lighting or other technical building systems as specified within the common general framework for calculating the energy performance of buildings in Annex I (1). Examples include installing a renewable energy system on site, improving external wall insulation, roofs and other external elements such as windows and doors, replacing the heating system with a more energy-efficient one, installing building automation and control systems to monitor, control and optimise energy performance.

For this approach, default energy savings are allocated to each measure based on common practices, renovation statistics, technical studies, etc. The effect in terms of energy performance improvements of implementing them on the building being exempted is then estimated, i.e. the energy performance of the building before and after the hypothetical implementation is compared and the unrealised energy improvements calculated. The floor area must be the same floor area that was used to determine the energy performance of the building to ensure consistency in the calculation.

$$Unrealised\ improvements_j = (EPerformance_j * A_j) - \left(EPerformance_j * A_j * (1 - \sum Measure\ energy\ savings_i)\right)$$

— Unrealised improvements$_j$: unrealised improvements of building j, in kWh/y

— EPerformance$_j$: current energy performance of building j, in kWh/(m^2y)

— A_j: floor area of building j

— Measure energy $savings_i$: energy savings associated with the implementation of the renovation measure I, in %

— i: set of renovation measures in the predefined list

As before, the unrealised energy improvements shall be calculated for every single building that is exempted. The total unrealised improvements are then calculated by adding up the unrealised improvements of all exempted buildings:

$$Total\ unrealised\ improvements = \sum Unrealised\ improvements_j$$

2.3.3.4.3.2. Quantifying equivalent energy improvements

The total unrealised energy improvements must be compensated by achieving equivalent energy performance improvements in other parts of the non-residential building stock. Taking the example from the previous section: the unrealised 35 000 kWh/y energy improvements of the exempted building could be obtained by renovating a building with a floor area of 700 m^2 and energy performance of 250 kWh/m^2y if its energy performance is reduced to 200 kWh/(m^2y) (calculated as 250 kWh/(m^2y) – (35 000 kWh/y/700 m^2)). The energy improvements can be calculated using the following equation:

$$Energy\ improvement_k = (EPerformance\ before\ renovation_k * A_k) - (EPerformance\ after\ renovation_k * A_k)$$

— Energy $improvement_k$: energy improvement achieved in an individual building in other part of the non-residential building stock, in kWh/y

— EPerformance: Energy performance in kWh/(m^2y)

— A_k: floor area of building k

The unrealised energy improvements can be implemented on a one-by-one basis. This requires monitoring that the unrealised energy improvements of exempted building j are equal to the energy improvements of building k in other parts of the building stock. However, the total equivalent energy improvements of all renovated buildings in other parts of the building stock can also be aggregated and then compared to the total unrealised energy improvements calculated in the previous section. The total equivalent energy improvements can be calculated by adding up the improvements of each single building k:

$$Total\ equivalent\ improvements = \sum Energy\ improvements_k$$

The total equivalent energy improvements achieved in all buildings in other parts of the non-residential building stock shall be equal to or higher than the total unrealised energy improvements as calculated in the previous section.

$$Total\ equivalent\ improvements \geq Total\ unrealised\ improvements$$

2.3.3.4.3.3. Ways to achieve equivalent energy improvements

There are different ways to achieve equivalent improvements. One approach is to achieve the unrealised improvements by renovating individual buildings in the better performing part of the non-residential stock, as illustrated in Figure 11. In the example, the red building (see Figure 11 (a)) applied for an exemption ([9]). Figure 11 (b) illustrates how to quantify the unrealised improvements. Equivalent improvements equal to or larger than the unrealised improvements are to be achieved by renovating other buildings out of the MEPS scheme (green buildings). This may require additional renovation schemes that target those buildings. This approach provides flexibility in targeting different buildings, but may require a high monitoring effort to keep track of where the equivalent improvements are being achieved.

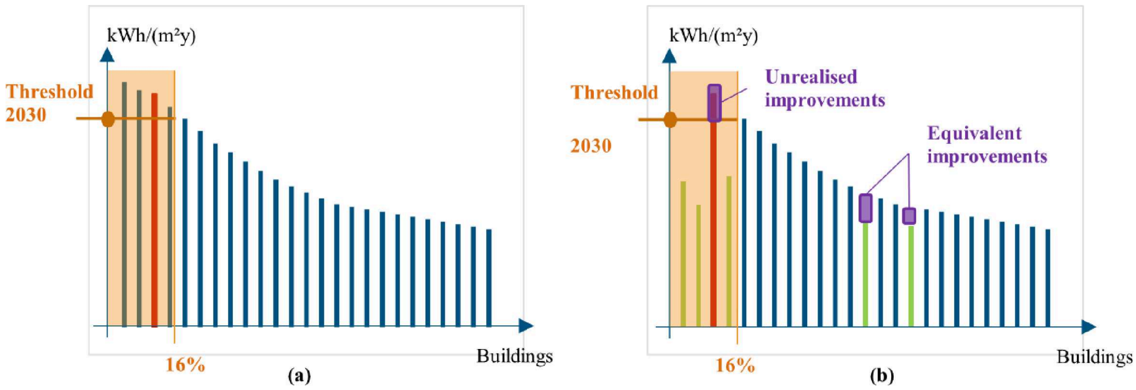

Figure 11. Exemptions: (a) Building exempted; (b) Achieving equivalent improvements in other parts of the non-residential building stock

A second approach aims to achieve additional energy improvements when renovating the buildings that are above the next threshold (see Figure 12). This approach facilitates the monitoring process since the targeted buildings for the equivalent improvements correspond only to the next set of worst-performing buildings instead of the entire portion of buildings out of the MEPS scheme. This approach also accelerates the renovation of the worst-performing buildings, but may require additional support mechanisms to encourage building owners to renovate their buildings earlier than the predefined deadline.

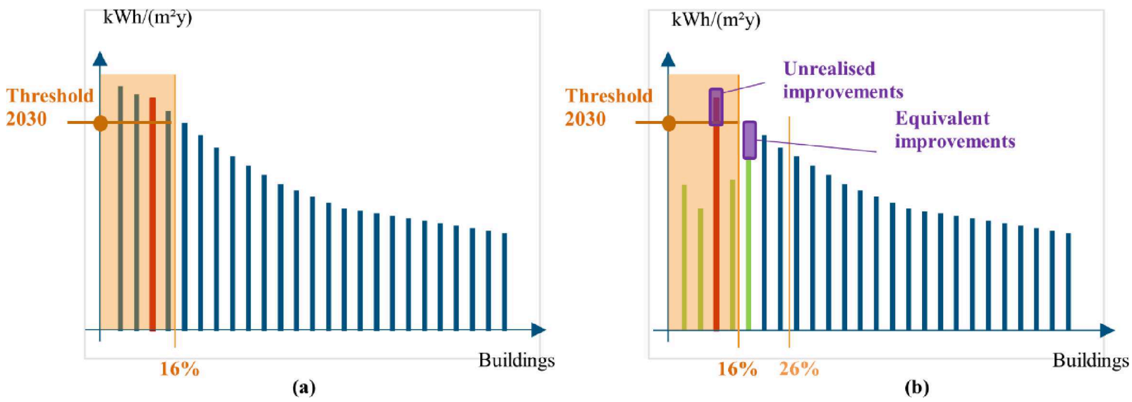

Figure 12. Exemptions: (a) Building exempted; (b) Achieving equivalent improvements in the next worst-performing non-residential buildings

([9]) Where the exemption is based on an unfavourable cost-benefit assessment, Member States shall require that, for the exempted building, at least those individual renovation measures with a favourable cost-benefit assessment are implemented.

2.3.4. *STEP 4: Set up an enabling framework*

2.3.4.1. Purpose of the enabling framework and key considerations

In order to support compliance, Member States must set up an enabling policy framework in accordance with Article 9(4) and Articles 17 and 18. While the policy framework in accordance with Article 9(4) has to be fully available, not all measures need to be available for all types of buildings or building owners. The choice for enabling measures partly depends on the national or local context as well as specific MEPS design choices. An analysis of existing practice shows that there are key general supportive measures, including:

a. Financial support schemes to ease the financial burden put on certain groups.

b. Technical assistance at several levels:

    a. Providing (free) advice to building owners throughout the entire renovation journey, from initial advice, in-depth analysis, support in securing financial incentives and finding contractors to quality control, e.g. through one-stop shops.

    b. Skills in the construction value chain: a skilled workforce is required to realise the renovation boost that will be triggered by MEPS. Investments are needed in training and capacity building, developing staff and structures to make sure there are enough skilled workers to deliver the renovation wave when it arrives, in line with Article 17(12).

    c. Supporting relevant authorities, e.g. local actors, to be able to implement the scheme.

c. Incentivising real estate investors and owners who are considering deep renovations through instruments like subsidies, tax incentives, and green bonds to go beyond the minimum requirements in line with the provision in Article 9(4) point c) on 'designing integrated financing schemes which provide incentives for deep renovations and staged deep renovations' and under Article 17 and Article 17(16).

d. Setting up or adapting financing schemes so that they include financial incentives for the issuance of renovation passports, and possibly additional investment incentives for measures recommended in a renovation passport.

e. Actions to increase public awareness and acceptance for effective implementation of MEPS. Support can be dedicated to carrying out tailored communication campaigns and to creating a network of integrated renovation services, such as one-stop shops as required by Article 18, to make the renovation journey smoother.

f. Special attention should be given to removing non-economic barriers such as split incentives (Article 9(4) paragraph d)) through the combination of measures, e.g. raising awareness about the increase in building value following energy renovation, technical support and legislation, for example as regards co-ownership rules, or allowing an increase in basic rent to recover the renovation cost in line with energy cost savings for tenants.

2.3.4.1.1. Addressing split incentives

While MEPS implicitly helps to overcome the lack of investments due to split incentives, the cost implications of split incentives remain. The guidance on Article 17 in Annex 2 provides options and examples of existing schemes that address split incentives.

2.3.4.1.2. Incentivising renovation of buildings eligible for individual exemptions

To be eligible for (temporary) exemptions from requirements under Article 9(1), building owners will have to individually prove compliance with the criteria set up at Member State level. This process could be used as a trigger for renovation by automatically linking the exemptions to the (partial) financing of a renovation passport, or an automatic invitation to a one-stop shop, similar to Article 19(13), where a building owner receives an invitation to a one-stop shop if an EPC label lower than C is issued.

2.3.4.1.3. Incentivising renovation of categories of buildings that Member States may exempt from MEPS requirements

Certain categories of non-residential buildings may be exempted from the requirements of Article 9(1), making use of Article 9(6), and might possibly be overlooked in the national renovation strategies. Having an enabling framework that directs special support to these building categories may lead to substantial additional energy performance improvements in these parts of the building stock.

2.3.4.2. Mechanisms of support

Article 9(4) requires Member States to provide financial measures and integrated finance schemes as well as technical assistance as part of the enabling framework.

2.3.4.2.1. Financial support to encourage deep renovation (Article 9(4)(c))

Building owners and investors should be incentivised to go beyond the maximum energy performance thresholds defined in Article 9(1). This can be achieved through premiums for one-stage deep renovations that directly meet the longer-term requirements. The early determination of the 2040 and 2050 targets for non-residential buildings at Member State level is therefore highly recommended. Financial support can then be staggered according to the performance level achieved. If building owners opt for a stepwise renovation, financing a renovation passport as well as supporting the implementation of the proposed steps before the MEPS enforcement dates is another way to design financial support.

Additional clarifications and examples are provided in The guidance on Article 17 in Annex 2.

2.3.4.2.2. Technical assistance

Building owners who are affected by MEPS should be well informed before it enters into force. Targeted information campaigns, for example distributed through property associations or municipalities, must be easy to grasp when explaining the reasons behind the requirements, as well as when and how to comply, including links to energy experts, one-stop shops or financial support programmes.

One-stop shops are particularly well positioned to distribute information on the requirements for building owners, but also to guide them through the renovation process, including financing (see Article 18 of the recast EPBD, Article 22(3) point (a) of Directive (EU) 2023/1791 and the respective guidance documents).

Revenues from emissions trading or from fines collected through the penalty mechanism to enforce MEPS can be partly used to finance the necessary institutional settings and technical assistance, and partly to finance targeted support to the building owners experiencing serious hardship (see ‘Criteria for exemptions’).

2.3.5. *STEP 5: Set up monitoring mechanism and penalty scheme*

Article 9(7) states that ‘Member States shall take the measures necessary to ensure the implementation of minimum energy performance standards, including appropriate monitoring mechanisms and penalties in accordance with Article 34.’ In that sense, Article 9(7) can be considered as a reminder of the general obligation of Member States to monitor and enforce EU Directives.

2.3.5.1. Monitoring

The first task is therefore to define a mechanism to identify (non-)compliance by the reference dates 2030, 2033 and later. One way to do this is to establish a registry for non-residential buildings above the maximum energy performance thresholds in accordance with Article 9(1). The registry could be created when identifying these buildings for compliance purposes (see 'Compliance: identifying buildings/owners to comply with MEPS') and can be linked to the national database for the energy performance of buildings, which needs to be set up in accordance with Article 22. The registry would be updated once a building owner provides evidence of the necessary energy performance improvements bringing the building below the maximum threshold and therefore complying with the requirements of the MEPS scheme.

To support compliance, relevant authorities could remind building owners on a regular basis, e.g. once a year before the reference date of the upcoming duty to comply (e.g. 2030). On that occasion, building owners should be informed about potential penalties in case of non-compliance as well as available measures to support implementation. Immediately after the reference date (e.g. after 2030), remaining non-compliances would be retrieved from the database, and another last reminder could be sent with a last deadline of a few months to prove compliance. After that deadline, an enforcement procedure would need to be started.

2.3.5.2. Penalty scheme

Member States shall introduce rules and sanctions for breaches of the MEPS obligation. The penalties must be effective, proportionate and dissuasive, as set out in Article 34 of the recast EPBD. Article 9(7) specifies that when laying down the rules on penalties, Member States shall take into account the financial situation and access to adequate financial support of homeowners, in particular for vulnerable households.

Penalties can be defined for different stages of the enforcement process. For instance, if a Member State implements a building owner register or a landlord licensing system and a deadline for the self-registration of building owners and properties, a penalty for not registering the relevant data on time can be implemented. At another stage, a penalty scheme can be set for building owners who stated that their building was already compliant at the moment of the notification of the MEPS obligation and failed to provide the evidence required by the compliance mechanism according to the deadline. Finally, a penalty scheme can be implemented for building owners who fail to comply with the applicable MEPS obligation by the respective deadline.

Examples of penalty mechanisms include public disclosure of non-compliant buildings, fines, restrictions on increasing the rent or selling/renting the property, and others. It is important to consider that the application of a penalty should not remove the obligation to comply. For each penalty mechanism established, it is recommended to define the timeline, the penalty for failing to comply (the first time), and the penalty for a recurrent failure to comply.

One example of a penalty mechanism would be the disclosure of non-compliant buildings in a non-compliant properties database. If building owners fail to comply with the MEPS obligation, the property is listed in the database, which could be accessed by potential renters/buyers, public authorities, key stakeholders, or even the general public. Such a penalty could be combined with other measures to increase effectiveness.

Fines as a penalty mechanism can be defined based on:

— a fixed amount, same value in euro for all non-compliant building owners;

— based on the size of the property, a certain amount of euro per m^2;

— the difference between the current energy performance of the building in kWh/(m^2y) and the threshold that was not complied with. For instance, if the current energy performance is 350 kWh/(m^2y) and the applicable threshold is 250 kWh/(m^2y), the fine is defined based on the difference (100 kWh/(m^2y)) and a certain amount of euro per kWh/(m^2y);

— the time without complying, e.g. a certain amount of euro per month after the deadline without complying with the MEPS obligation;

— a combination of the previous options, e.g. a fixed amount plus an extra amount based on the size of the property.

If fines are deployed as a penalty mechanism, the requirement to take into account the financial situation of building owners is particularly relevant. The fine scheme should consider the principle of proportionality so as not to impose an excessive burden on individual building owners compared to the objective of the MEPS scheme. Special circumstances such as building owners who have gone bankrupt or have another exceptional financial status shall be considered.

3. TRAJECTORY FOR THE PROGRESSIVE RENOVATION OF THE RESIDENTIAL BUILDING STOCK

3.1. Scope of the requirements

The purpose of Article 9(2) is the progressive renovation of the residential building stock to ensure that the residential segment contributes to transforming the national building stock into a zero-emission stock by 2050. It requires Member States to set out a trajectory for the gradual renovation of the residential building stock. The trajectory is expressed as a decrease in the average primary energy use in kWh/(m^2y) of the entire residential stock, with binding milestones for 2030, 2035, 2040, 2045, and 2050.

This trajectory has to be in line with the national roadmap and the targets included in the Member State's NBRP and directed towards transforming the national building stock into a zero-emission stock by 2050.

The trajectory aims at improving the overall energy performance of the residential building stock, with a focus on the worst-performing buildings. The trajectory must ensure that at least 55% of the decrease in the average primary energy use for the indicated years is achieved through the renovation of buildings that belong to the 43 % worst-performing residential buildings. This means that in designing the trajectory for residential building stock, Member States will identify the number of residential buildings and residential building units or floor area to be renovated annually, including the number or floor area of the 43 % worst-performing residential buildings and residential building units.

To achieve the targets in their national trajectory, Member States will apply measures such as minimum energy performance standards, technical assistance and financial support to lower the average primary energy use of the entire residential building stock. While doing this, Member States will not disproportionately exempt rental residential buildings or building units from the policy measures. Member States are free to decide whether to set minimum energy performance standards at national level and adapted to national conditions.

3.2. Definitions

3.2.1. *Definition of residential buildings within the scope of Article 9*

A residential building or building unit is defined in Article 2(18) as a 'room or suite of rooms in a permanent building or a structurally separated part of a building which is designed for all-year habitation by one private household'.

For mixed-used buildings, i.e. buildings that include both residential and non-residential building units (e.g. a residential building with shops on the ground floor), Member States may identify the most appropriate approach and, according to Recital 34, may continue to choose whether to treat them as residential or non-residential buildings, or a mix of the two.

If a mixed-used building is being renovated, double counting of energy performance improvements must be avoided, so improvements must be clearly categorised as either residential or non-residential. All residential buildings come within the scope of Article 9(2), regardless of whether the owner or user is a public or private-sector body. Residential public buildings, including social housing, fall within the scope of Article 9(2).

3.3. Designing a trajectory for renovating the residential building stock

There are several steps involved in designing a trajectory and the measures needed to progressively renovate residential building stock.

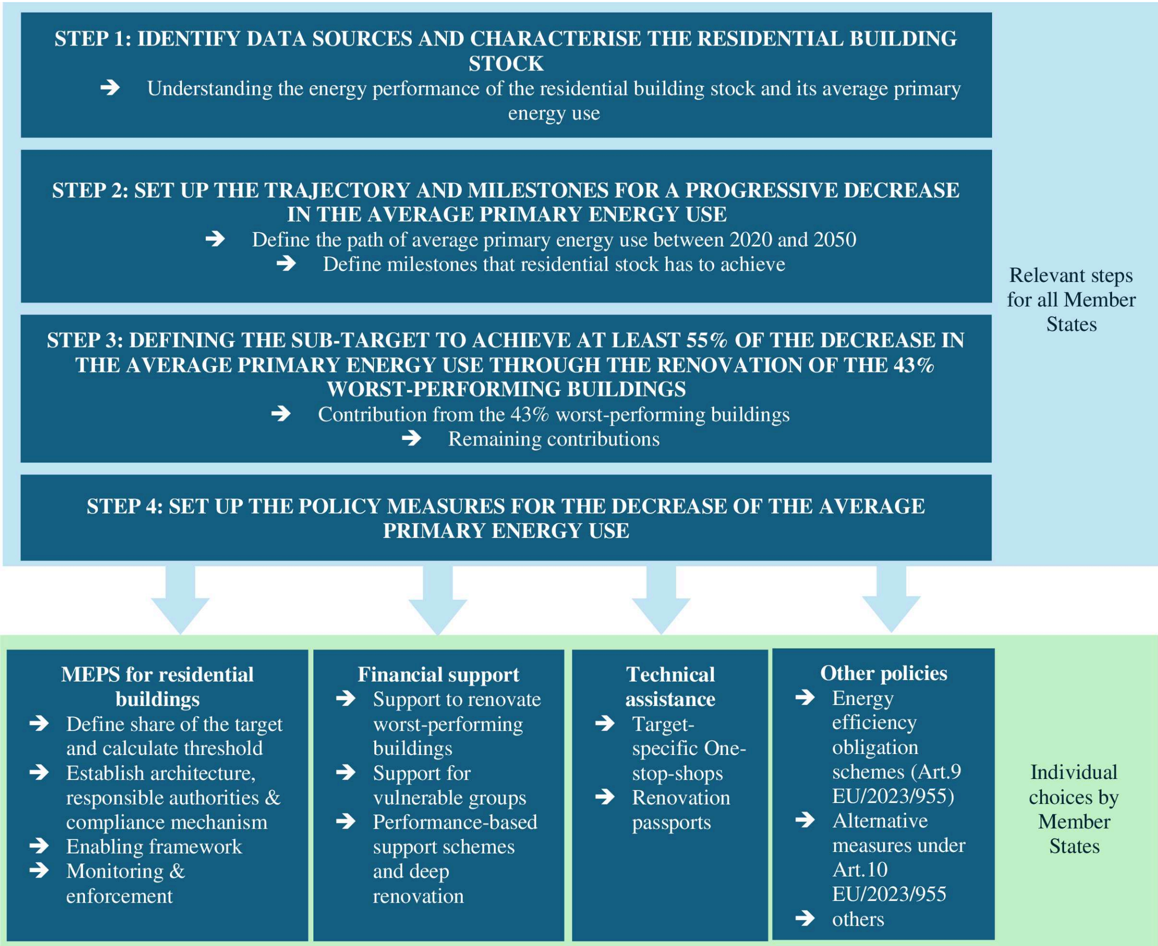

Figure 13. Recommended steps for designing a trajectory for the progressive renovation of the residential building stock

To make sure all design elements are covered and a proper framework is set up, the following four steps are proposed:

— identify data sources and classify the residential building stock;

— set up the trajectory and milestones to achieve a progressive decrease in the average primary energy use;

— set the sub-target to achieve at least 55 % of the decrease in the average primary energy use through the renovation of the 43 % worst-performing buildings;

— adopt policy measures to reduce the average primary energy use.

The sections below provide examples and options for the different features of the Article 9 trajectory following the four steps set out in Figure 13.

3.3.1. *STEP 1: Identify data sources and classify the residential building stock*

Under Article 9(2), Member States must express their national trajectory as a decrease in the average primary energy use of the entire residential building stock from 2020 to 2050. The reference year against which any progress in average primary energy consumption is compared is therefore 2020 (from 1 January 2020 to 31 December 2020). Member States need to identify their residential building stock and its characteristics, i.e. collect and process information describing the building stock according to its main characteristics and to derive its energy performance on that basis.

The aim of this process is to set a reference value for the average primary energy use of the residential building stock in 2020, based on representative data. It should also enable Member States to set an energy performance threshold that distinguishes the 43 % of residential buildings with the worst energy performance, based on either the number of buildings or their total floor area. Member States may use data for a more recent year than 2020 along with the relevant assumptions (such as new construction rates and records of renovations or demolitions) to supplement the data and achieve a realistic characterisation of the building stock in 2020.

The recommendations on planning the resources and time needed to classify the stock, on using data from EPCs (Energy Performance Certificates), the link to the database described in Article 22, the reuse and extension of existing databases and data protection that apply to residential building stock are similar to those for the non-residential building stock.

As for the non-residential stock, at least two general approaches can be used to classify the residential stock and identify its characteristics, either individually or in combination. The first approach is to use a) EPC data alongside complementary data sources and the second is b) statistical sampling and ad hoc data collection. These approaches are described in the sub-sections below.

3.3.1.1. Data sources and preliminary classification and building categories

Member States may use EPC data in conjunction with other data sources such as research results, censuses, results from energy audits or aggregated energy metering data to classify the residential building stock. Data on the physical characteristics and other features of the residential building stock such as use, construction date, typology, location, geometric features or data on technical building systems can be collected from sources that include 3D urban models, satellite images, digital building logbooks, cadastral data, building permit registers and interviews with architects or developers. It is recommended that Member States assess the quality, completeness and representativeness of the datasets to ensure that different segments of the residential stock are properly represented.

As for non-residential buildings, it is recommended to have a preliminary overview of the stock in order to classify residential buildings. It is useful to start with the overall size of the residential building stock and then estimate, for instance, the share of single-family houses, apartment blocks and other types of residential buildings.

To classify the residential building stock, it is advisable to divide it into manageable segments by size, type, façade material and building system. Patterns of common local or regional building practices can also be used as criteria for defining categories. Examples of other criteria include date of construction, climate zone and heating system technology. Reference building categories used for the purposes of the comparative methodology framework to identify cost-optimal levels of energy performance requirements could also be used. This helps divide the housing stock into building segments sharing similar characteristics, which makes it easier to develop assumptions for each segment if required, and to improve the results when estimating the energy performance of buildings for which no data is available.

3.3.1.2. Estimating the energy performance of residential buildings based on EPCs and data on the physical characteristics of the buildings

It is important to ensure that the EPCs are sufficiently representative [10] of the residential building stock. Thus, EPC coverage of the residential building stock needs to be specifically assessed, including the extent to which they cover different building types, date of issue and other relevant factors.

The available EPC data can be combined with information on the physical characteristics and other features of the same buildings to create a set of reference residential buildings for each category. Data from EPCs may also be used to approximate the energy performance of buildings in the same category and buildings with very similar physical characteristics in the same area.

If the information on the energy performance of subgroups or segments of the residential sector is not representative, information on the use, construction date, typology, location, geometric characteristics or technical building systems for each individual building can be used as input into energy models to simulate the operation of buildings and estimate their energy performance. Once a set of reference buildings from the residential building stock has been selected, a simplified approach could be used to estimate the energy performance of the reference buildings.

Coupling bottom-up data (buildings' physical characteristics, location, energy performance, etc.) with top-down data (aggregated data for different energy carriers' consumption, final energy consumption, national statistics on building construction practices, etc.) can refine the classification of the residential building stock. The estimates made using bottom-up data can be compared with the available top-down data to calibrate the assumptions and estimates made.

For the purposes of Article 9(2), Member States have to describe the data sources and methodology they use in characterising the residential building stock and its energy performance in their NBRPs.

3.3.1.3. Statistical sampling and ad hoc data collection

Where the data on the energy performance of the residential building stock from EPCs or other data sources is not sufficiently representative, statistical sampling and ad hoc data collection can be used to help classify different building segments. New data can be collected to complement existing data and fill specific gaps, e.g. on building typologies, geographical areas or climate zones. Backward extrapolation techniques can help by using more recent data together with data on new buildings and demolition trends to calculate the primary energy use of a specific building segment over a previous period of time. This approach can be used on its own or alongside existing data to verify the findings and assess their plausibility.

When using statistical sampling, it is recommended to have a preliminary overview of the residential building stock that breaks it down into different categories of buildings with similar characteristics in terms of type, typology, location, date of construction and more. The different categories of buildings should be represented in the final statistical sample.

The collected information can be put into a simulation model to estimate the energy performance of the buildings. The results can then be extrapolated to the entire building stock based on the initial classification. The results can also be cross-checked with available aggregated data on the energy performance of the building stock. In this case, it is important to ensure that the indicators used reflect the energy uses covered by Annex I to the EPBD (e.g. excluding cooking).

[10] A representative dataset reflects the characteristics of the whole residential building stock, mirroring for instance the relative share of different building categories according to age, size, climate region, etc.

3.3.2. *STEP 2: Set the trajectory and milestones to achieve a progressive decrease in the average primary energy use*

The trajectory is expressed as a decrease in the average primary energy use from 1 January 2020 to 2050. Figure 14 illustrates this concept. The average primary energy use of the residential building stock in 2020 serves as the reference point for milestones in: 2030, 2035, 2040, 2045, and 2050. Article 9(2) sets out the milestones to be achieved by 2030 and 2035, targeting reductions in average primary energy use of 16 % and 20-22 %, respectively. Under Article 9(2), Member States must set milestones for 2040, 2045, 2050 in line with a progressive decrease in average primary energy use with the aim of transforming the residential building stock into a zero-emission building stock by 2050.

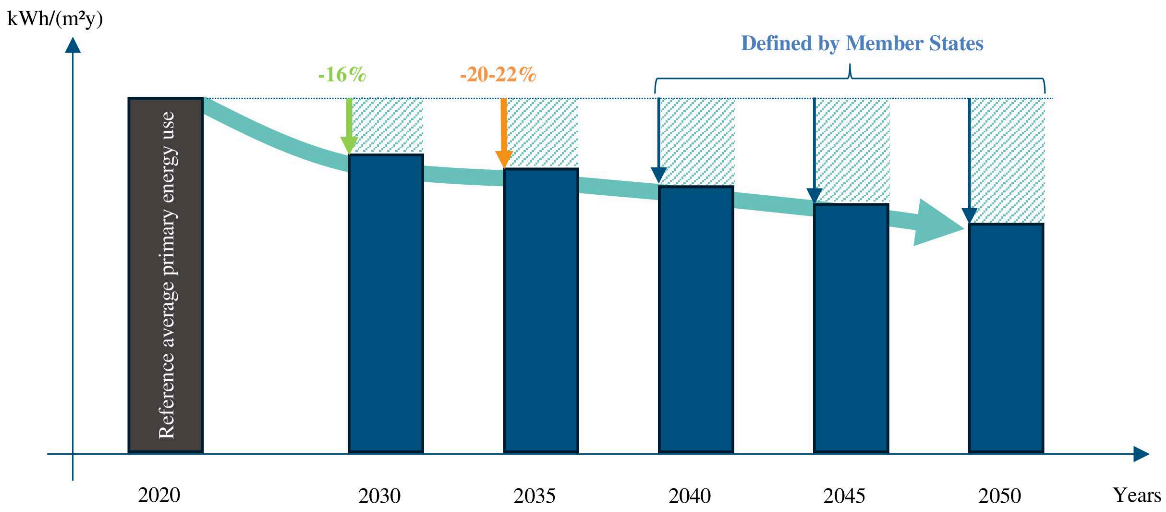

Figure 14. Overview of the trajectory and milestones for the progressive renovation of the residential building stock

In addition to average primary energy use, Member States may draw up additional indicators of non-renewable and renewable primary energy use and of operational greenhouse gas (GHG) emissions produced in $kgCO_2eq/(m^2y)$ in accordance with Article 9(3). Using these additional indicators can improve how the decarbonisation of the energy supply for buildings and the greenhouse gas emissions of the residential building stock are monitored, aligning the trajectory with national emissions targets and existing heating and cooling plans. If Member States choose to include these complementary indicators in their approach, milestones for these indicators should be set for the same years as the main trajectory (2030, 2035, 2040, etc.), as illustrated in Figure 15.

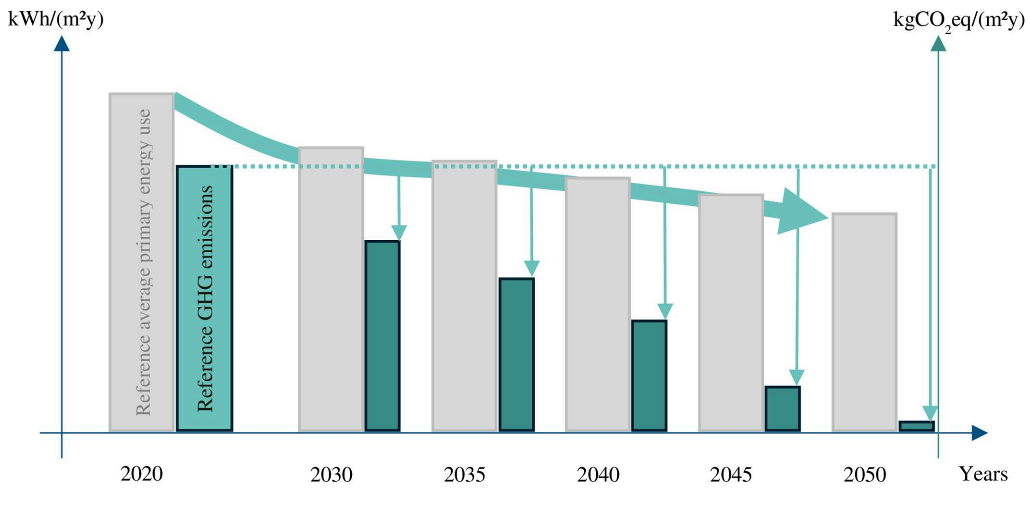

Figure 15. Illustration of complementary indicator of GHG emissions for the residential building stock

3.3.2.1. Average primary energy use in 2020

Under Article 9(2), the average primary energy use of the entire residential building stock is the metric used to set the trajectory for the progressive renovation of the residential building stock. The average primary energy use of the residential stock relates to the primary energy of the building stock in (kWh/y) and its floor area (m^2) as described by the equation below. It is important to recall that the exclusion and exemption from the baseline set out under Article 9(6) in relation to non-residential buildings do not apply here. The baseline should therefore include all residential stock buildings.

$$Average\ PEU = \frac{Total\ primary\ energy}{Total\ A}$$

— Total primary energy: Primary energy use of the residential building stock in kWh/(y)

— Total A: total building floor area of the residential building stock, m^2

The required data for calculating the average primary energy use of the residential building stock can be obtained through different approaches. As described in STEP 1 on classifying the building stock, Member States may use a combination of data on individual buildings such as EPCs, censuses, results from energy audits, energy metering data, surveys and ad hoc data collections and aggregated data derived from energy statistics or data collections. The choice of the approach depends greatly on data availability.

A combination of different data sources is recommended to ensure that all buildings segments are represented and all end uses are considered. It is recommended that the method Member States use to calculate average primary energy use is in line with the energy performance of buildings described in Annex I to the EPBD. To this end, when measured data is used, Member States should ensure that these are corrected for climate and behaviour, and aligned with the energy performance described in Annex I (e.g. energy used for cooking should be excluded).

If the characterisation of the building stock enables the individual primary energy use and floor area of each residential building to be determined, the total primary energy use of the residential building stock could be calculated as per the equation below.

$$Total\ primary\ energy = \sum (PEU_i * A_i)$$

— PEU: Primary energy use in kWh/(m^2y)

— A: building floor area, m^2

— i: from 1 to N (total number of residential buildings)

Another possible approach to calculating the total primary energy use is to use aggregated data on the final energy use of the residential building stock (e.g. from Eurostat) combined with national primary energy factors to obtain the total primary energy of the residential building stock in (kWh/y) as below.

$$Total\ primary\ energy = \sum (E_i * PEF_i)$$

— E: Final energy by energy carrier in (kWh/y)

— PEF: Primary energy factor by energy carrier

Once the total primary energy use of the residential building stock is calculated, the average primary energy use can be obtained by dividing the total primary energy use by the total floor area of the residential building stock or by the number of buildings.

Member States must describe the data sources and methodology they use in their NBRPs . The methodology should be consistent throughout the implementation and reporting periods to ensure that the trajectory and the reporting on the results are consistent. Any adjustment to the methodology applied over time should be described in detail in the plans.

3.3.2.2. Milestones and sub-targets

The provisions under Article 9(2) related to the national trajectory for the progressive renovation of the residential building stock can be divided into two requirements:

1) reaching the overall milestones to lower the average primary energy use by the deadlines (e.g. 16 % by 2030); and

2) reaching the sub-target to achieve at least 55 % of this reduction (e.g. 55 % of the 16 % reduction by 2030) through renovation of the 43 % worst-performing buildings, specifying the number of buildings or floor area to be renovated.

While the decrease in the average primary energy use refers to the entire residential building stock, the sub-target to be achieved among the 43 % worst-performing buildings needs to be achieved specifically through renovation works.

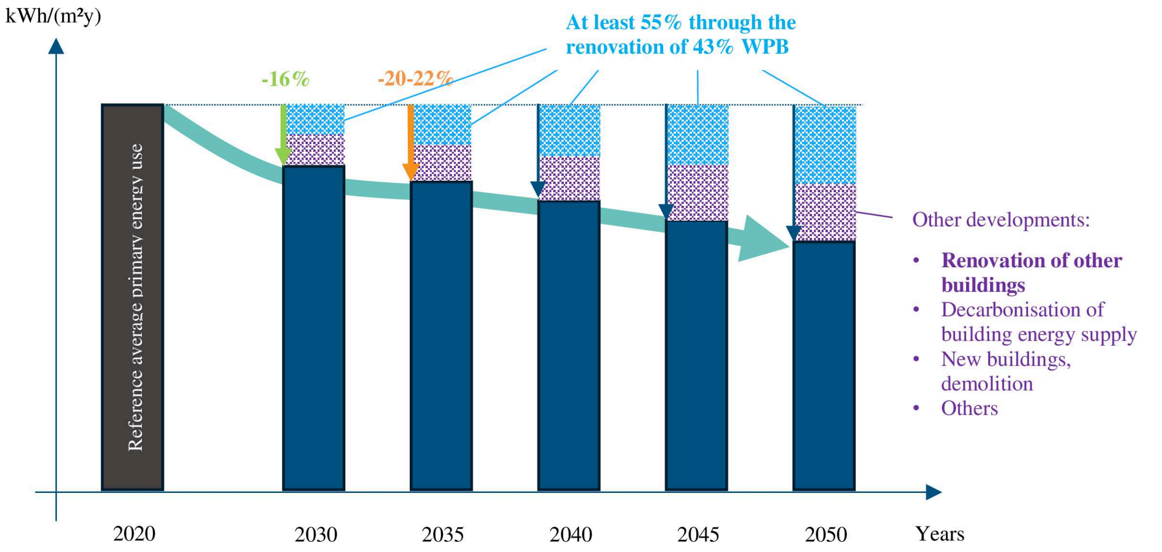

Figure 16. Trajectory to achieve a progressive renovation of the residential building stock

The total floor area of the residential building stock will change due to demolitions and new buildings built after the reference year, 2020. Demolitions after 2020 will remove floor area from the building stock, while new buildings will add new floor area. The building floor area removed and added will reduce and increase the primary energy use in different proportions. These changes in floor area and primary energy use will influence the average primary energy use of the entire residential building stock.

However, the demolition of buildings and the construction of new buildings cannot be considered as renovation measures, while the 55 % sub-target must explicitly be 'achieved through the renovation' of the 43 % worst-performing residential buildings'. Therefore, the effects of demolitions of worst-performing buildings on the average primary energy use cannot be considered in the context of the 55 % sub-target.

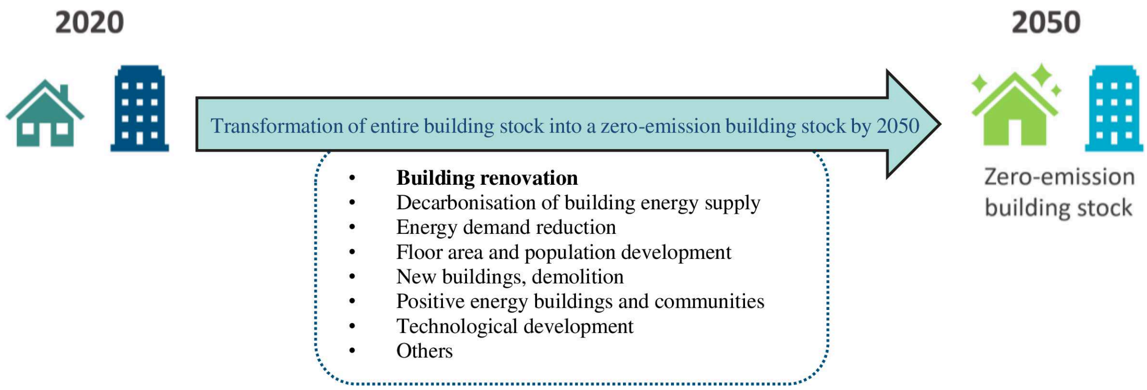

Figure 17. 2050 zero-emission building stock

The major milestones on the path to achieving a zero-emission building stock by 2050 apply to the building stock as a whole; not every single building needs to become a zero-emission building as defined in Article 11. Several factors will contribute to achieving a zero-emission building stock in the long term: the progressive renovation of buildings to enhance their energy performance will be a key factor, but a role will also be played by the overall decarbonisation of the energy supplied to buildings, especially the decarbonisation of heating systems, together with further transformation of energy systems and socio-demographic dynamics. Member States should take into account all these factors when setting the 2050 milestone.

When setting longer-term milestones, Member States could usefully draw on national projections or the scenarios developed for their national decarbonisation strategies, national energy and climate plans (NECPs), for the achievement of renewable energy and energy efficiency targets, as well as nationally determined contributions. The assumptions for the trajectory for the progressive renovation of the residential building stock should be consistent with the underlying assumptions of the NECP scenarios, especially the assumptions related to the energy mix (e.g. primary energy factors). This would ensure consistency across national strategies.

According to the final paragraph of Article 9(2), Member States may adjust the milestones for 2030 and 2035 if the average fossil share of energy use in residential buildings is lower than 15% to ensure that the average primary energy use of the entire residential building stock by 2030, and every five years thereafter, is equivalent to, or lower than a nationally determined value derived from a linear decrease in the average primary energy use from 2020 to 2050, in line with the transformation of the residential building stock into a zero-emission building stock.

3.3.2.3. Eligible measures for reducing the average primary energy use of the residential building stock

As explained above, the eligible measures will be different for the two sub-targets contributing to the achievement of each milestone. The 45 % sub-target can be achieved through building renovation measures and changes in the energy performance of the building stock due to new buildings and demolition. The 55 % sub-target can only be achieved through renovation works reducing the average primary energy use of the 43 % worst-performing buildings. Behavioural measures do not count towards either sub-target.

An increase in the share of renewable energy in power generation will have an impact on the primary energy use of a building and is therefore to be considered as an improvement of the energy performance of the building stock for the overall targets as per Article 9(2). If adjustments to primary energy factors or weighting factors for energy carriers result in improved calculated energy performance, Member States must explain these changes to the Commission and demonstrate that they accurately reflect a real shift in the energy mix. The choices made and data sources are to be reported using the EN 17423 format or any superseding document. It is also expected that the documented primary energy factors for 2030 will be aligned with those used in the national climate and energy plans.

The measures to achieve the 55 % sub-target (reduction of at least 55 % in average primary energy use must come from renovating the 43 % worst-performing residential buildings) should therefore focus on renovations improving the energy performance in line with the energy performance calculations set out in Annex I of the EPBD (see STEP 3). This includes renovation of the building envelope and changes in technical building systems including the technical equipment for space heating, space cooling, ventilation, domestic hot water, built-in lighting, building automation and control, on-site generated renewable energy, or combinations thereof.

Under the fifth subparagraph of Article 9(2), Member States' renovation efforts to achieve the sub-targets must not disproportionately exempt rental residential buildings or building units.

If a reduction in primary energy consumption is achieved through the renovation of buildings affected by natural disasters, these savings can be counted towards the targets involving the 43% worst-performing buildings. Member States are recommended to monitor the number of buildings or the floor area of renovated buildings that were affected by natural disaster, and the reduction in primary energy use due to their renovation and to report on it in their NBRPs (Article 3).

The two previous sections form the starting point for setting the target path and the milestones to be achieved to reduce the average primary energy consumption of the residential building stock in the specified years. Under Article 9(2) and as part of the assessment of the NBRPs , the Commission must monitor the decrease in average primary energy use including the number of buildings and building units or floor area of the 43 % worst-performing residential buildings and make recommendations if necessary. Therefore, it is recommended that Member States' NBRPs report the effect of the various measures implemented to reduce the average primary energy use of the residential building stock.

3.3.2.4. Reporting requirements on the trajectory

Under Articles 3 and 9(2), Member States' NBRPs must include the methodology as well as the data they use to set the trajectory, estimate the milestone values, determine the 43% worst-performing residential buildings, and also the number of buildings and building units or floor area to be renovated annually.

Figure 18 illustrates the main items to be reported as part of the national trajectories.

Figure 18. Reporting the trajectory of the progressive renovation of the residential building stock

3.3.2.5. Estimating the number or floor area of buildings to be renovated to achieve the decrease in the average primary energy use

Estimating the number (or floor area) of buildings to be renovated depends on a number of variables such as the physical characteristics of the portions of the building stock targeted, their characteristics (use, ownership, occupancy, etc.), and the policies in place or to be in place for renovating these buildings.

Multiple considerations apply to the number (or floor area) of buildings to be renovated from the 43% worst-performing buildings to achieve the sub-target, as described in STEP 3.

For the number (or floor area) of other buildings to be renovated to contribute to the overall target, Member States should consider what renovation works contribute to the remaining portion of the target. This is closely related to the assumptions made for the trajectory in terms of other factors such as decarbonisation of the building energy supply and the changes in the energy performance of the building stock due to new buildings and demolition, etc. (see Section 2.3.2.2). Member States must, therefore, estimate the number (or floor area) of buildings to be renovated for the remaining portion of the overall milestones in line with the assumptions and estimations made in their analyses for upgrading the building stock into a zero-emission building stock by 2050.

3.3.3. *STEP 3: Setting the sub-target to achieve at least 55 % of the decrease in the average primary energy use by renovating the 43 % worst-performing buildings*

3.3.3.1. Setting the threshold for the 43 % worst-performing buildings

To identify the 43 % of worst-performing buildings, it is recommended to rank the residential buildings in the 2020 stock based on their energy performance, measured by primary energy use (kWh/(m²y)). A threshold can then be set to identify the bottom 43 % of the residential building stock. This threshold can be calculated using either the number of buildings or the total floor area. The buildings can be ranked either by creating a frequency distribution or by analysing individual data points. For a frequency distribution, the range of primary energy use (e.g. 0-500 kWh/(m²y)) is divided into specific intervals or classes. Each class represents a defined range (e.g. class 1 for 0-19 kWh/(m²y), class 2 for 20-39 kWh/(m²y), etc.). Buildings are then assigned to these classes based on their primary energy use, and the frequency of buildings or floor area within each class is calculated.

If the threshold is calculated by the number of buildings, the worst-performing buildings are counted, starting with the building with the poorest energy performance, until 43 % of the total number of buildings is reached, as shown in Figure 19 (fictional residential building stock with 25 buildings). The energy performance in primary energy use (kWh/(m²y)) of the building immediately following the 43 % mark sets the threshold of the 43 % worst-performing buildings. All residential buildings with an energy performance that is worse than this threshold will be part of the 43 % worst-performing buildings.

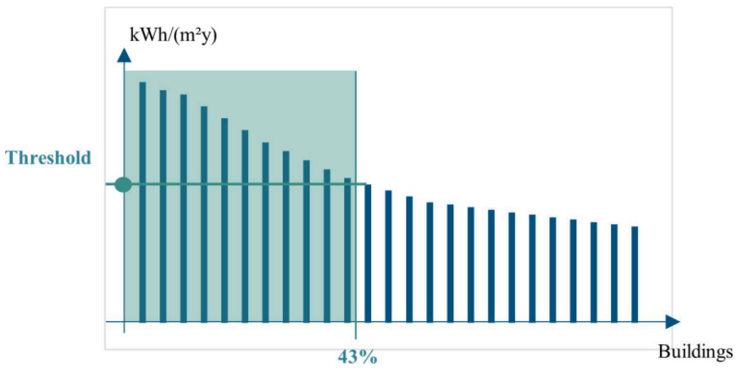

Figure 19. 43 % worst-performing buildings from the residential building stock

If the threshold is set based on building floor area, the approach mirrors the method used for the number of buildings. Starting with the worst-performing building, the floor area is ranked until it reaches 43 % of the total. The primary energy use of the next building, after surpassing the 43 % floor area, defines the threshold in (kWh/(m²y)) for the 43 % worst-performing buildings.

Selecting either the number of buildings or the floor area may result in identifying different portions of the residential building stock, either smaller or larger. When using floor area to identify the 43 % worst-performing buildings, building size is taken into account, but using the number of buildings may lead to small buildings (which may have a limited potential for renovation) to be overrepresented. Member States are advised to assess data availability and the characteristics of their residential building stock, such as the breakdown by single-family and multi-family buildings (by number or floor area) and the average size of buildings in each group. This information should be used to determine a suitable approach to identifying the set of 43 % worst-performing buildings (based on number of buildings or floor area) with the largest potential for energy savings and renovation.

When drafting a new NBRP (after the first plan, which is due in draft by 31 December 2025 and in its final version by 31 December 2026), the composition of buildings in the 43 % worst-performing category may change due to improvements in the building stock resulting from renovations triggered by Article 9(2). It is therefore recommended that Member States adjust the ranking to reflect the updated composition of the 43 % worst-performing residential buildings.

The following calculation can be used to estimate the contribution to each milestone required from the renovation of the 43 % worst-performing buildings:

$$WPB\ Sub-target = 55\ \% * Milestone\ decrease(\%) * (Average\ PEU_{2020} * \sum A_i)$$

— WPB Sub-target: decrease in the average primary energy use to be achieved through the renovation of 43 % worst-performing residential buildings, in kWh/y

— PEU_{2020}: Primary energy use in kWh/(m^2y) in 2020

— A: building floor area in m^2

— i: from 1 to N (total number of residential buildings)

3.3.3.2. Estimating the number or floor area of buildings to achieve each sub-target

According to Article 9(2), Member States must identify the number or floor area of residential buildings and residential building units to be renovated annually, including from the 43 % worst-performing buildings.

A number of different variables can significantly affect the estimate of this figure. For instance, assumptions about the energy performance of buildings before renovation (e.g. 150 kWh/(m^2y) versus 500 kWh/(m^2y)), as well as the extent (or depth) of the renovations, can result in widely varying estimates of the number or floor area of buildings that would need to be renovated to meet the sub-target. In a simplified approach, changing the intended depth of renovation from 30 % to 60 % will halve the estimated number of buildings that need to be renovated.

It is recommended, therefore, that Member States consider multiple factors related to the physical characteristics of buildings, other specific attributes (e.g. occupancy and ownership structures), and the expected impact of the policy measures (and required resources) envisaged to stimulate the renovation of residential buildings.

Additional objectives, such as not disproportionately exempting rental residential buildings or building units in the renovation plan under Article 9(2), or the protection of vulnerable households may also influence the categorisation of buildings. It may be useful, in order to better target the policy measures, to differentiate vulnerable households within the group of owner-occupied buildings. This reflects the intent of the provisions in Article 17(18), which require, as a priority, that the financial incentives created by Member States target vulnerable households, people affected by energy poverty, and people living in social housing, in accordance with Article 24 of Directive (EU) 2023/1791.

It is recommended that Member States conduct a detailed study of the characteristics of the 43 % worst-performing buildings, along with additional specific factors, while concurrently developing policies and measures to encourage the planned renovations. Analysing these aspects and how they are linked can produce a more comprehensive and accurate estimate of the number or floor area of buildings that need to be renovated to achieve the sub-target.

3.3.4. *STEP 4: Adopt policy measures to reduce the average primary energy use*

Member States have the discretion to select policy instruments to meet the Article 9(2) requirements and to implement renovation measures to achieve the required decrease in average primary energy consumption. Article 9(2) explicitly mentions minimum energy performance standards (MEPS), technical assistance and financial support measures as examples of possible policy instruments and measures. Figure 20 provides an overview of these measures.

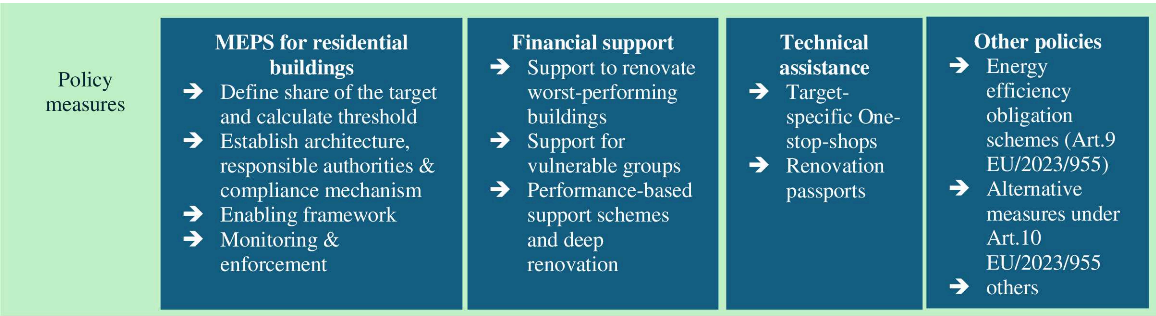

Figure 20. Policy measures to achieve the required decrease in average primary energy use

According to Article 9(2), Member States are not to disproportionally exempt rental residential buildings or building units from renovation work. They should therefore ensure the fair distribution of renovation works and benefits between rental and owner-occupied buildings. The policy mix, including measures such as MEPS, financial support, and technical assistance should be designed to meet the specific needs of both segments and provide mechanisms to ensure a fair distribution of benefits. If the main policy measure does not explicitly tackle split-incentives, additional measures should be implemented to overcome any remaining barriers.

The following sections present examples of policy measures that can be implemented by Member States to achieve the required reductions in the average primary energy use of the residential building stock while also ensuring that benefits are distributed fairly.

3.3.4.1. MEPS for residential buildings

Member States may use the MEPS scheme to trigger the renovation of residential buildings and comply with Article 9(2). According to Article 2(4), 'minimum energy performance standards' are the rules that require existing buildings to meet an energy performance requirement as part of a broad renovation plan for a building stock or at a trigger point on the market. Trigger points include sale, rent, donation or change of purpose in the cadastre or land registry, set time periods or by a specific date, all points that trigger the renovation of existing buildings. It is for the Member States to choose the design options and scope of any MEPS scheme for the residential building stock.

Several EU countries have already used the MEPS scheme for the residential building stock as have other non-EU regions, in different contexts and with different characteristics ([11]). If Member States also aim to implement MEPS for residential buildings, they need to set the share of the target they want to achieve through this policy instrument and the subset of the buildings that will be covered by the MEPS scheme (e.g. all worst-performing or only the *very* worst-performing buildings (EPC class G, or classes F and G)). Member States may also opt to implement MEPS for a specific sub-segment of the residential building stock, such as rented properties or rented multi-family buildings in a particular age category. Separate schemes for structurally weak regions within Member States can be used to improve the fair distribution of renovation work and their benefits. Generally, the suitability of policy instruments for different segments of the residential stock will increase in proportion to the thoroughness with which the building stock and its segments have been analysed in STEP 3. Based on these decisions, Member States can set a threshold within the chosen segment for those worst-performing

([11]) For a detailed summary on previous and existing practices see Minimum Energy Performance Standards (MEPS) in the Residential Sector.

buildings that must comply with the MEPS requirement by a certain date. A similar approach to the steps for non-residential buildings can be taken to set thresholds and identify the residential buildings to comply with MEPS. Any regulatory measures, such as a MEPS scheme, should be supported by an enabling framework to ensure effective implementation and a fair distribution of the costs and benefits. In principle, the features of an enabling framework for MEPS in non-residential buildings can also be applied to residential buildings, since specific measures are needed to address and protect tenants and vulnerable groups in both building segments.

Financial incentives and technical assistance are central to any enabling framework and are essential for the implementation of provisions related to the residential building stock. These aspects are discussed individually in the following sections.

3.3.4.2. Financial support ([12])

Most EU Member States have adopted financial support schemes to encourage building renovations. A wide range of literature highlights the approaches taken, innovative strategies, and best practices in this area ([13]).

Financial support should incentivise early action by encouraging building owners to complete renovations ahead of the milestones outlined in the set trajectory.

Given that Article 9(2) requires a sub-target for renovating the worst-performing buildings, and recognising the strong connection between Article 9 and Article 17 of the Directive, the following sections focus on financing strategies aimed at: (a) the worst-performing buildings, (b) vulnerable groups, and (c) performance-based mechanisms.

3.3.4.3. Financial support for renovating worst-performing buildings

Financial support can be granted to support the renovation of worst-performing buildings. The type of public support may vary. For example, it can take the form of low-interest or interest-free loans, a repayment bonus that reduces the amount of interest to be repaid and thus shortens the loan term, or tax relief. The level of support may also vary and may be designed as a bonus on top of existing support programmes or to fully finance the renovation of selected worst-performing buildings owned by energy-poor households.

To qualify for support, building owners should provide evidence that their property is among the 43% worst-performing buildings. The simplest way to verify this is by presenting a valid energy performance certificate (EPC). Member States are free to set other eligibility criteria. Examples include focusing on buildings constructed in certain years or periods, alongside additional factors such as unrenovated building envelopes (or sections of them), the age of fossil-fuel heating systems, or recent metered energy consumption data.

3.3.4.4. Financial support for vulnerable groups to renovate buildings

There is an overlap between the worst-performing buildings and buildings inhabited by vulnerable households, including households in energy poverty. To provide direct financial support to those in need and also renovate the worst-performing buildings, support schemes can be designed especially for this target group.

([12]) Where applicable, financial support must comply with State aid rules. For energy efficiency in buildings, see in particular Article 38a of Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty, OJ L 187, 26.6.2014, p. 1, and Section 4.2 of the Communication from the Commission – Guidelines on State aid for climate, environmental protection and energy 2020, OJ C 80, 18.2.2022, p.1.
Please see also guiding template 'Renovate' available here: RRF guiding templates - European Commission.

([13]) https://op.europa.eu/en/publication-detail/-/publication/a3032517-c761-11ec-b6f4-01aa75ed71a1/language-en; https://ibroad2epc.eu/portfolio-items/enhancing-incentives-through-ibroad2epc/; https://www.bpie.eu/wp-content/uploads/2021/03/OurBuildings-Long-term-renovation-strategies-report_final.pdf; https://energy.ec.europa.eu/system/files/2022-12/SWD-Analysis-of-2020-LTRS.PDF.

In practice, those support schemes often cover a high share of the costs. See, for example, Ireland's Better Energy Warmer Homes scheme, Slovenia's ZERO500 programme, the Scottish government's considerable support provided under the Social Housing Net Zero Heat Fund to ensure Scotland's Energy Efficiency Standard for Social Housing was met and the Basque one-stop-shop *Opengela*, providing loans to cover up to 100 % of renovation costs. In general, the lower the income level of the vulnerable household, the higher the support should be.

The Social Climate Fund ([14]), which was set up alongside the Emissions Trading System for fuel combustion in buildings, road transport and additional sectors (ETS 2), provides Member States with a facility to design support measures for the direct benefit of vulnerable groups. It is specifically designed to channel investment into the renovation of buildings occupied by these groups, besides other measures and investments in the building and transport sectors. The worst-performing buildings and vulnerable households are often distributed differently across different regions of the Member States. Public authorities at national and regional level should ensure that there is sufficient support available to vulnerable households to renovate their buildings, whether or not related to MEPS. Central authorities should provide higher levels of support to regions with a higher share of worst-performing buildings and vulnerable households. Technical support from central contact points (one-stop shops) can play a crucial role in ensuring a fair distribution of the financial support available.

Further clarification on support to vulnerable households is provided in the guidance on Article 17 (Annex 2).

In addition, a dedicated financing scheme could be created to fund the renovation of worst-performing social housing buildings, whether or not linked to MEPS. This is particularly useful if social housing buildings in the Member State have a lower energy performance compared to other buildings in which vulnerable households live.

3.3.4.5. Performance-based support schemes

Financial support alone does not inherently guarantee that energy performance improvements are carried out. For this reason, Article 17(14) requires Member States to link their financial measures to the targeted or achieved energy performance improvements specified by one or several criteria, listed in the paragraph. This can be achieved by designing schemes that, for example, are tied to the measures laid down in a renovation passport, or schemes that incorporate a plausibility check through metering energy use before and after the works. Additionally, running tenders for energy savings could produce favourable cost-benefit renovation solutions if projects that commit to the highest savings at the lowest cost qualify for extra support. These schemes would require at least minimal post-intervention monitoring.

In line with Article 9(4)(c), priority should be given to deep, performance-driven renovations that offer enhanced support for upgrades resulting in future-proof buildings, such as the upgrades specified in a renovation passport. This approach helps prevent lock-in effects and ensures long-term energy efficiency and sustainability.

To partly tackle the issue of split-incentives, performance-based modernisation fees could balance rent increases from renovations by capping them while ensuring that tenants benefit from the improvements. At the same time, these fees would provide property owners with a stable source of income for refinancing the renovation costs (see e.g. the energy performance allowance known as EPV ([15]) in the Netherlands). Another way to tackle split-incentives is to allocate CO_2-pricing costs between tenants and landlords based on the energy performance of the building (as in Germany). This approach encourages both parties to invest in energy efficiency improvements.

3.3.4.6. Technical assistance

Article 18 requires Member States to create and widely implement one-stop shops to assist building owners in improving the energy performance of their buildings.

([14]) https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/social-climate-fund_en#:~:text=Social%20Climate%20Fund.%20Video%20explainer:%20the%20EU%20Emission.

([15]) https://www.rvo.nl/onderwerpen/energieprestatievergoeding.

The guidance on Articles 21, 22 and 24 of the Energy Efficiency Directive ([16]) provides clarifications on the set-up and role of these one-stop shops, in particular under Section 5.3. 'OSS for the provision of technical, administrative, and financial advice for energy efficiency – Article 22(4), (5) and (6)' and Section 6.5. 'Foster technical assistance and roll-out of enabling funding and financial tools – Article 24(3)(d)'.

In addition, the Commission will publish guidelines to develop those one-stop shops addressing key policy considerations for public authorities, as per Article 22(6) of the EED and Article 18(1) of the EPBD.

The paragraphs below highlight only some specific aspects relevant to implementation of Article 9(2).

To effectively implement policy measures like MEPS schemes and ensure that financial aid is directed to the buildings occupied by vulnerable groups, one-stop shops should focus on providing targeted support. These centres should offer specialised assistance to meet the unique needs of these specific groups, ensuring equitable access to resources and guidance.

To be effective and ease access for different societal groups, one-stop shops should also be set up as physical advisory centres, rather than solely operating online.

One-stop shops play a key role in supporting policy measures deployed as part of the renovation efforts. For instance, if hard-to-reach segments such as co-owned large apartment blocks are covered by MEPS schemes, building owners will need to accelerate and streamline decisions on renovations. Providing expert advice and appointing a central coordinator would be particularly helpful in assisting such a procedure.

Similarly, one-stop shops could be dedicated to assisting vulnerable households and direct them to financial support for the renovation activities.

Renovation passports are a tailored roadmap for the deep renovation of buildings following a set number of steps. They are another key tool to provide advisory and technical assistance to residential buildings owners. The EPBD brings in a common framework for renovation passports in Article 12 and Annex VIII and further provisions to promote their use. For more details on renovation passports please see the dedicated guidance in Annex 4.

3.3.4.7. Monitoring impact

In accordance with Articles 3(5) and 9(2), the Commission will assess NBRPs, explicitly considering the reduction targets for average primary energy use in 2030, 2035, 2040, 2045 and 2050. The Commission will also evaluate whether the target share has been achieved in the 43 % of residential buildings with the worst energy performance. The assessment of the first NBRP will feed into the review of the Directive, which the Commission is required to conduct by 31 January 2028 pursuant to Article 28. According to Article 28, if the assessment of the Directive and related legislation indicates that the policies and measures reported in the plans are unlikely to achieve the targets, including those under Article 9(2) for the residential building stock, the Commission will consider proposing mandatory minimum energy performance standards across the entire building stock.

To monitor the impact of policy measures on progress on the trajectory for the progressive renovation of the residential building stock, it is essential to track several additional aspects: the number of buildings renovated and the energy improvement delivered by renovation, the social impacts of implemented MEPS, and other key variables such as renovation rates, the scope and depth of renovations and the building energy supply mix.

Member States must ensure that energy performance improvements in individual buildings are not counted more than once. Improvements should be clearly attributed to a specific policy instrument. If a renovation is driven by multiple policy instruments, the energy performance improvements should be attributed to each instrument proportionally.

([16]) Commission Recommendation (EU) 2024/2481 setting out guidelines for the interpretation of Articles 21, 22 and 24 as regards the consumer-related provisions of Directive (EU) 2023/1791. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202402481.

Monitoring progress along the trajectory could be aided by drawing on data in national databases for the energy performance of buildings referred to in Article 22. The data aggregated in the database developed by each Member State can help to monitor the overall reduction in average primary energy use across the residential building stock.

A bottom-up approach is recommended, e.g. by using EPC registers or self-reporting systems, to monitor target achievement in the worst-performing-building segment. Regularly updated or new EPCs issued after a major renovation under Article 20 can be an important tool to monitor progress in energy performance in certain segments of the building stock, especially the worst-performing buildings.

To better use policy feedback for future policymaking, annually monitoring the impact of individual measures from the policy mix implemented under Article 9(2) is highly recommended. It can subsequently be used for the purpose of wider reporting obligations, e.g. under Regulation (EU) 2018/1999 (the Governance Regulation) and may be designed to be compliant with Article 10(2) of Directive (EU) 2023/1791.

If MEPS are used as part of the policy mix for the progressive renovation of the residential building stock, Member States must bring in a monitoring mechanism to evaluate the impact of MEPS according to Article 9(7). Apart from monitoring target achievements, Member States must monitor social impacts, in particular on the most vulnerable groups, following Article 9(4e). This can include monitoring the reduction in energy expenses for households, especially low-income households (alongside monitoring the energy poverty rate), the percentage of vulnerable or low-income households benefiting from renovation and conducting social cost-benefit analyses of a set of reference renovation projects.

ANNEX 2

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Financial incentives, skills and market barriers (Article 17) and one-stop shops (Article 18)

TABLE OF CONTENTS

1. INTRODUCTION

This document contains guidance and recommendations on Article 17 and Article 18 of the recast Energy Performance of Buildings Directive ('the recast EPBD') ([1]).

Article 17 lays down requirements for the financing framework to support energy-performance improvements in buildings. The aim of this financing framework is to optimally address the barriers to the energy renovation of buildings. This aim is reflected in the first paragraph of the Article, which states that 'Member States shall provide appropriate financing, support measures and other instruments able to address market barriers in order to deliver the necessary investments identified in their national building renovation plan to transform their building stock into zero-emission buildings by 2050'.

Member States are advised to rely on the process for preparing their national building renovation plans to:

— identify such barriers, both economic and non-economic, and assess how they can best tackle them through financing instruments and other types of measures, regulatory or not, including through their: (i) 'policies and measures' ([2]); (ii) 'public investments'; and (iii) 'budgetary sources' ([3]);

— ensure that the investments estimated to take place by 2030, 2040 and 2050 match the total investment needs ([4]).

On financing instruments specifically, Article 17(6) also stipulates that 'Member States shall make best cost-effective use of national financing and financing available established at Union level, in particular the Recovery and Resilience Facility, the Social Climate Fund, the Cohesion Fund, InvestEU, auctioning revenues from emission trading pursuant to Directive 2003/87/EC of the European Parliament and of the Council (31) and other public funding sources. Those funding sources shall be deployed consistently with a path to achieving a zero-emission building stock by 2050'. As per this paragraph, Member States have to ensure that the share of national financing (national budget) and EU financing they rely on for building renovation is in line with both the potential and needs for buildings to meet their energy and climate targets ([5]). In addition, Article 17(6) also states that Member States must ensure they achieve a zero-emission building stock by 2050 in a cost-effective way.

Article 17(6) should be read jointly with the planning and reporting requirements set out in Article 3 and Annex II on the national building renovation plans, based on which Member States must provide an outline of: (i) the investment needs for the implementation of their national building renovation plan; (ii) the financing sources and measures for implementation of the plan; and (iii) their administrative resources for building renovation ([6]).

The process of preparing their national building renovation plans will allow Member States to shape their financing framework so that it supports those objectives, but also delivers on other key priorities as also laid down in the recast EPBD ([7]). These other key priorities include: (i) alleviating energy poverty; (ii) empowering vulnerable households; and (iii) making housing affordable.

Against this background, this document provides guidance on:

— addressing the barriers to renovations by ensuring both the deployment of enabling instruments and the accessibility of financing schemes and permitting procedures (Section 2);

— ensuring the best cost-effective use of financing (Section 3);

— prioritising vulnerable households (Section 4).

(1) Directive (EU) 2024/1275.
(2) As per the template for the national building renovation plans, Annex II, Section (c) 'Overview of implemented and planned policies and measures'.
(3) Template for the national building renovation plans, Section (d) 'Outline of the investment needs, the budgetary sources and the administrative resources'.
(4) *Idem*, with the breakdown between public and private investments. This means that the Member States must also provide – and justify – their estimated leverage factor (volume of private investments triggered by the public investments).
(5) As laid down typically in their national energy and climate plans.
(6) As laid down in Section (d), with the mandatory indicators 'total investment needs for 2030, 2040, 2050, public investments, private investments, budgetary resources'.
(7) Including in Article 17 and Annex II.

Member States are therefore invited to refer to this document not only when transposing the recast EPBD but also when preparing their national building renovation plans.

For several provisions of Article 17, this guidance refers to other recent Commission recommendations and documents, either directly in the main body of the document or in Appendix I 'Other relevant Commission documents for transposing Article 17 of Directive EU/2024/1275'. Appendix I lists those other guidance documents and reports, etc. In particular, Appendix I lists the relevant subsections of Article 17 for transposing, and links these relevant subsections to the provisions of Article 17 of the recast EPBD.

Article 18 has a different focus. It requires Member States to set up technical assistance facilities to assist members of the public throughout the renovation process.

The establishment of these technical assistance facilities, most commonly known as one-stop shops, should involve all necessary actors, including: homeowners; administrative personnel; technical experts; businesses; banks.

Member States must ensure adequate coverage of these one-stop shops throughout their territories and to all members of the public. The EPBD provides different criteria to evaluate and ensure this outreach capacity, including: (i) the number of facilities per citizen; (ii) the time it takes a member of the public to reach one of these one-stop shops; or (iii) the geographical coverage of these one-stop shops.

On Article 18, this document provides guidance in four areas, each of which are discussed in the bullet points below.

— The first area of guidance is on the types of services and support that technical assistance facilities and one-stop shops must provide. In that respect this guidance should be read together with the following two documents:

  — Commission Recommendation [8] (EU) 2024/2481 setting out guidelines on Articles 21, 22 and 24 of the Energy Efficiency Directive (EED) recast 'Information and awareness raising'; and

  — the upcoming joint guidelines responding to the requirement of Article 22(6) of the EED recast and Article 18(1) of the EPBD recast, to include indications, suggestions and examples of practices as inspiration for Member States setting up and operating their one-stop shops.

— The second area of guidance covers recommendations to ensure the effective deployment of technical assistance and one-stop shops across the national territory according to the criteria indicated in Article 18(1).

— The third area of guidance covers recommendations on how to efficiently combine online and physical/on-the-ground approaches.

— The fourth area of guidance covers recommendations on invitations to one-stop shops such as the mandatory invitations (i.e. when an invitation to one-stop shops has to be issued) pursuant to Article 19(13).

These one-stop shop facilities are one of the main elements of the enabling framework to effectively encourage and support renovations. They should therefore be an integral part of both the development and delivery of national building renovation plans. Member States are therefore invited to refer to the one-stop shops both when transposing the provisions in Article 18, and when preparing their national building renovation plans (the Annex II template includes a specific section to describe policies and measures related to 'the creation of one-stop shops or similar mechanisms pursuant to Article 18').

[8] Commission Recommendation (EU) 2024/2481 of 13 September 2024 setting out guidelines for the interpretation of Articles 21, 22 and 24 of Directive (EU) 2023/1791 of the European Parliament and of the Council as regards the consumer related provisions. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202402481.

2. BARRIERS TO RENOVATION, FINANCING INSTRUMENTS AND ACCESSIBILITY OF FINANCING (ARTICLE 17 - PARAGRAPHS 2 TO 9, 11 AND 13)

2.1. Scope and objectives of the requirements

Article 17 refers to barriers to renovations ([9]) in several paragraphs.

Article 17(1) requires Member States to 'provide appropriate financing, support measures and other instruments able to address market barriers'.

Article 17(3) asks Member States to 'assess and, where appropriate, address barriers related to upfront costs of renovations'.

Problems related to the upfront costs of renovations are typically due to three main causes: (i) a lack of solvency (the structural ability of the building owner to meet its financial obligations, e.g. repaying a loan); (ii) a lack of liquidity (ability to cover the cost of renovation at a certain moment in the short term, i.e. ability to provide the necessary capital to renovate the building before the works have taken place and the benefit of the renovation have materialised); or (iii) a failure to prioritise the renovation works compared to other spending considered by the building owner. These three different situations warrant different approaches.

Given these different barriers, Article 17(7) requires Member States to give financial assistance to promote the energy renovation of buildings. It states:

'To support the mobilisation of investments, Member States shall promote the effective development and use of enabling funding and financial tools, such as energy efficiency loans and mortgages for building renovation, energy performance contracting, pay-as-you-save financial schemes, fiscal incentives, for example reduced tax rates on renovation works and materials, on-tax schemes, on-bill schemes, guarantee funds, funds targeting deep renovations, funds targeting renovations with a significant minimum threshold of targeted energy savings and mortgage portfolio standards. […] Member States may also promote and simplify the use of public-private partnerships.'

Article 17(9) complements this by stating that 'the enabling funding and financial tools may include renovation loans or guarantee funds for energy performance renovations, including in combination with relevant Union programmes, where applicable' ([10]).

On fiscal incentives specifically, Member States have many options. For example, they can impose lower rates of value added tax for energy renovations as opposed to non-energy renovations or new construction. They can also give incentives through the property tax system. Property tax is usually attached to the value of the building unit, but Member States could impose a reduced rate for building units where it can be demonstrated that the building unit has undergone an energy renovation. The property tax incentive could also take the form of a discount or refund given through annual income taxes. ([11])

Article 17(7) also refers to 'mortgage portfolio standards'. This mechanism is defined in Article 2(39) as 'mechanisms incentivising mortgage lenders to establish a path to increase the median energy performance of the portfolio of buildings covered by their mortgages towards 2030 and 2050, and to encourage potential clients to improve the energy performance of their property in line with the Union's decarbonisation ambition and relevant energy targets in the area of energy consumption in buildings, relying on the criteria for determining environmentally sustainable economic activities set out in Article 3 of Regulation (EU) 2020/852' (Taxonomy Regulation ([12])).

([9]) The typical barriers to renovations are set out in Section 2.2 of the Commission Impact Assessment accompanying the Proposal for a Directive of the European Parliament and of the Council on the energy performance of buildings (recast), Part 1/4. Accessible at https://op.europa.eu/en/publication-detail/-/publication/daf643a4-5da2-11ec-9c6c-01aa75ed71a1/language-en.

([10]) In addition, where applicable, Member State must ensure that supported investments comply with State aid rules.

([11]) The design of these policies also needs to take into account the foregone revenue that would have otherwise been collected and the incentives should be targeted as a priority to vulnerable or low- and middle-income households.

([12]) Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32020R0852.

Member States' support for such innovative financial instruments will make it possible to remedy the different types of difficulties in upfront cost financing while providing more value for money for the public funding dedicated to renovations (higher leverage effect). This greater value for money in public funding can be achieved by lowering the share of financial support provided through grants by prioritising the use of grants only for vulnerable households. As part of their national energy and climate strategies, and in the framework of their national hub on energy efficiency financing as part of the European Energy Efficiency Financing Coalition ([13]), Member States could consider discussing potential trajectories that would allow national credit institutions to progressively allocate a higher share of their turnover to mortgages and non-collateralised loans targeting the energy renovation of worst-performing buildings.

The leverage factor is the proportion of private investment mobilised through public funds. The leverage factor for the energy renovation of buildings will vary significantly depending on the type of support provided. A mix of public subsidies and private mortgages will be different from a mix of public and private funds in a financial scheme (e.g. through the use of guarantees), and these will be different again from a scheme that provides technical assistance (e.g. the ELENA facility ([14])).

In addition to Articles 17(7) and 17(9), Article 17(11) relates i.a. to the bundling of energy-renovation loans into products that can be traded and invested in by banks and other financial actors. Article 17(11) asks Member States to 'facilitate the aggregation of projects to enable investor access as well as packaged solutions for potential clients. Member States shall adopt measures that promote energy efficiency lending products for building renovations, such as green mortgages and green loans, secured and unsecured, and ensure that they are offered widely and in a non-discriminatory manner by financial institutions and are visible and accessible to consumers. Member States shall ensure that banks and other financial institutions and investors receive information on opportunities to participate in the financing of the improvement of the energy performance of buildings'.

On the scope of this innovative funding and these financial tools, please refer to Section 2.2.1 of the annex to the Commission Recommendation on transposing Article 30 of the Energy Efficiency Directive recast ('EED recast') ([15]). ([16]).

For rented buildings specifically, split incentives, as defined in Article 2(54) of the EED recast are a significant barrier to renovation. Removing these split incentives is required as part of the enabling framework for minimum energy performance standards (MEPS) schemes as per Article 9(4)(d) of the recast EPBD. In addition, Article 22(9) of the EED recast stipulates that 'Member States shall take the necessary measures to remove regulatory and non-regulatory barriers to energy efficiency as regards split incentives between owners and tenants, or among owners of a building or building unit'. The recast EPBD also requires Member States to 'report such barriers and the measures taken' to address these barriers in their national building renovation plans ([17]).

Higher rents, compliance with minimum standards, and the increase in a property's value from a future-proofed building can provide economic incentives for building owners to engage in energy renovation of their building. However, these individual economic incentives may have to be complemented by additional measures such as financial instruments or updates to tenancy laws to ensure that existing tenants do not face eviction or dramatically higher rents following an energy renovation of their dwelling.

([13]) European Energy Efficiency Financing Coalition.
([14]) ELENA – European Local ENergy Assistance.
([15]) Commission Recommendation of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast'), https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=OJ:C_202301553.
([16]) Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ%3AJOL_2023_231_R_0001&qid=1695186598766.
Split-incentive is defined as meaning 'the lack of fair and reasonable distribution of financial obligations and rewards relating to energy efficiency investments among the actors concerned, for example the owners and tenants or the different owners of building units, or owners and tenants or different owners of multi-apartment or multi-purpose buildings'.
([17]) As part of section (a) 'Overview of the national building stock'.

Article 17(5) refers to both the issue of non-economic barriers to building renovation and ways to overcome these non-economic barriers. It stipulates that Member States ‘shall take appropriate regulatory measures to remove non-economic barriers to building renovation. With regard to buildings with more than one building unit, such measures may include removing unanimity requirements in co-ownership structures, or allowing co-ownership structures to be direct recipients of financial support’. Depending on the framework prevalent in Member States, co-ownership structures are not considered legal persons and therefore might not be legally able to: (i) be direct recipients of funding (public or private); (ii) carry out administrative procedures; or (iii) be legally responsible for the works. This generates uncertainty and complexity in the renovation process. Member States should evaluate whether these constraints are justifiable in the case of energy renovations. Removing such non-economic barriers also forms part of the required enabling framework for MEPS schemes as defined in Article 9(4)(d).

In multi-apartment buildings in co-ownership structures ([18]), the owners of different units may have differing needs, understandings, motivations and practical reasons for undertaking or not undertaking a renovation. In such buildings, it may be more difficult to carry out renovations compared with single building units, due to the shared nature of the façade, heating systems, and other common elements. The owners typically have to reach agreement on the distribution of the investment costs, related typically to the distribution of benefits. Co-ownership structures, such as multi-storey apartments, present a distinctive set of challenges and opportunities for renovation compared with single buildings or building units. Typical challenges in these co-ownership structures include the need to reach agreement on the distribution of the investment costs or the distribution of benefits. This may include a requirement to obtain unanimous consent from all unit owners. However, there are also a number of opportunities to be gained from updating co-ownership structures. These include: (i) simplifying the administration process by reducing the number of individual applications, agreements and monitoring processes; (ii) achieving economies of scale by allowing the bulk procurement of materials; (iii) sharing labour costs and streamlining project management; and (iv) incentivising comprehensive renovation in areas not strictly related to energy performance (such as structural upgrades, and improvements to accessibility and indoor climate).

Complex and lengthy administrative procedures around energy renovation projects can create further uncertainty and add significant barriers to renovation efforts. For changes to buildings that require permits, the time taken by local authorities to reach a decision can vary, and longer procedures make projects more challenging for a variety of reasons (e.g. seasonal weather requirements). Complex and lengthy administrative procedures are also a problem when waiting for decisions on financing applications or other support. These complexities and uncertainties can lead to difficulties in securing additional financing, purchasing the necessary materials, or scheduling renovation works with the involved professions (electricians, architects, plumbers, etc.).

The accessibility of financing is the focus of three paragraphs in Article 17. The three bullet points below discuss these three paragraphs in more detail.

— Article 17(2) requires Member States to ‘ensure that applications and procedures for public financing are simple and streamlined in order to facilitate access to financing, especially for households’. Potential recipients of financial support, and households in particular, may indeed be discouraged by complex procedures.

— Article 17(8) requires Member States to ‘ensure that information about available funding and financial tools is made available to the public in an easily accessible and transparent manner, including by digital means’. Transparency implies information on the available budget, section or allocation procedure and processing times.

— In addition, Article 17(13) states that ‘Member States shall ensure that […] programmes [*with the aim of increasing the energy performance of buildings*] are developed in a way that they are accessible to organisations with lower administrative, financial, and organisational capacities’.

2.2 below describes criteria for ensuring compliance with those provisions.

([18]) With ‘co-ownership structure’ to be understood for this provision as buildings with several building units and owners, not necessarily the joint ownership of a single building unit.

2.2. **Choice of policy measures to fulfil the requirements**

2.2.1. *Enabling funding and financial tools and promotion of lending products for building renovations*

The Commission Recommendation on transposing Article 30 of the EED recast (Section 2.2.2. of the annex thereto) provides several potential measures to fulfil the requirement to promote the effective development and use of enabling financial and funding tools (i.e. the requirements set out in Articles 17(7) and 17(9)). In addition, useful information on innovative products is contained in the report on the evolution of financing practices for energy efficiency in buildings ([19]).

Information on on-bill and on-tax financing specifically is provided in Section 2.3 of the annex to the guidance on Article 30 of the EED recast ([20]).

On compliance with the Eurostat guidance on the recording of energy performance contracts in government accounts, further explanations are provided in the annex to the guidance on Article 29 of the EED recast ([21]), Section 4.3.

Options for how Member States can promote energy efficiency lending products for building renovations and ensure a wide offering of such products (Article 17(11) EPBD) are listed in Section 2.2.2 of the annex to the guidance on Article 30 of the EED recast.

2.2.2. *Addressing split incentives*

On top of the financing instruments listed in Article 17(7) (which include direct financial and fiscal incentives towards the target groups of tenants/landlords and on-bill finance), other mechanisms target the problem of split incentives. For example, Section 5.5 of the annex to the guidance on Article 22 of the EED recast ([22]) provides ways to remove such barriers related to split incentives, that can be of a regulatory or financial nature. Regulatory measures include: (i) minimum performance standards; (ii) a revision of rent laws and condominium laws; and (iii) individual metering or submetering, as required under Directive EU/2023/1791, which enables tenants to become more aware of their energy consumption.

The EED recast states that individual meters must be installed to measure the consumption of heating, cooling or domestic hot water for each building or building unit, subject to technical feasibility and cost-effectiveness.

Article 15(3) of the EED recast also addresses the case of multi-apartment or multi-purpose buildings supplied from district heating or cooling or relying on their own common heating or cooling systems. For such buildings, Member States must also have in place national rules to ensure transparency and accuracy of accounting for individual consumption. Detailed guidance on those transparency and accuracy rules (such as on heat allocation to individual apartments) is provided in Section 5, ('Heat allocation rules') of the Annex to the Commission Recommendation on metering and billing provisions ([23]).

([19]) Energy Efficiency Financial Institutions Group (2022): Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry. https://op.europa.eu/en/publication-detail/-/publication/a3032517-c761-11ec-b6f4-01aa75ed71a1/language-en.
The report on financing energy renovations at local and regional level also provides an analysis of several schemes from across the EU: Economidou, M., Della Valle, N., Melica, G., Valentini, O. and Bertoldi, P., (2021): Financing energy renovations at local and regional levels. https://publications.jrc.ec.europa.eu/repository/handle/JRC123755.

([20]) Annex to the Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast'). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:C_202301553.

([21]) Annex to the Commission Recommendation 2024/2476 of 13 September 2024 setting out guidelines for the interpretation of Article 29 of Directive (EU) 2023/1791 as regards energy services. EUR-Lex - 32024H2476 - EN - EUR-Lex.

([22]) Commission Recommendation (EU) 2024/2481 of 13 September 2024 setting out guidelines for the interpretation of Articles 21, 22 and 24 of Directive (EU) 2023/1791 of the European Parliament and of the Council as regards the consumer related provisions. EUR-Lex - 32024H2481 - EN - EUR-Lex.

([23]) Commission Recommendation (EU) 2019/1660 of 25 September 2019 on the implementation of the new metering and billing provisions of the Energy Efficiency Directive 2012/27/EU. EUR-Lex - 32019H1660 - EN - EUR-Lex.

Some Member States rely on indoor-temperature-based rental agreements, such as all-inclusive rents (‘warm rent’), whereby owners (i.e. landlords) and tenants agree on the indoor temperature for the heating or cooling season, and rents are set on this basis ([24]). This can be monitored by indoor temperature sensors and linked to individual energy meters based on weather normalisation and calibration ([25]), in compliance with Article 18(1) of the EED recast ([26]). In this way, building owners, who pay the heating costs, benefit from the reduced energy costs resulting from the renovation. Tenants in this scenario typically pay for the rebound effects which would arise if they were to (significantly) increase the indoor temperature post renovation. ‘Warm rent’ models may lead to higher energy use in situations when tenants would open the windows for ventilation purpose, in particular in less energy-efficient buildings with no automated ventilation, but the use of individual meters will limit this risk.

Section 4 of this document discusses some considerations for situations affecting vulnerable tenants specifically.

2.2.3. *Co-ownership structures*

Dedicated financing instruments for co-ownership structures: The accessibility of financial instruments for co-ownership structures can ensure the renovation of building units under co-ownership is viable. Some members of the co-ownership structure may find it difficult to finance or obtain loans individually and through conventional channels. As a result, the renovation of the entire building may not be possible because the necessary capital cannot be raised. The availability of financing instruments that allow co-ownership structures to make combined applications for financial support (or – depending on their legal nature – making the co-ownership structure itself the direct recipient of support), enables the renovation of a number of dwellings under a single financial assistance programme. As the examples below show, such specific instruments for multi-unit buildings in the form of loans and loan guarantees can facilitate access to finance for renovation.

Existing practice: financing of co-ownership structures

The Estonian Business and Innovation Agency (formerly KredEx) oversees the administration of renovation financing programmes dedicated to apartments. These programmes comprise a combination of grants, loans and guarantees. Examples of four of these programmes are set out in the four bullet points below.

— The *Reconstruction Grant 2022-2027* ([27]), offers a grant that covers some of the investment costs that improve energy performance in apartment buildings with three or more apartments. The apartment buildings must have been in use before 2000 and at least 80 % of the apartments must be owned by natural persons. The government of Estonia has earmarked a total of EUR 300 million from the European Union Structural Funds for this programme.

— The *Apartment building renovation loan* ([28]) is available for apartment associations that encounter difficulties in obtaining financing through conventional channels. The minimum loan amount is EUR 15 000. Loan conditions include a requirement for self-financing of at least 5 % (i.e. the apartment owners must finance at least 5 % of the renovation cost to be eligible to receive a loan for the remaining 95 %).

([24]) European Commission Joint Research Centre (2017): Overcoming the split-incentive barrier in the building sector. Unlocking the energy efficiency potential in the rental & multifamily sectors, https://op.europa.eu/en/publication-detail/-/publication/ae5716d7-fb39-11e7-b8f5-01aa75ed71a1/language-en.

([25]) Agora Energiewende and Universität Kassel (2021): CO_2 Emissions Trading in Buildings and the Landlord-Tenant Dilemma: How to solve it. https://www.agora-energiewende.org/publications/co2-emissions-trading-in-buildings-and-the-landlord-tenant-dilemma-how-to-solve-it.

([26]) Article 18(1): ‘Where meters or heat cost allocators are installed, Member States shall ensure that billing and consumption information is reliable, accurate and based on actual consumption or heat cost allocator readings, in accordance with Annex IX, points 1 and 2 for all final users’.

([27]) https://www.kredex.ee/en/kodudkorda.

([28]) https://www.kredex.ee/en/services/ku-ja-kov/Apartment-building-renovation-loan.

— The *Loan guarantee for apartment associations* [29] provides a guarantee of up to 80 % of the loan amount for apartment associations that require a guarantee to secure a bank loan for renovation work. However, this programme is not dedicated only to energy efficiency improvements.

— The *Factory reconstruction grant* [30] for apartment buildings facilitates the adoption of new technical solutions in apartment buildings, such as factory-assembled and prefabricated building elements and components that improve the energy performance of the buildings and achieve a better indoor climate.

Removing unanimity requirements in co-ownership structures: In co-ownership structures, such as apartment buildings, it is crucial to foster a consensus among owners on collective decisions, such as those pertaining to maintenance, renovations, or other significant actions affecting the property. However, requiring a unanimous vote may lead to stalemate situations where there are not enough owners willing to finance a renovation project with the result that energy renovation never happens. Removing the requirement for a unanimous vote by replacing it with a requirement for simple majority may facilitate the decision-making process and encourage the participation of building owners.

Existing practices: voting rules in co-ownership structures

In Estonia, a decision on the scope and budget of renovation works can be implemented if a majority of 51 % of building owners agree [31]. [32].

In Spain, amendments to the law on condominiums, particularly through Law 8/2013 [33], have replaced the unanimity vote requirement with a majority vote requirement. This majority vote requirement also allows the costs of decisions on the installation of energy or water efficiency equipment to be shared based on based on owners' participation quotas (i.e. based on the usual share of the building's common costs paid by the condominium owner) [34]. This legislative change aims to streamline decision-making processes within condominiums, making it easier for communities of owners to implement environmentally beneficial upgrades without facing the previous hurdles posed by unanimity requirements. For example, Article 15 of Spain's Law 8/2013 sets out rules for procedures needed to undertake energy renovations in a multi-residential property. This article states that energy renovation works can be carried out with the approval of at least one third of the neighbours, who must finance the works.

In the Netherlands, a super-majority of 70% of residents in favour of home improvement work is sufficient to allow the work to go ahead [35].

In Germany, under the 'WEG' reform (the 2020 reform of the Housing Ownership Act), the community of apartment owners can decide by simple majority that renovation measures must be carried out. On the distribution of costs, a graduated procedure applies: if the decision is only passed by a simple majority resolution, only those owners who voted in favour of the measure share the costs. However, if the community decides on the measure with a two thirds majority of the votes cast, everyone has to pay - in proportion to their co-ownership shares [36].

Similar measures to ease the governance structure of jointly owned apartment buildings are in place in Austria, France and Lithuania.

[29] https://www.kredex.ee/en/services/ku-ja-kov/loan-guarantee-apartment-associations.
[30] https://www.kredex.ee/en/element.
[31] https://www.fi-compass.eu/sites/default/files/publications/case_study_renovation_loan_programme_estonia_0.pdf.
[32] https://link.springer.com/chapter/10.1007/978-3-030-23392-1_16.
[33] BOE-A-2013-6938 Ley 8/2013, de 26 de junio, de rehabilitación, regeneración y renovación urbanas.
[34] https://www.boe.es/buscar/act.php?id=BOE-A-1960-10906.
[35] https://www.rijksoverheid.nl/onderwerpen/energie-thuis/vraag-en-antwoord/gaat-de-huur-omhoog-na-renovatie.
[36] https://www.energetische-stadtsanierung.info/wp-content/uploads/2022/03/Arbeitshilfe-WEG_2022-02-09.pdf.

The role of building managers: Ensuring the involvement of managers throughout the renovation is essential. Within the building co-ownership, these building managers could contact owners to explain legal requirements, building regulations, financing conditions, etc. This is particularly helpful before decisions are taken (e.g. before assemblies), but is also necessary throughout the renovation process (i.e. by keeping owners involved and informed). Building managers could also contact the one-stop shops, which could provide them with information and tools to carry out their role or engage them directly in the process if relevant.

2.2.4. *Administrative complexity, uncertainty and delays for planning energy renovations*

One-stop shops offer a significant opportunity to facilitate administrative procedures and overcome the difficulties that may be associated with them. For more on one-stop shops, please refer to the annex to the guidance on Articles 21, 22 and 24 of the EED recast ([37]) (Section 5).

In addition, Member States are required to submit to the Commission their first national building renovation plan by 31 December 2026 and the first draft by 31 December 2025. Member States are invited to include in their plan an assessment of the administrative procedures around permitting and financial support instruments, with the goal of speeding up decision-making on building permitting and financing support. In their national building renovation plans, Member States could: (i) analyse the durations of procedures for permitting and finance, and set time limits for these procedures; and (ii) allocate more resources to the enforcement of those time limits, similar to the requirements stemming from Directive 2023/2413/EU (RED III) ([38]), which addresses common challenges in administrative and authorisation procedures for renewable energy projects ([39]).

Existing practice: permitting processes

Czechia introduced substantial changes to the permitting process for construction projects. Law 283/2021 ([40]) restructures the responsibilities of permitting authorities by creating single contact points for different building categories. The law also introduces a primarily digital procedure that enables permit seekers and authorities to communicate through an online platform. There are limits to the duration of processing times between initial application and the time a decision is reached and these limits must be communicated to the applicant. For residential buildings, this limit is 30 days ([41]).

2.2.5. *Accessibility: simple and streamlined applications and procedures for receiving support*

Clarity and transparency are critical parameters for accessible financing instruments. Clarity should include ensuring that instructions for applications are detailed and understandable to a non-expert audience. In addition, application templates should be provided to all applicants, and required support documents should be clearly listed. If applicable, the submission deadlines for calls and selection criteria should be disclosed to allow sufficient planning and preparation times.

([37]) Commission Recommendation (EU) 2024/2481 of 13 September 2024 setting out guidelines for the interpretation of Articles 21, 22 and 24 of Directive (EU) 2023/1791 of the European Parliament and of the Council as regards the consumer related provisions. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202402481.

([38]) Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652. Directive - EU - 2023/2413 - EN - Renewable Energy Directive - EUR-Lex.

([39]) This assessment and related measures could be part of Section (c) ‘Overview of implemented and planned policies and measures addressing market barriers and market failures’, indent (n) ‘addressing market barriers and market failures’.

([40]) https://mmr.gov.cz/cs/ministerstvo/stavebni-pravo/pravo-a-legislativa/novy-stavebni-zakon.

([41]) The full entry into force of the law was on 1 July 2024. Therefore, the degree to which permits are granted within this timeline could not be accessed by the time this document was published.

To maximise clarity and transparency, the use of digital procedures should be strongly considered. The digital submission of applications offers solutions for: (i) completeness checks; and (ii) pop-up windows with explanations or requests for additional information based on the inputs made. In addition, digital tools enable the fast exchange of data between authorities and direct communication with financing applicants.

Existing practice: administrative support

A good example of administrative support is Vienna's Clean Heating for all programme. This programme is featured in the EU's Social Climate Fund guidance on cost-effective measures and investments ([42]), and the programme uses a simple online portal and supports beneficiaries throughout the application process.

Support programmes should also aim to avoid short rounds of a stop-and-go approach where there are multiple requests for additional information. Avoiding these multiple exchanges is critical when the length of the application process may be the decisive factor in determining whether the energy renovation project proceeds or not.

When the demand for financial support is expected to exceed the public budget earmarked for it, calls for applications for financial support that have sufficient timespans and clear selection criteria are the preferred option, on top of adaptations of the financial support (typically by lowering the percentage of eligible costs covered by grants).

Where different authorities are involved in the allocation of financing, or when the decision on financing is connected to a decision on permits, close collaboration between all authorities can help to streamline benefits and result in faster reactions to applicants.

One-stop shops are highly relevant solutions as they combine the necessary expertise on financial and technical support. Their benefits are also highlighted in the guidance for Article 22 ([43]) and for Article 30 ([44]) of the EED recast. It is also recommended to take a combined approach on Articles 17 and 18 of the recast EPBD (i.e. to address both articles at the same time) to combine awareness raising with technical and financial support targeted at the appropriate governance level.

Existing practices: advice to households

There are several initiatives in place that provide combined advice to households. For example, the pilot project OpenGela in the Basque region of Spain offers advice and support at neighbourhood level. The advice and support cover administrative, technical and financial issues for energy-related issues, but also for other relevant topics, such as accessibility for people with a disability. In addition to the one-stop shop service itself, OpenGela also developed an online tool with an energy map of all buildings in the Basque region. The tool provides an integrated framework to support the development of renovation plans complemented with estimates of financial implications at multiple levels: national, regional, neighbourhood and individual dwelling. OpenGela also supports the development of strategies to apply the measures set out in the national building renovation plans, for example, by identifying needs, including identifying the worst-performing buildings. This information can then be used to determine the areas where it would be most beneficial to set up one-stop shops. Finally, the tool can also be used as a basis or starting point for each building to determine its energy-renovation needs. In the Basque Country, the model is based on identified building typologies and information from the property register ([45]).

A similar initiative specifically intended for multifamily apartment buildings exists in Vilnius, Lithuania, where the 'Renovate the City' project (*Atnaujinkime miestą* in Lithuanian) offers advice to both owners and tenants about renovation benefits, technical options and financing opportunities, depending on the tenant structure of the building ([46]).

([42]) European Commission, Directorate-General for Climate Action, Ludden, V., Laine, A., Vondung, F. et al., Support for the implementation of the Social Climate Fund – Note on good practices for cost-effective measures and investments, Publications Office of the European Union, 2024, https://data.europa.eu/doi/10.2834/602067.

([43]) EUR-Lex - 32024H2481 - EN - EUR-Lex.

([44]) EUR-Lex - 32023H01553 - EN - EUR-Lex.

([45]) https://opengela.eus/what-is-opengela.

([46]) https://amiestas.lt/apie-mus/.

Households may not be very familiar with financing applications and the necessary project documentation. Beyond general application procedures, access to ambitious energy renovation financing usually requires calculations of energy performance or potential improvements in GHG emissions. To account for this and allow for a wide range of households to access financing programmes, the involvement of external experts such as energy advisers should be actively considered. External experts could be allowed to prepare and submit applications.

Existing practice: submission of applications

In the German support scheme for replacing fossil-fuelled boilers with heat pumps, energy advisers are allowed to submit applications on behalf of property owners ([47]).

Such support for the preparation of assessments, documentation and applications should be covered financially by the programme based on realistic estimations.

The consideration of accessibility and support should also be made available to small and medium-sized enterprises (SMEs) as they face similar constraints.

2.2.6. *Accessibility: easily accessible information on financing options*

Easily accessible information about financing support schemes is a crucial design feature for public policy on energy renovation. This is because easily accessible information supports inclusivity and broader participation across diverse household demographics, enterprises (especially SMEs), and building owners overall. A key criterion for this accessibility is the use of language and wording that is understandable to non-expert audiences. By avoiding technical jargon and presenting information clearly, policymakers can engage a wider audience, ensuring that all households and enterprises (especially SMEs), regardless of their expertise in energy efficiency or finance, can understand and benefit from available support schemes. This inclusivity is essential in promoting widespread energy renovations, leading to greater energy efficiency and reduced carbon footprints across communities.

Integrating both digital and non-digital information streams makes it possible for public policy to effectively support and encourage comprehensive energy-renovation efforts.

— Digital platforms, such as websites, offer significant advantages for disseminating information about financing support schemes. These platforms provide wide access and can be regularly updated, ensuring the best possible transparency on programme deadlines, funding volumes, and other critical details. Furthermore, digital services can offer targeted information based on pre-selected data related to building location, type, and energy performance, making it easier for households to find relevant support options. Such websites are in place in many EU countries already, but should be evaluated based on the user experience and clarity of the information they present.

However, to accommodate households with limited internet access or literacy, non-digital means, such as local events and brochures, should also be employed. This multi-channel approach ensures that all households, regardless of their access to digital resources, can stay informed and take advantage of available energy renovation financing. Approaching households locally can be an appropriate way to create awareness of energy renovations and support programmes.

Existing practice: physical and mobile provision of information

The city of Freiburg in Germany set up an 'Energy Caravan' to inform building owners from different neighbourhoods about energy renovation ([48]). Such an approach offers great opportunities to combine financial and technical support information as part of a one-stop shop as defined in Article 18.

([47]) https://www.energiewechsel.de/KAENEF/Redaktion/DE/Dossier/waermepumpe.html.

([48]) Information on this initiative is available through the BUILD UP platform: https://build-up.ec.europa.eu/en/resources-and-tools/case-studies/energy-caravan-campaign-decarbonise-freiburgs-built-environment.

The local-level approach also makes it possible to reach areas with higher shares of vulnerable households with targeted information, and can be considered as creating the enabling framework for a MEPS instrument according to Article 9(4)(b) of the EPBD.

3. USE OF FINANCING (ARTICLE 17 - PARAGRAPHS 12 AND 14 TO 16)

3.1. Scope and objectives of the requirements

Article 17(14) of the recast EPBD states that financial assistance has to be tied to the energy savings or improvements created by the energy renovation project. It states that 'With due regard to vulnerable households, Member States shall link their financial measures for energy performance improvements and reduced greenhouse gas emissions in the renovation of buildings to the targeted or achieved energy savings and improvements, as determined by one or more of the following criteria:

(a) the energy performance of the equipment or material used for the renovation and the related greenhouse gas emission reduction; in which case, the equipment or material used for the renovation is to be installed by an installer with the relevant level of certification or qualification and shall comply with at least minimum energy performance requirements for building elements or higher reference values for an improved energy performance of buildings;

(b) standard values for the calculation of energy savings and greenhouse gas emission reduction in buildings ([49]);

(c) the improvement achieved due to such renovation by comparing energy performance certificates issued before and after renovation;

(d) the results of an energy audit;

(e) the results of another relevant, transparent and proportionate method that shows the improvement in energy performance, for example by comparing the energy consumption before and after renovation with metering systems, provided it complies with the requirements set out in Annex I.'

This requirement applies to all types of financial measure, including tax measures.

The requirement applies irrespective of whether the renovation in question constitutes a 'major renovation' within the meaning of Article 2(22) of the recast EPBD.

Member States must use one or more of the above-mentioned criteria (a) to (e). They must also ensure that the works have actually been carried out.

Criterion (e) is about employing alternative, suitable, transparent and proportionate methodologies to demonstrate improved energy performance. For instance, a comparison of the metered energy consumption before and after the renovation may be employed. Nevertheless, the procedure and basis for using metered energy consumption must comply with the requirements set out in Annex I. This means that the calculation methodology for metered energy consumption must be capable of capturing the influence of occupant behaviour and the local climate (the influence of the local climate (deviations from typical temperatures, etc.) should be excluded from the result).

The reference 'with due regard to vulnerable households' should be read in conjunction with Article 17(18), which states that 'Financial incentives shall target, as a priority, vulnerable households, people affected by energy poverty and people living in social housing […]'. This means that Member States must ensure that their financing schemes address jointly those two priorities: (i) prioritising higher support to vulnerable households; and (ii) including criteria related to the targeted or achieved energy savings and improvements ([50]). One cannot be prioritised over the other. These two requirements must be complied with simultaneously to deliver on those two essential objectives, namely to ensure cost-efficient energy renovations and help vulnerable households to carry out energy renovations.

([49]) The standard values could be calculated on the basis of typical energy-saving measures (e.g. adding insulation, installation of heat pump, installation of PV panels) when applied to typical building typologies (e.g. single residential buildings under 200 m^2, multi-residential buildings of a certain type).

([50]) In addition, Article 8(3) of the EED recast asks 'Member States [to] implement energy efficiency obligation schemes, alternative policy measures, or a combination of both, or programmes or measures financed under a national energy efficiency fund, as a priority among […] people affected by energy poverty, vulnerable customers, people in low-income households and, where applicable, people living in social housing.'

Article 17(14) should also be read together with Article 17(12), which stipulates that 'Member States shall put in place measures and financing to promote education and training with a view to ensuring that there is a sufficient workforce with the appropriate level of skills corresponding to the needs in the building sector, especially targeting SMEs, including microenterprises, as appropriate. One-stop shops set up pursuant to Article 18 may facilitate access to such measures and financing.'

Skills are central to ensuring the quality of a renovation, so financial measures for energy performance should require that renovation measures are implemented by qualified or certified installers. This is particularly important in the case of criterion (a) above, according to which a qualified and certified installer must be involved to both: (i) install the equipment or material used for the renovation; and (ii) verify the improvements. Member States should review their national regulations on relevant professions of installers to ensure that only qualified and certified installers are involved in the renovation process.

The limited availability of workers equipped with the right skills can in turn be a barrier to the wide rollout of energy renovations. Therefore, Article 17(12) requires measures and financing to be put in place to train and qualify workers with the skills needed to improve the energy performance of buildings. The inclusion of this paragraph highlights: (i) the importance of a workforce capable of carrying out the needed work; and (ii) the responsibility of Member States to support training and education at all levels of the building value chain. Examples of the skills needed to transform the building stock through energy renovations include: (i) performing energy audits; (ii) installing energy-efficient and renewable-energy-fuelled building systems; and (iii) determining appropriate insulation solutions.

SMEs, including microenterprises, face particular difficulties in training their employees. Among other factors, these difficulties are related to their limited financial capacity and the inherent constraints of their size, which result in less flexibility to take on new work when employees are in training or out of the jobsite. When designing training or qualification schemes, Member States should pay close attention to the situation, needs and constraints of SMEs. This includes the design of the training and qualification schemes (i.e. the requirements for workers), as well as the design of support measures specifically targeting SMEs. This is particularly relevant given the very high proportion of SMEs in the building sector (over 90% of construction companies are SMEs).

Article 17(16) provides that deep renovations and staged deep renovations should benefit from greater support, including financial, fiscal, administrative and technical support. The relevance of the prioritised support for deep renovations is also highlighted in Article 9(4)(c) as part of the enabling framework for a MEPS scheme.

The terms 'deep renovation' and 'staged deep renovation' are defined in Article 2(20) and 2(21). From 2030 onwards, zero-emission buildings should be the default result of a deep renovation process. Article 11 further lays down the requirements for these buildings in terms of carbon emissions and energy demand.

Renovations to achieve zero-emission buildings may not always be feasible. In such cases, the lack of feasibility can be determined based on technical or economic conditions. The requirement to comply with the definition of 'zero-emission building' (laid down in Article 11) can be adapted for these difficult renovation cases, and for the specific purpose of Article 17, a 60% reduction in primary energy use can therefore be considered a deep renovation and receive priority support. Given the depth of renovation needed to achieve this 60% reduction, and the proportionally higher funding rates that this 60% reduction can be awarded, the Commission recommends that, when using public funds, the energy savings should be calculated on the basis of: (i) comparing energy-performance certificates (EPCs) issued before/after the renovation; (ii) an energy audit; or (iii) another relevant, transparent and proportionate method.

It should be noted that a major renovation may need to take place to bring a building up to nearly zero-energy building or zero-emission building standard in one single renovation, particularly if starting from a worst-performing building. In this case, the issuance of an EPC after the renovation works have been completed is already a requirement (Article 20(1)). Furthermore, Article 23(8) requires Member States to put in place inspection schemes or alternative measures to certify the quality of the delivered works.

Existing practices: relying on EPCs before and after the works

In Greece, the 'SAVING' programme for residential property owners uses EPCs in the initial application and later for the certification of the project. These EPCs are used both to prioritise the worst-performing buildings during the application process, and to confirm that buildings have achieved significant energy savings following the works.

In Romania, an EPC is required for the pre-renovation state of the building (together with the energy audit report), and a new EPC is required for the renovated building (after all the work has been completed) together with an implementation report (describing how the impact indicators have been met). The impact of the refurbishment is assessed on the basis of the difference between the initial EPC and the final EPC in: (i) the difference between final and primary energy; (ii) CO_2 emissions; and (iii) renewable energy (and other key performance indicators).

In Portugal, the EPC is used to evaluate the success of the incentive programme itself, at aggregate level.

For further guidance on the criteria for feasibility, please refer to the guidance on Technical Building Systems, Indoor Environmental Quality and inspections (Annex 10) – Section 5.

3.2. **Choice of policy measures to meet the requirements**

3.2.1. *Linking the financial measures to the targeted or achieved energy savings and improvements*

On the choice of tool(s) to be used, EPCs can play a key role in assessing the impact of a given renovation measure, while also supporting the quantification of the energy performance of the national building stock ([51]). EPCs are also used by credit institutions to verify energy savings and meet the requirements of financial instruments. The integration of EPCs and building renovation passports with incentive programmes would improve their effectiveness by: (i) giving clearer guidelines for public administrations on what renovation interventions should be incentivised as a priority; (ii) tying the exact amount of funds to specific and measurable energy improvements; and (iii) providing building owners with clear, reliable and actionable information, thus making renovations more accessible.

The framework for the introduction of renovation passports and the requirements to be met by a renovation passport system are set out in Article 12 and Annex VIII. Some of these provisions are mandatory, while others are not. In essence, the renovation passport provides an estimate of energy improvements after each step in the renovation process, including: (i) the improvement in energy performance; (ii) savings in primary and final energy consumption; and (iii) the reduction of operational greenhouse gas emissions.

Therefore, a Member State could decide, for example, to either require an EPC before and after renovation or to rely on a renovation passport, while ensuring that the works are carried out.

Having chosen the quality criteria to be applied, Member States should disseminate and communicate the national measures transposing Article 17(14) of the recast EPBD to all appropriate authorities/agencies (i.e. operational authorities) responsible for designing and implementing financial measures. This is important to ensure that the design and implementation of the measures are linked to one or more of the criteria.

3.2.2. *Greater support for deep renovations and sizeable programmes*

To offer greater support for deep renovations, specific financing instruments or criteria can be created or made accessible in addition to the more general schemes for energy renovations which sometimes achieve only minimum energy performance improvements. On financial support, different levels of support can be determined according to the increase in energy performance as measured by an EPC, an energy audit or a renovation passport.

([51]) Building Performance Institute Europe (2024): Enhancing incentives through iBRoad2EPC. How to best use financial and non-financial incentives for renovation in implementing markets. iBRoad2EPC-D5.4-Enhancing-incentives-through-iBRoad2EPC.pdf.

Existing practices: modular coverage of costs through grants

In Vienna, the Wohnfonds Wien offers low-interest loans for which energy renovations in general are eligible. However, for renovations to achieve specific minimum energy performance improvements and reaching a high energy performance, increasing parts of the loan can be transformed into grants ([52]).

In Germany, the Bundesförderung für effiziente Gebäude (Federal support for energy-efficient buildings) increases the level of grant support depending on the resulting energy performance of a building ([53]). In addition, it offers a range of options to increase the level of support for: (i) renovations that result in the use of renewable energy sources; (ii) the renovation of a worst-performing building; or (iii) renovations conducted through a serial renovation process.

A third example is the MaPrimeRénov' scheme in France. The regular scheme can be upgraded through the additional support scheme MaPrimeRénov' Parcours accompagné (*parcours accompagné* means 'guided procedure' ([54])). In this additional support scheme, the number of energy classes gained through the renovation (e.g. an upgrade in EPC from F to C) increases the eligible grant amount. In the German example above, the renovation of worst-performing buildings is rewarded with additional support. Moreover, the costs for technical assistance from an energy adviser throughout the renovation process are covered by the scheme. MaPrimeRénov Parcours accompagné further differentiates the support levels based on the household's income, making it a good example of how to help vulnerable households to undertake deep renovations. This feature is further highlighted in Section 4.2 of this report and creates strong synergies with the enabling framework for a MEPS framework in residential buildings in line with Article 9(4) by targeting vulnerable households while improving worst-performing buildings with deep renovations.

On administrative support, Member States could require the relevant authorities (in most cases the local authorities) to take into consideration deep renovations, for instance by: (i) simplifying procedures for deep renovation; (ii) providing greater flexibility in the application of specific rules for deep renovation (e.g. permits for RES installations); or (iii) prioritising the processing of applications for deep renovation. Providing clear information on the timeframe for procedures and any subsequent updates in the process is particularly relevant for deep renovations, which require detailed planning of works and resources. Therefore, Member States are encouraged to revise both the procedures for these deep renovations and the information they provide to the public on these deep renovations. Additional support or assistance, especially tailored assistance, has been demonstrated to be a useful tool to facilitate deep renovation processes.

On technical support, Member States could provide specific advice tailored for deep renovations, for instance through one-stop shops. This could include not only advice on efficiency measures or the installation of renewable energy equipment on-site, but also advice on other building aspects such as: fire protection, accessibility, structural stability or seismic protection. These are all important aspects to consider when a building is deeply renovated. It should be noted that these and other aspects may already be part of existing requirements when carrying out a deep or major renovation (e.g. bringing a building up to modern fire-safety standards or updating the electric installation).

Article 17(16) also requires greater incentives for sizeable programmes to renovate several buildings or neighbourhoods. This approach can be particularly relevant for systematic approaches to connected blocks of worst-performing buildings or vulnerable households.

In this respect, the terms 'sizeable programmes' and 'high number of buildings' are not to be understood in absolute terms. It is instead important to consider: (i) the size of the programme in relation to the budget size of the public authority running the programme; (ii) the size of the programme in relation to the number and share of buildings targeted on the territory covered by such a programme; and (iii) the relative energy performance of the buildings that are to be renovated. Specific support options that combine greater and dedicated financial, fiscal, administrative and technical support or that enable the use of different support elements are well suited for sizeable programmes. A minimum energy efficiency gain (defined as a reduction in primary energy use of at least 30%) and tiered support depending on the improvement in performance should form part of these instruments.

([52]) https://www.wohnfonds.wien.at/erstinfo_thewosan_energieeinsparung.
([53]) https://www.energiewechsel.de/KAENEF/Redaktion/DE/Dossier/beg.html.
([54]) https://www.anah.gouv.fr/anatheque/le-guide-des-aides-financieres-2024.

Member States should provide greater support to deep renovations and medium renovations at scale, not only through direct financial instruments from national governments to end recipients like building owners, but also through their regulations, guidance and financial support to lower levels of government and financial intermediaries.

3.2.3. *Support for training and capacity building*

The limited availability of skilled workers has been identified as a significant bottleneck to the uptake of renovations. This limited availability results in delays, increased costs and potential quality issues. In line with the national building renovation plans, Member States are encouraged to put in place measures to support the development of a skilled workforce. ([55]) Member States may do this by supporting both the supply and demand side of skills.

On the demand side, Member States may introduce requirements to ensure that works are carried out by trained professionals with sufficient skills or with specific requirements for qualifications. This may include changing existing requirements or creating new ones if such requirements are not already in place. To allow for the progressive introduction and adoption of requirements, Member States may make these requirements compulsory when financial support is provided through public funds (e.g. subsidies, fiscal incentives or financial instruments).

On the supply side, Member States may support the development or deployment of the training themselves. This may include, for example, subsidies or fiscal incentives to companies when they provide training for their employees. Given the significant challenges faced by SMEs (including microenterprises) Member States are strongly encouraged to develop specific measures to facilitate their access to training. This could include especially tailored schemes ([56]).

When developing their measures to support training and capacity building in the construction sector, Member States are encouraged to use the lessons learnt from the BUILD UP Skills initiative.

The BUILD UP Skills initiative ([57]) managed by the EU's Climate, Infrastructure and Environment Executive Agency (CINEA) has supported more than a hundred projects since 2011. These projects provided a framework for the upskilling actions needed across Europe to make energy renovations possible at the scale implied by the targets for energy efficiency and energy performance of buildings. BUILD UP Skills has supported the development by key stakeholders of national skills strategies, which in 2024 had been updated in 15 Member States. In addition, the supported projects piloted innovative approaches that are now available for replication and upscaling at national level. These innovative approaches included: (i) qualification and training schemes reflecting emerging skills; (ii) awareness campaigns to increase the demand for skills; and (iii) measures to increase demand for skills and qualifications in procurement procedures. The Commission encourages Member States to take advantage of the work done throughout multiple projects (from identifying needs to implementing training) in the further development of their actions on skills. This could apply both when Member States are drafting their national building renovation plans and when Member States are developing financial schemes for training.

4. **SOCIAL FAIRNESS (ARTICLE 17 (3) AND ARTICLES 17(17) TO 17(19))**

4.1. **Scope and objectives of the requirements**

The definition of 'vulnerable households' in Article 2(28) refers to both: (i) households struggling to afford energy or at risk of not being able to afford energy in the future due to price increases; and (ii) households that cannot afford the investment necessary for a renovation. This scope of definition means that vulnerability can include both property owners and tenants. The bullet points below discuss these two categories in more detail.

— Vulnerable homeowners often live in buildings with poor energy performance because they are unable to afford the necessary renovation works. Loans for covering the upfront investments may be unavailable or carry high additional costs, due to the financial situation of the prospective borrower.

([55]) To address this issue, the Large-Scale Skills Partnership for the Construction ecosystem, implemented under the Pact for Skills, promotes upskilling and reskilling of 30% of the workforce each year by 2030 across the industry. https://pact-for-skills.ec.europa.eu/about/industrial-ecosystems-and-partnerships/construction_en.

([56]) Those schemes would be adapted to the targeted trade (construction sector, architectural and engineering activities, etc.).

([57]) BUILD UP Skills | BUILD UP.

— Vulnerable tenants are in a different situation but can also face financial challenges before – or as a result of – energy performance renovations. In worst-performing buildings they may face high energy bills. Going beyond the concept of energy poverty and the definition of 'vulnerable households' in Article 2(28) strictly speaking, certain tenants may face a rent increase after an energy renovation that is more than the amount the tenant saves thanks to the reduced energy costs. This can lead to a situation where low-income households are forced out of their home as an indirect result of the energy renovation. This effect is also referred to as 'renoviction' in the EU Commission staff working document on energy poverty ([58]) on which the Commission Recommendations on energy poverty ([59]) are based.

Several provisions from the recast EPBD are linked to vulnerable households, including in Article 3, Article 9, Article 17 and Article 18. Member States are therefore expected first to identify the segments of their population that would fall under the scope of 'vulnerable households'.

The Commission's staff working document 'EU guidance on energy poverty' ([60]) discusses the situation of households in energy poverty. It sets out indicators and data sources and also explains challenges in diagnosing whether a tenant or owner is vulnerable. The information provided in that document is a highly relevant basis for determining eligible target groups for financing support and rent safeguards ([61]).

Member States should also lay down criteria to define the other categories of 'vulnerable households', not just energy-poor households.

Specific attention to vulnerable households is required as part of the enabling framework for minimum energy performance standards. As defined in Article 9(4)(a), appropriate financial measures are a key element to support the implementation of MEPS, including when MEPS are laid down for residential buildings.

The considerations and instruments described in the following section offer guidance on how to also comply with the additional requirements for a MEPS framework for residential buildings.

4.2. **Choice of policy measures to fulfil the requirements**

4.2.1. *Providing greater support to building owners with lower financial capacity*

As stated in Article 17(18), incentives for renovations must be available as a priority to vulnerable households and people living in social housing. To target those recipients, Member States are invited to set eligibility rules, based for example on: (i) income ceilings (no eligibility above a certain income); (ii) degressive support, linked to the household's income (the higher the income, the lower the support); (iii) number of dependent family members (such as children); and (iv) number of properties owned and type of property (for instance no financial support for holiday homes or for owners of many properties).

Another complementary option is to reserve a minimum share of the overall funding to vulnerable households and social housing providers.

To ensure that the measures target the relevant groups, Member States should ensure that criteria for prioritisation are linked – or proportional – to the available indicators related to social fairness, vulnerable households or energy poverty. For example, criteria could be linked to the national definition of energy poverty or 'low-income household'.

([58]) European Commission, 2023, SWD(2023) 647 final. Commission Staff Working Document EU guidance on energy poverty accompanying the document Commission Recommendation on energy poverty. https://energy.ec.europa.eu/publications/commission-staff-working-document-eu-guidance-energy-poverty_en.

([59]) Commission Recommendation (EU) 2023/2407 of 20 October 2023 on energy poverty. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202302407.

([60]) European Commission, 2023, SWD(2023) 647 final. Commission Staff Working Document EU guidance on energy poverty accompanying the document Commission Recommendation on energy poverty. https://energy.ec.europa.eu/publications/commission-staff-working-document-eu-guidance-energy-poverty_en.

([61]) The annotated template on the National Building Renovation Plans provides clarifications on indicators related to energy poverty. https://circabc.europa.eu/ui/group/8f5f9424-a7ef-4dbf-b914-1af1d12ff5d2/library/a8116057-2055-48e7-81c5-ee94a62de5c8.

Existing practices: linking the financial support to household income

Several existing instruments provide examples of linking financial support to household income.

The ‘Gent Knapt Op’ (‘Gent is renovating’) programme provides grant amounts ranging from EUR 15 000 to EUR 30 000 in funding for homeowners with limited income to renovate their homes. This initiative aims to improve living conditions by addressing essential repairs, improving energy efficiency, and increasing overall comfort. By offering substantial financial support, the programme helps vulnerable households reduce energy costs and improve their quality of life ([62]).

The ‘Klimabonus’ programme in Berlin provides tenants with supplemental rent support ranging from EUR 0.40 to EUR 0.60 per square metre per month, depending on the energy efficiency measures put in place by the landlord/owner and the standards achieved by these energy-efficiency measures. This bonus aims to mitigate the impact of rising living costs due to necessary energy-saving renovations made by the landlord/owner, ensuring that low-income households can afford their rent despite improvements that might otherwise increase their housing expenses ([63]).

The Warmer Homes Scheme, managed by the Sustainable Energy Authority of Ireland, offers free energy-efficiency upgrades to eligible low-income households. The scheme covers improvements such as attic and wall insulation, energy-efficient lighting, and heating system upgrades, aiming to reduce energy costs and improve comfort. Eligibility criteria include: (i) owning and living in a home built before 2006; (ii) the home having a Building Energy Rating Certificate (BER) of C, D, E, F or G; and (iii) receiving certain welfare payments ([64]).

Another example of degressive support is the French support scheme MaPrimeRénov Parcours accompagné ([65]), which has already been mentioned above. This scheme helps owner-occupiers to finance energy renovation works, including energy audits. The scheme offers different funding categories based on income ceilings and allows homeowners to combine incentives and local grants, enabling low-income homeowners to receive support of up to 90% of the total project cost. To benefit from the grant, homeowners must visit the government’s website, create an account, follow the application steps, and provide necessary documents (latest income tax return, valid email address, etc.).

In addition to those ‘in-built’ parameters, Member States are invited to contact vulnerable households, who may not be aware of the financial support at hand or may not feel entitled to ask for it.

4.2.2. *Addressing the risk of ‘renoviction’ and the owner-tenant dilemma*

According to Article 17(17), ‘Member States shall address the eviction of vulnerable households caused by disproportionate rent increases following energy renovation of their residential building or building unit’. It is for Member States to lay down the criteria specifying the level at which the rent increase would be ‘disproportionate’ for vulnerable households.

As non-exhaustive indications, the rent increase could be disproportionate compared to:

— the costs incurred by the building owner and compared to the estimated payback on those costs based on the higher rent, or

— the improved energy performance.

([62]) https://stad.gent/nl/wonen-bouwen/betaalbaar-wonen/gent-knapt-op.
([63]) https://www.berlin.de/sen/soziales/service/berliner-sozialrecht/kategorie/ausfuehrungsvorschriften/av_wohnen_anlage1-571941.php#:~:text=Klimabonus,-Zur%20Umsetzung%20des&text=Durch%20den%20Klimabonus%20soll%20den,Euro%20und%2022%2C00%20Euro.
([64]) https://www.citizensinformation.ie/en/housing/housing-grants-and-schemes/grants-for-home-renovations-and-improvements/warmer-homes-scheme/#:~:text=The%20Sustainable%20Energy%20Authority%20of,as%20the%20Warmer%20Homes%20Scheme.
([65]) https://france-renov.gouv.fr/aides/maprimerenov-renovation-ampleur.

Article 17(17) goes on to say that Member States should take those steps 'without prejudice to their national economic and social policies and to their systems of property law'. What this means is that a Member State can decide to assess whether there are measures that would not require fundamental changes to its property laws, but that would still protect tenants. As an example, in a Member State where rents are not currently capped or rent increases not regulated, a Member State may decide either to introduce rent regulations, or direct support to tenants or both.

At the same time, financial instruments should be put in place to financially benefit both tenants and owners (Article 17(19)). Building renovation is beneficial for vulnerable households because: (i) it improves the indoor environmental quality of their dwelling; and (ii) it can lower their energy bills. However, as mentioned in Section 2.1. of this guidance, the split incentives ('split' because the owner/landlord pays for the upgrade, but the tenant receives the benefit of a warmer house that is cheaper to heat) can deter the building owner from undertaking the works.

The following considerations can serve as guidance to address this split-incentive barrier, including in MEPS schemes.

Options for reconciling the split between incentivising owners to renovate and safeguarding tenants from high rent increases would usually involve tenancy regulations and payments to owners or tenants.

Tenancy and rental regulations are a key policy instrument for protecting tenants from the risk of disproportionate or excessive rent increases and evictions resulting from the expenses incurred by building owners for renovations. Overall, regulations must encourage dialogue between landlords and tenants about rent increases, inconveniences, etc. Rent increases should be proportionate to the cost of renovations, meaning also that: (i) rent increases should not discourage deep renovations; (ii) there should be sufficient safeguards for tenants to mitigate rent increases and 'renoviction' in the form of appropriate welfare measures; and (iii) there should be legal recourse for potentially disproportionate increases.

In addition, and depending on the national or regional tenancy regulations, if the building owner can increase the rent substantially following the energy renovation, then some percentage of the subsidy they received for the energy renovation should be clawed back.

Existing practice: owner-tenant dialogue and capped rent increases

In Denmark, as per the Tenancy Act and the Housing Regulation Act ([66]), rent increases must be mutually agreed upon and based on the documented cost of the energy improvement work. This increase should provide a reasonable return on the expenses incurred, covering depreciation, maintenance, administration, and insurance costs. For works resulting in energy savings, landlords can raise the rent based on the total reasonable expenses, but not exceeding the savings achieved for tenants. Landlords may be required to offer temporary accommodation to tenants who have the right to return to the same flat after the renovation.

According to the German Civil Code (Section 559), the share of implementation costs of energy renovations allowed to be passed on via rents is capped at 8% per year and may not exceed EUR 3 per m^2 per month in the six years following the implementation, subject to other conditions ([67]). Additionally, in Germany, the environmental-protection ordinance (Milieuschutzgesetz) was introduced to prevent as much as possible: (i) the composition of an area's population from being completely changed as a result of expected renovation measures; and (ii) less assertive population groups (i.e. lower income groups or groups with lower levels of education) from being pushed out of an area that has recently undergone energy renovation. Several actions by building owners are subject to approval by local government and if these actions change the overall character of a dwelling (e.g. merging of apartments) they are usually not approved. Rent caps are possible by mutual agreement ([68]).

([66]) https://dklegalpractice.ca/EN/landlord-tenant/tenant-focused-concerns/renovictions.
([67]) https://www.gesetze-im-internet.de/englisch_bgb/englisch_bgb.html#p2550.
([68]) https://www.berliner-mieterverein.de/recht/infoblaetter/info-68-milieuschutzgebiete-was-mieter-wissen-sollten.htm.

In France, rent increases must follow the rules of the rent reference index. In areas of high rental demand, the adjustment of the annual rent cannot exceed 15% ([69]) of the actual cost of renovation carried out since the last renewal of the lease (including non-energy-related improvement works), including taxes ([70]).

In the Netherlands, the energy performance of a rental property affects its maximum rent through a point system (*woningwaarderingsstel* ([71])). Better energy efficiency, determined by energy labels and indices, adds more points, thereby increasing potential rent. From 2021, the energy performance of a rental property influences its rent points based on its energy label ([72]). The points system varies for independent and shared living spaces, with better energy labels leading to higher points, thus allowing higher rents. Energy renovations that improve performance can thus lead to higher rents, but tenants must be informed of these changes.

In Sweden, tenants have multiple avenues for protection and recourse, including rent reductions, temporary relocations, and legal mediation through organisations, such as the Tenants' Union (Hyresgästföreningen) and the Rent Tribunal (Hyresnämnden), which mediates disputes between tenants and landlords about renovations.

In addition to regulation, the rent increases for vulnerable tenants can be alleviated through direct financial support payments, an example of which is given in the box below.

Existing practice: payment to cover the rent increase

In Germany, the Wohngeld scheme ([73]) is available to low-income households and provides financial support to cover housing costs. The support rates are determined in part by energy and carbon costs, but since the latest revision in 2022 they also include a component to account for higher rents in energy renovated buildings).

Many programmes exist to alleviate the cost of energy for ordinary citizens. Member States could use similar measures to compensate for rent increases after renovation.

A robust approach to reducing the split-incentive problem is by combining different financing instruments that support both owners and tenants while also limiting negative impacts for both sides. For example, making a direct link between investment costs for energy renovations and the combined total of permitted rent increases for all tenants in a building is an important underlying element. This also makes it possible to factor in any public grants that reduce the cost of the private investments made by the owner and deduct these from the project investment costs.

Incentives for building owners to carry out energy renovation should remain in place, while not penalising vulnerable households. Combining the capping of rent *increases* (not the capping of the rent) and support payments to tenants can provide an effective balance between incentives and safeguards. Table 1 below describes attention points for policy development depending on whether either of the two instruments or both are already in place.

([69]) https://www.service-public.fr/particuliers/vosdroits/F34407?lang=fr.
([70]) https://www.service-public.fr/particuliers/vosdroits/F13723.
([71]) https://www.volkshuisvestingnederland.nl/onderwerpen/wet-betaalbare-huur#:~:text=De%20Wet%20betaalbare%20huur%20is,de%20kwaliteit%20van%20de%20woning.
([72]) https://www.rijksoverheid.nl/onderwerpen/huurwoning-zoeken/vraag-en-antwoord/welke-invloed-heeft-het-energielabel-op-de-huurpunten-van-mijn-woning.
([73]) https://www.bmwsb.bund.de/SharedDocs/topthemen/Webs/BMWSB/DE/wohngeld-plus/wohngeld-plus-artikel.html.

Table 1

Policy options to address split incentives depending on the existing safeguards in place for vulnerable tenants

		Tenant protection through capped rent *increase* in place	
		Yes	No
Direct support to tenants for rent payments in place	**Yes**	Additional support payments could be introduced to cover the remaining difference, if any, between (measured) monetised energy cost savings for the tenant and the rent increase resulting from the renovation.	The sole reliance on support payments for vulnerable tenants in the context of increasing renovations of residential buildings, particularly worst-performing ones, may require the Member State to substantially increase these support payments in response to energy renovations. This factor has to be considered in the planning of necessary financing volumes for rent support in order to safeguard vulnerable tenants. Alternatively or in complement, a cap on rent increases may be introduced.
	No	Without additional support to vulnerable households, the role of caps on rent increases is critical. However, such caps may limit the incentives for building owners if these caps do not allow the building owner to recover enough of their incurred costs. Specific support instruments targeted at owners of rented buildings for the works they undertake could be set up to complement the cap. Alternatively or in complement, tenant support payments may be envisaged (see cell above).	Without either of the two instruments, tenants may be left exposed to large increases in rent. The introduction of an aligned policy framework should be considered. Such a framework could combine regulation for rent increases and tenant support payments to cover cost differences.

5. ONE-STOP SHOPS (ARTICLE 18 AND ARTICLE 19 (3))

5.1. Introduction: scope, legal context and policy context

Article 18(1) of the EPBD recast requires the Commission to provide guidelines on setting up one-stop shops (OSS) to improve the energy performance of buildings. These guidelines respond to this requirement and aim to support Member States in ensuring that technical assistance facilities (including one-stop shops) are available across their territory in compliance with Article 18 of the EPBD recast. They also clarify other aspects relevant to one-stop shops such as inviting building owners to a one-stop shop pursuant to Article 19(13) of the EPBD recast.

The present guidelines are to be read together with the following two documents.

— The first document is Commission Recommendation [74] (EU) 2024/2481 setting out guidelines on Articles 21, 22 and 24 of the EED recast 'Information and awareness raising'.

— The second document is the upcoming joint guidelines responding to the requirement of Article 22(6) of the EED recast and Article 18(1) of the EPBD recast.

[74] Commission Recommendation (EU) 2024/2481 of 13 September 2024 setting out guidelines for the interpretation of Articles 21, 22 and 24 of Directive (EU) 2023/1791 of the European Parliament and of the Council as regards the consumer related provisions. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202402481.

5.2. Relevant definitions and concepts

The concept of 'one-stop shop' (OSS) is not legally defined in the EED and EPBD recast. Nevertheless, Articles 18(2) and 18(3) of the recast EPBD detail the services that technical assistance, including inclusive one-stop shops to be set up by Member States pursuant to Article 18(1), must offer. These services include: (i) providing streamlined technical and financial information; (ii) providing independent advice; (iii) providing holistic support with a particular focus on households affected by energy poverty and worst-performing buildings; and (iv) providing support covering the different stages of the retrofit project.

In addition, Commission Recommendation (EU) 2024/2481 setting out guidelines on Articles 21, 22 and 24 of the EED recast (Section 3.2.2. of the Annex) indicates that one-stop shop refers 'to a virtual or physical place where stakeholders are supported in all questions as well as implementation stages of renovation project[s] related to energy efficiency, ranging from advice on the topic to all information and services they need to implement an ambitious global energy efficiency/renovation project'. One-stop shops typically provide technical, administrative and financial advice and assistance on energy efficiency, in particular for building renovations.

Section 5.3 below provides examples of one-stop shop services.

The concept of the one-stop shop expresses the idea of a simplification of the practical renovation journey for building owners, particularly by reducing and simplifying contacts to be made and procedures to be undertaken. The objectives pursued when setting up one-stop shops vary and may include all or some of the objectives set out in the following five bullet points.

— The first possible objective is to disseminate information and practical advice on building renovations, with a major effort to ensure both: (i) the consistency of the messages and information provided by all the actors involved in renovations; and (ii) the credibility of the entity (or entities) disseminating these messages and this information. The objective is to make simple, practical and clearly understandable the actions to be taken to improve and renovate the buildings.

— The second possible objective is to rationalise access to financial support (e.g. by setting up a single funding portal) by streamlining objectives and eligibility conditions, and optimising management costs.

— The third possible objective is to clarify liabilities and secure trust, a necessary condition for more ambitious refurbishments. Clarifying liabilities and securing trust also helps to structure new markets which, while they could eventually be supplied by the private sector, are not spontaneously structured by private initiatives, or at least not at the desired pace.

— The fourth possible objective is to pool skills by bringing together specialist skills and supporting the development of new skills.

— The fifth possible objective is to aggregate small-scale investments and reach critical mass with some of these investments. Achieving this critical mass for investors could then justify the development of dedicated financial solutions, including financial instruments and dedicated partnerships with financial institutions ([75]).

5.3. Availability of one-stop shops across national territories

Financing alone will not be enough to meet the need for renovation. Together with financial support, it is also indispensable to provide the right enabling framework and break down non-financial barriers to renovation. One of the ways this can be done is by setting up accessible and transparent advisory tools and assistance instruments such as one-stop shops that provide integrated energy renovation services.

([75]) Note that this last point is the subject of specific guidance aimed at unlocking private investment, in accordance with Article 30 of the EED recast (see: Commission Recommendation of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency (EED recast), C/2023/8558, ELI: http://data.europa.eu/eli/C/2023/1553/oj.

To be effective, one-stop shops should provide technical assistance and be easily available to all those involved in building renovations, including homeowners, administrators, and providers of financing, and businesses such as SMEs and microenterprises.

This section provides some clarifications on how to effectively implement the obligation to ensure easy and smooth access to one-stop shops for every relevant stakeholder in terms of geographical coverage and format (online vs physical).

5.3.1. *Geographical coverage*

Article 18(1) of the EPBD recast sets out that:

'Member States shall ensure that technical assistance facilities are available across their territory by establishing at least one one-stop shop:

(a) per 80 000 inhabitants;

(b) per region;

(c) in areas where the average age of the building stock is above the national average;

(d) in areas where Member States intend to implement integrated district renovation programmes; or

(e) in a location that can be reached within less than 90 minutes of average travel time, on the basis of the means of transport that is locally available.'

The key requirement in the above provision is that Member States must set up and operate by the EPBD transposition deadline (29 May 2026) one-stop shops in their territory in accordance with one or several of the five criteria of (a) to (e) set out in Article 18(1). Although the minimum requirement is to comply with one of the criteria only, Member States are responsible for ensuring the effective implementation of the obligation to ensure that technical assistance facilities are available across their territory. Therefore, they are encouraged to structure the ecosystem and the distribution of one-stop shops across the territory to tap into the potential of one-stop shops, including by going beyond Article 18(1) when appropriate. The already established networks of local energy agencies with relevant expertise could also be used to set up one-stop shops for energy renovations.

As a preliminary clarification, 'one-stop shops' can have different names in the Member States as long as they comply with the EPBD requirements.

When implementing the provision in Article 18(1), Member States need to ensure that its objective is achieved, namely that technical assistance facilities are available across their territory. To ensure the effective implementation of this requirement, Member States could follow a step-by-step approach combining the above criteria, for example:

— Step 1: Set up at least one one-stop shop offering the services listed in Article 18(2) and 18(3) per region ([76]) (criterion b).

— Step 2: Set up additional one-stop shops in regions where the one-stop shop established as per step 1 cannot be reached within less than 90 minutes of average travel time from every part of these regions (criterion e). This step should ensure effective availability and accessibility across the territory.

— Step 3: In areas/regions with high population density such as metropolitan areas: assess the need to ensure the availability of at least one one-stop shop for every 80 000 inhabitants (criterion a). This step should ensure accessibility of the one-stop shops in a reasonable time for the greatest number of users.

— Step 4 (if relevant): set up additional one-stop shops in areas ([77]) where the government or local municipality intends to implement an integrated district renovation programme (criterion d) or where the average age of the building stock is above the national average (criterion c).

([76]) Referring to NUTS 2 regions as per the EU Common classification of territorial units for statistics.
([77]) Referring to NUTS 3 regions as per the EU Common classification of territorial units for statistics.

The criterion of accessibility in a reasonable time (within 90 minutes of average travel time) indicates that a minimum level of on-site presence with physical offices needs to be ensured, where reasonably possible ([78]). The set up of a 'network of physical one-stop shops at local level where independent experts are available to follow up' was also recommended by the citizens' panel on energy efficiency ([79]).

To comply with criterion (d), Member States will need to ensure that they have comprehensive and up-to-date knowledge of initiatives for integrated district renovation programmes. Integrated district renovation programmes address the renovation of buildings that are spatially related such as housing blocks. By targeting a high number of buildings, they may help to increase the cost-effectiveness of the renovations and offer a variety of solutions at a larger scale. They may also address complementary issues related to urban planning such as: energy supply, mobility, green infrastructure, waste, and water treatment. In addition, they may consider local and regional resources, circularity and sufficiency.

In addition, as per Article 18(1) EPBD recast, 'Member States may designate the one-stop shops established pursuant to Article 22(3), point (a), of Directive (EU) 2023/1791 as one-stop shops for the purposes of this Article'. In other words, Member States may rely on the one-stop shops set up to comply with the EED requirement to transpose the EPBD requirement. It is important to note that Member States that decide to do this must comply with the obligation to ensure availability across the territory as per Article 18(1) EPBD recast and ensure that those one-stop shops offer the services described in Articles 18(2) and 18(3).

5.3.2. *Combining online and physical approaches*

As mentioned in the previous section, the provision on availability across the territory in Article 18(1) has to be understood as ensuring an on-site presence with physical offices.

This is because a fully online approach is insufficient for the type of renovation work that is called for (i.e. integrated renovations contributing to the EU's climate, competitiveness and energy-security objectives). Firstly, this is because citizens have different levels of digital literacy, and even the best online tool will inevitably miss a significant proportion of the population, often the oldest and most vulnerable. But more fundamentally it is because it is less likely that a household would undertake major works in their living space at a significant cost without having multiple in-person interactions with the person(s) specifying the work, i.e. providing detailed instructions or guidance on what needs to be carried out during the project.

In this context, it is relevant to recall what emerged during the citizens' panel on energy efficiency, which the European Commission organised between February and April 2024. The panel consisted of 150 randomly selected citizens from all EU Member States. They adopted 13 final recommendations. Recommendation 1 highlights the importance of the accessibility of one-stop shops across the entire territory of the Member State. In this context, participants highlighted the importance of ensuring that all citizens have access to these establishments (including citizens from smaller towns, rural areas, or remote areas or citizens with reduced mobility). The recommendation from the panel highlights the importance of the local level which is closest to the citizens. The panel recommended that Member States set up 'a network of physical one-stop shops at municipal level (city halls, libraries) where independent experts are available to follow up. The network should not discriminate between rural/urban areas, and social groups. The one-stop-shop should provide advice on legislative, financial, technical aspects, and local service providers. Local actors are called upon to spread awareness of the service' ([80]).

Not all one-stop shops in the relevant territory need to provide all the services described in Article 18(2) and Article 18(3) of the EPBD recast, but all those services have to be provided according to the criterion or criteria chosen by the Member State. The services may also be provided in a complementary way by various one-stop shops and/or other technical assistance facilities.

Member States are invited to refer to the guidelines on Article 22(6) of the EED recast, which provide inspiring cases, examples and models of different types of one-stop shop.

([78]) Referring to the accessibility challenges inherent to outermost regions, recognised under Article 349 of the Treaty of the Functioning of the European Union (TFEU).
([79]) https://citizens.ec.europa.eu/european-citizens-panels/energy-efficiency-panel_en.
([80]) European Citizens' Panel on Energy Efficiency, 2024, Final recommendations.

Furthermore, in order to ensure the greatest outreach at a moderate cost, Member States could also set up additional online one-stop shops. Online one-stop shops can be helpful in raising the awareness of building owners as to how they consume energy, the importance of controlling their energy consumption, and the means of controlling their energy consumption. The impact of the advice provided can be increased if it is well combined with information on available financial support. Online tools can be used to identify and pre-select owners who could benefit the most from such targeted services. For a moderate cost, online approaches are likely to reach a large audience, and may not only trigger immediate actions but also inspire more people to engage in renovation.

Finally, recommendation 1 from the citizens' panel on energy efficiency also highlighted the importance of the accessibility of information provided to consumers to empower households and organisations to become more energy efficient. The panel recommended the creation of 'an online portal with a self-audit function to help consumers assess their needs regarding transport, home improvements, and low-costs tips. It would provide them with a solutions package, including next steps and contact information' ([81]). This recommendation confirms the importance of an online tool serving as a first step in the process. Nevertheless, it is essential to complement an online offer with a physical presence, at least in dedicated regional/local offices, but also on the site of the property to be renovated as is already the case in many regions and municipalities.

5.4. **Invitation to a one-stop shop**

Setting up a network of one-stop shops is necessary but not sufficient to ensure they are used and that they contribute to the renovation efforts needed to improve the energy performance of buildings. Therefore, this section examines the factors and means that can encourage people to contact one-stop shops – either off their own initiative or due to mandatory requirements.

While information and marketing may be enough to trigger the simplest renovation actions, they are not sufficient to trigger deep energy renovations, which are more complex and expensive and which are typically undertaken at specific moments in time.

For example, it is particularly important to approach households when they are in the process of buying their home, as they may be inclined to carry out significant renovation works before moving in. Households may also be encouraged to carry out work when their family expands or, conversely, when children leave home. Using energy more efficiently and reducing energy bills is not necessarily a central trigger in any of these situations, but these can be complementary goals in a process initiated by other concerns. A typical example of an energy 'trigger' is when a boiler or another piece of energy equipment is faulty or breaks down. However, if a boiler breaks down, the household is more likely to be focused on the urgency of fixing the boiler, and less likely to be considering a comprehensive energy renovation.

Another triggering event can be an obligation to renovate stemming from the implementation of MEPS as laid down for non-residential buildings in Articles 9(1) and possibly 9(2) of the recast EPBD, depending on a Member State's measures. When identifying building owners that need to comply with any national MEPS, the relevant authorities may ensure that they are invited to a one-stop shop to receive renovation advice.

Finally, pursuant to Article 19(13) of the recast EPBD, owners of buildings with an EPC below level C must be invited to a one-stop shop to receive renovation advice on whichever of the following two dates is earlier:

— immediately after the energy performance certificate of the building expires; or

— five years after the issuance of the energy performance certificate.

To ensure this provision is effectively implemented, Member States and relevant authorities are invited to plan well in advance: (i) the additional demand for technical assistance services that this provision will create for one-stop shops; and (ii) the related budget.

([81]) European Citizens' Panel on Energy Efficiency, 2024, Final recommendations.

They could do so by:

(1) estimating and identifying the number of buildings that fall under this category and/or are concerned by MEPS using the national EPC database or other relevant source (e.g. landlord registry, application form of financing scheme);

(2) planning accordingly the one-stop shop resources to cope with the invitations, in part to ensure that this provision leads to meaningful results (e.g. that a minimum percentage of invited owners end up embarking on the energy renovation and related renovations works) and no frustration from the building owner if faced with too much delay for meeting with an expert.

In addition, Member States should:

(1) determine the best ways to identify the concerned owners, such as through registries of landlords, local homeowner associations, business registers and others;

(2) ensure that all concerned owners receive the invitation, for which Member States can rely on a combination of letters, emails, phone calls and informative workshops.

Appendix I

Other relevant Commission documents for transposing Article 17 of Directive EU/2024/1275

		Guidance and existing practices provided in other EU Commission documents					
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') (1)	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) (2)	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) (3)	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) (4)	Other documents and reports
1	Appropriate financing, support measures and other instruments to address market barriers						Description of barriers to energy renovations in Section 2.2 or the impact assessment accompanying the proposal for the EPBD recast (SWD)(2021 453 final) Link: https://op.europa.eu/en/publication-detail/-/publication/daf643a4-5da2-11ec-9c6c-01aa75ed71a1/language-en
1	Deliver the necessary investments identified in their national building renovation plan to transform their building stock into zero-emission buildings by 2050						See template for the national building renovation plans for the necessary investments.

		Guidance and existing practices provided in other EU Commission documents					
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') ([1])	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) ([2])	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) ([3])	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) ([4])	Other documents and reports
2	Member States shall ensure that applications and procedures for public financing are simple and streamlined in order to facilitate access to financing, especially for households		Importance of trust, engagement and communication for households at risk of energy poverty described in Chapter VIII (SWD)		Examples on support and use of intermediaries for access to financing instruments from vulnerable households (Section 3.5.4)		Guidance on Article 24 EED, and guidelines on setting up one-stop shops as per Article 22(6) of the EED and Article 18(1) of Directive EU/2024/1275 (to be published)
3	Address barriers related to upfront costs of renovations					Mentions barriers (financial and non-financial) together with drivers for renovations in Section 2.4. Instruments described in Section 2.3	
4	Consider whether to use revenue-based parameters						

Guidance and existing practices provided in other EU Commission documents							
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') ([1])	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) ([2])	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) ([3])	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) ([4])	Other documents and reports
4	Member States may use the national energy efficiency funds, where such funds are set up pursuant to Article 30 of Directive (EU) 2023/1791, to finance dedicated schemes and programmes for energy performance renovations	Covered in detail in Section 3					
5	Member States shall take appropriate regulatory measures to remove non-economic barriers to building renovation.					Lists barriers (financial and non-financial) together with drivers for renovations in Section 2.4	Summary of the full range of barriers in Section 2.2 or the impact assessment accompanying the proposal for the EPBD recast (SWD(2021 453 final) Link: https://op.europa.eu/en/publication-detail/-/publication/daf643a4-5da2-11ec-9c6c-01aa75ed71a1/language-en

Guidance and existing practices provided in other EU Commission documents							
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') (1)	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) (2)	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) (3)	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) (4)	Other documents and reports
							More detailed description of non-economic barriers mainly, such as hassle factor, perceived risks, etc. in European Environment Agency (EEA) report 'Accelerating the energy efficiency renovation of residential buildings'. Link: https://www.eea.europa.eu/publications/accelerating-the-energy-efficiency
5	With regard to buildings with more than one building unit, such measures may include removing unanimity requirements in co-ownership structures, or allowing co-ownership structures to be direct recipients of financial support		Split incentives discussed in Chapter VII Part 2.c.i. (SWD)			Some relevant instruments and lessons learnt mentioned in Section 2.3.3 (page 67)	European Commission Joint Research Centre (2017): Overcoming the split-incentive barrier in the building sector. Unlocking the energy efficiency potential in the rental & multifamily sectors, Link: https://op.europa.eu/en/publication-detail/-/publication/ae5716d7-fb39-11e7-b8f5-01aa75ed71a1/language-en

		Guidance and existing practices provided in other EU Commission documents						
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') (1)	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) (2)	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) (3)	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) (4)	Other documents and reports
6	Make best cost-effective use of national financing and financing available established at Union level and of other public funding sources		EU financing options to combat energy poverty are described with several examples in Chapter X (SWD)		Recommendations on cost-effective support for energy renovations and protection of vulnerable households in Section 3.1.5, examples in Section 3.1.1-3.1.4		For EU-level financing, specific reports on the Cohesion Fund, the European Regional Development Fund (ERDF), InvestEU, etc. e.g: link: https://managenergy.ec.europa.eu/publications/2021-2027-cohesion-policy-support-energy-efficiency-and-building-renovation_en.
6	Those funding sources shall be deployed consistently with a path to achieving a zero-emission building stock by 2050						See template for the national building renovation plans for the necessary investments.

		Guidance and existing practices provided in other EU Commission documents					
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') ([1])	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) ([2])	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) ([3])	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) ([4])	Other documents and reports
7	Member States shall promote the effective development and use of enabling funding and financial tools, such as energy efficiency loans and mortgages for building renovation, energy performance contracting, pay-as-you-save financial schemes, fiscal incentives, for example reduced tax rates on renovation works and materials, on-tax schemes, on-bill schemes, guarantee funds, funds targeting deep renovations, funds targeting renovations with a significant minimum threshold of targeted energy savings and mortgage portfolio standards.	Guidance for potential measures to promote enabling financing tools in Section 2.2.2; descriptions of on-bill financing and on-tax schemes covered in Section 2.3	Relevance of energy performance contracting for vulnerable housing outlined in Chapter VII Part 2.c.ii. (SWD) Examples of different financing and policy instruments, including innovative ones are collected in Chapter X (SWD)	In the scope of the guidance		Summary of financing instruments in Section 2.3.1 with additional examples in Annex D. Specified recommendations for commercial buildings (Section 2.3.2) and residential ones (Section 2.3.3).	European Commission Joint Research Center (JRC) report (2019): 'Accelerating energy renovation investments in buildings'. It covers a range of finance schemes Link: https://publications.jrc.ec.europa.eu/repository/handle/JRC117816. More information and analysis on Energy Performance Contracting and its implementation on building renovation can be found in this report: Moles-Grueso, S., Bertoldi, P. and Boza-Kiss, B., Energy Performance Contracting in the EU – 2020-2021 Link: https://publications.jrc.ec.europa.eu/repository/handle/JRC133984

Paragraph of Article 17	Specific provision	Guidance and existing practices provided in other EU Commission documents					
		Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') (1)	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) (2)	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) (3)	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) (4)	Other documents and reports
7	They shall guide investments into an energy-efficient public building stock, in line with Eurostat guidance on the recording of energy performance contracts in government accounts.						Section 4.3.2. of the annex to the Commission guidance on Article 29 EED provides clarifications on how the rules of the European System of National and Regional Accounts should apply to energy performance contracts Link: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=OJ:L_202402476
7	Member States may also promote and simplify the use of public-private partnerships	Mentioned in Section 2.4.1				European Energy Efficiency Fund is mentioned as a public-private partnership for public buildings (Section 2.3.4)	

		Guidance and existing practices provided in other EU Commission documents					
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') [1]	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) [2]	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) [3]	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) [4]	Other documents and reports
8	Member States shall ensure that information about available funding and financial tools is made available to the public in an easily accessible and transparent manner, including by digital means	Described in relation to general energy efficiency finance in Sections 2.2.1 and 2.2.2	Importance of trust, engagement and communication for households at risk of energy poverty described in Chapter VIII (SWD)		Covered with some example of good practice in Section 3.4 and Section 4.1		
9	The enabling funding and financial tools may include renovation loans or guarantee funds for energy performance renovations	Loan guarantees described in Section 2.5.2				Part of the list of financing instruments in Section 2.3.1 and Annex D	
9	including in combination with relevant Union programmes, where applicable	Use of InvestEU and cohesion policy framework described in Section 2.5.2					

Guidance and existing practices provided in other EU Commission documents							
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') [1]	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) [2]	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) [3]	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) [4]	Other documents and reports
10	By 29 May 2025, the Commission shall adopt a delegated act in accordance with Article 32 supplementing this Directive by establishing a comprehensive portfolio framework for voluntary use by financial institutions that supports lenders in targeting and increasing lending volumes provided in accordance with the Union's decarbonisation ambition and relevant energy targets, in order to effectively encourage financial institutions to increase lending volumes provided for energy performance renovations. The						

Guidance and existing practices provided in other EU Commission documents							
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') ([1])	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) ([2])	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) ([3])	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) ([4])	Other documents and reports
	actions set out in the comprehensive portfolio framework shall cover increasing lending volumes for energy renovations and shall include suggested safeguards to protect vulnerable households through blended funding solutions. The framework shall describe best practices to encourage lenders to identify and act upon the worst-performing buildings within their portfolios.						
11	Member States shall facilitate the aggregation of projects to enable investor access as well as packaged solutions for potential clients	Covered in Sections 2.4.1 and 2.4.2		In the scope of the guidance		Part of the instruments described in Sections 2.3.1 and 2.5	

		Guidance and existing practices provided in other EU Commission documents					
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') ([1])	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) ([2])	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) ([3])	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) ([4])	Other documents and reports
11	Member States shall adopt measures that promote energy efficiency lending products for building renovations, such as green mortgages and green loans, secured and unsecured, and ensure that they are offered widely and in a non-discriminatory manner by financial institutions and, are visible and accessible to consumers	Almost identical wording in Section 2.2, particularly information on the scope of innovative enabling financing tools and non-discrimination in Section 2.2.2				Part of the list of financing instruments in Section 2.3.1 and Annex D	
11	Member States shall ensure that banks and other financial institutions and investors receive information on opportunities to participate in the financing of the improvement of the energy performance of buildings	Covered in Section 2.4.2		In the scope of the guidance			

		Guidance and existing practices provided in other EU Commission documents					
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') ([1])	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) ([2])	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) ([3])	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) ([4])	Other documents and reports
12	Member States shall put in place measures and financing to promote education and training with a view to ensuring that there is a sufficient workforce with the appropriate level of skills corresponding to the needs in the building sector, especially targeting SMEs, including microenterprises, as appropriate.		Examples for the promotion of green skills in construction and building sectors are described in Chapter IX (SWD)				
12	One-stop shops established pursuant to Article 18 may facilitate access to such measures and financing	One-stop-shops covered in Section 2.1.2, but not specific to training				Mentioned as an important driver of investment and renovation in Section 2.3.3	Guidance on Article 24 EED, and guidelines on setting up one-stop shops as per Article 22(6) of the EED, and Article 18(1) of Directive EU/2024/1275 (to be published)

		Guidance and existing practices provided in other EU Commission documents					
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') (1)	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) (2)	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) (3)	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) (4)	Other documents and reports
13	The Commission shall, where appropriate and upon request, assist Member States in setting up national or regional financial support programmes with the aim of increasing the energy performance of buildings, especially of existing buildings, including by supporting the exchange of best practice between the responsible national or regional authorities or bodies.						
13	Member States shall ensure that such programmes are developed in a way that they are accessible to organisations with lower administrative, financial, and organisational capacities.						

		Guidance and existing practices provided in other EU Commission documents					
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') ([1])	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) ([2])	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) ([3])	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) ([4])	Other documents and reports
14	With due regard to vulnerable households, Member States shall link their financial measures for energy performance improvements and reduced greenhouse gas emissions in the renovation of buildings to the targeted or achieved energy savings and improvements, as determined by one or more of the following criteria: (a) the energy performance of the equipment or material used for the renovation and the related greenhouse gas emission reduction; in which case, the equipment or material used for the renovation is to be installed by an installer with the						

		Guidance and existing practices provided in other EU Commission documents						
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') ([1])	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) ([2])	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) ([3])	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) ([4])	Other documents and reports
	relevant level of certification or qualification and shall comply with at least minimum energy performance requirements for building elements or higher reference values for an improved energy performance of buildings; (b) standard values for the calculation of energy savings and greenhouse gas emission reduction in buildings; (c) the improvement achieved due to such renovation by comparing energy performance certificates issued before and after renovation; (d) the results of an energy audit; (e) the results of another relevant, transparent and						

Paragraph of Article 17	Specific provision	Guidance and existing practices provided in other EU Commission documents					
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	proportionate method that shows the improvement in energy performance, for example by comparing the energy consumption before and after renovation with metering systems, provided it complies with the requirements set out in Annex I.						
16	Member States shall incentivise deep renovation and staged deep renovation with higher financial, fiscal, administrative and technical support.						
16	Where it is not technically or economically feasible to transform a building into a zero-emission building, a renovation						

		Guidance and existing practices provided in other EU Commission documents					
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	resulting in at least a 60% reduction of primary energy use shall be considered to be a deep renovation for the purposes of this paragraph.						
16	Member States shall incentivise sizeable programmes that address a high number of buildings, in particular the worst-performing buildings, such as through integrated district renovation programmes, and that result in an overall reduction of at least 30% of primary energy use, with higher financial, fiscal, administrative and technical support, according to the level of performance achieved.						

Guidance and existing practices provided in other EU Commission documents								
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') [1]	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) [2]	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) [3]	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) [4]	Other documents and reports
17	Without prejudice to their national economic and social policies and to their systems of property law, Member States shall address the eviction of vulnerable households caused by disproportionate rent increases following energy renovation of their residential building or building unit		Definition of energy poverty in Chapter IV, with indicators, data sources and further explanations (SWD) General elements for tackling energy poverty, including social tariffs and rebates described in Chapter VI (SWD) Examples of practices to avoid renovictions in Chapter VII Part 2.c.ii. (SWD) Further examples of financing and policy instruments in Chapter X (SWD)		Eviction not described in dedicated section, but several practice examples include measures relevant for this provision (e.g. Sections 3.2.3, 3.3.5)		
18	Financial incentives shall target, as a priority, vulnerable households, people affected by energy poverty and people living in social housing, in accordance with Article 24 of Directive (EU) 2023/1791		Good practices in Chapter VII Part 2.c (SWD) Further examples of financing and policy instruments in Chapter X (SWD)		Recommendations and best practices collected across the document (e.g. Sections 2.1, 3.1.5, 3.4.2, 3.4.3, 3.5.4)		

		Guidance and existing practices provided in other EU Commission documents					
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') [1]	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) [2]	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) [3]	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) [4]	Other documents and reports
19	When providing financial incentives to owners of buildings or building units for the renovation of rented buildings or building units, Member States shall aim at financial incentives benefiting both the owners and the tenants		Description of options to reduce split-incentive challenges in Chapter VII Part 2.c.i., including examples of on-bill financing and energy performance contracting (SWD) Further examples of financing and policy instruments in Chapter X (SWD)				Section 5.5 of the guidance on Article 22 of Directive EU/2023/1791 provides options on how to remove such barriers related to split incentives European Commission Joint Research Centre (2017): Overcoming the split-incentive barrier in the building sector. Unlocking the energy efficiency potential in the rental & multifamily sectors, Link: https://op.europa.eu/en/publication-detail/-/publication/ae5716d7-fb39-11e7-b8f5-01aa75ed71a1/language-en

		Guidance and existing practices provided in other EU Commission documents					
Paragraph of Article 17	Specific provision	Annex of Commission Recommendation C/2023/1553 of 12 December 2023 on transposing Article 30 on national energy efficiency funds, financing and technical support of the Directive (EU) 2023/1791 on energy efficiency ('EED recast') ([1])	Commission Recommendation 2023/2407 of 20 October 2023 on energy poverty (including SWD(2023) 647 final) ([2])	Unlocking private investment in energy efficiency – guidance to Member States and market actors, as per Article 30(10) EED [*upcoming*]	Support for the implementation of the Social Climate Fund. Note on good practices for cost-effective measures and investments (June 2024) ([3])	Report on the evolution of financing practices for energy efficiency in buildings, SMEs and in industry, Energy Efficiency Financial Institutions Group (EEFIG, 2022) ([4])	Other documents and reports
19	Member States shall introduce effective safeguards, to protect in particular vulnerable households, including by providing rent support or by imposing caps on rent increases, and may incentivise financial schemes that tackle the upfront costs of renovations, such as on-bill schemes, pay-as-you-save schemes or energy performance contracting, as referred to in Article 2, point (33), and Article 29 of Directive (EU) 2023/1791.		Examples of on-bill financing and energy performance contracting described in Chapter VII Part 2.c.i., Examples of regulatory safeguards in tenancy regulations mentioned in Chapter VII Part 2.c.ii. (SWD) Details and examples on affordability for energy poverty households in Chapter VI (SWD) Further examples of financing and policy instruments in Chapter X (SWD)				

([1]) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:C_202301553.
([2]) Recommendation: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202302407; Staff Working Document: https://energy.ec.europa.eu/document/download/a17c2aa6-02ca-49b3-8df6-b106ca9f37ed_en?filename=SWD_2023_647_F1_OTHER_STAFF_WORKING_PAPER_EN_V5_P1_3016190.PDF.
([3]) https://op.europa.eu/en/publication-detail/-/publication/af68b4c7-3508-11ef-b441-01aa75ed71a1/language-en.
([4]) https://op.europa.eu/en/publication-detail/-/publication /a3032517-c761-11ec-b6f4-01aa75ed71a1/language-en.

ANNEX 3

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Energy performance certificates (Articles 19-21, Annex V) and independent control systems (Annex VI)

TABLE OF CONTENTS

1. INTRODUCTION

This guidance document provides clarifications and practical recommendations on how to implement and make operational most of the requirements regarding energy performance certificates (EPCs) which have been substantially updated or added in the recast Energy Performance of Buildings Directive (EPBD), Articles 19-21 and Annexes V and VI.

2. ENERGY PERFORMANCE CERTIFICATE CLASSES

2.1. Setting energy performance classes, timeline and visual identity

Article 19 of the recast EPBD, with Annex V, sets the framework for classifying buildings. At opposite ends of the scale, class A is for zero-emission buildings, and class G corresponds to the very worst-performing buildings in the national building stock at the time when the scale was introduced. Member States that on 29 May 2026 already designate zero-emission buildings as A0 may continue to use that designation instead of class A. For the remaining classes from B to F, or A to F for Member States using A0, Member States have to ensure an appropriate distribution of energy performance thresholds among the energy performance classes.

The introduction of classes A to G, with definitions for classes ‘A’ and ‘G’, is a step towards a clearer and simpler way to classify buildings in each country and across the EU. It is also crucial for removing barriers in the EU-wide housing market and it will facilitate the work of cross-border players such as banks, insurance companies, financial operators, construction companies and real-estate companies. However, a direct comparison of buildings across countries based only on their classes could be misleading and imprecise given the possible differences between national methodologies for calculating energy performance.

The energy performance of the building must be expressed in the EPC as a number indicating primary energy use in kWh/(m^2.y), while the energy performance class must expressed as a letter from a closed scale from A to G. The energy performance of the building must be determined in accordance with Annex I, to be consistent with the use of energy performance as the key metric and indicator in other provisions in the EPBD. The reference to closed scales means that each class should be defined by an upper and lower value and be clearly distinguished from the adjacent classes.

Of particular relevance in this context is the provision in Annex I (point 1, fourth subparagraph) which clarifies that the energy performance of a building must be expressed by a numeric indicator of primary energy use per unit of reference floor area per year, in kWh/(m^2.y) for the purposes of both energy performance certification and compliance with minimum energy performance requirements.

The national classification scheme should therefore establish that the attribution of classes must be based on energy performance, which should be calculated in accordance with Annex I.

Member States may continue to use a methodology based on reference buildings to classify buildings, provided they comply with the requirements for establishing and attributing classes A-G based on energy performance.

Alongside EPC classes based on energy performance, Member States may add further indicators to the EPC. Member States may for instance consider establishing additional greenhouse gas (GHG) emission classes (optional indicator in Annex V.2b) to show how far the building is from being climate-neutral. However, such a voluntary additional classification can only work as a secondary rating, for instance to raise awareness about specific aspects and issues. It cannot be a substitute for the obligatory classes based on energy performance.

Article 19(1) further indicates some of the mandatory elements to include in the EPCs, which are complemented by the provisions in Annex V regarding mandatory and voluntary elements for EPCs (see Section 7).

Article 19(3) requires Member States to ensure that EPCs have a common visual identity throughout their territory. This is already common practice now and ensures that, even though EPCs are issued by several different operators, they are based on the same calculation and assessing methods and they have a uniform look across the country. Member States have some discretion to adapt the visual identity to address differences across regions and should also take into account regional or linguistic differences within their territories, making the information accessible to the public.

As regards the timeline for transposing and implementing such requirements, as for most other provisions in the EPBD, Member States have until 29 May 2026 (transposition deadline) to make sure that their national classification scheme is in line with the new provisions. If necessary, they must redefine the national energy performance classes for buildings by then, and adapt the methodology used to attribute them. An exception applies to Member States that already rescaled their energy efficiency classes between 1 January 2019 and 28 May 2024. The date of rescaling is taken as the date of official publication of the legal act or equivalent document that defines the energy classes. These Member States may postpone the introduction of the new classification scheme required by Article 19(2) until 31 December 2029 at the latest. This exception ensures that national classification systems are not changed too often, to have stability in the classification system for operators in the market and building owners. For Member States where EPCs are defined and managed at regional level, it is understood that the obligation applies at regional level.

While not specifically mentioned in Article 19, Member States may attribute different energy performance levels and classes to different building categories and types of both residential and non-residential buildings. This is a common and good practice already now, and it is justified by the differences in energy use patterns and building types. Member States may also differentiate energy performance levels based on climatic zones in the country. The differentiation of classes between building categories will also have the advantage of facilitating monitoring and compliance with specific provisions on individual buildings, such as minimum energy performance standards based on Article 9.

This approach is also consistent to the energy demand level which constitutes one of the criteria for zero-emission buildings (class A). Under Article 11(2), a maximum threshold must be set for the energy demand of a zero-emission building. Under Article 11(6), this energy demand threshold may be set by building type and with reference to climate zones within a country. Maximum thresholds could also be different for new and existing buildings being renovated.

2.2. **Definition of class A**

Under Article 19(2), from 29 May 2026, EPCs must specify the energy performance class of a building based on a closed scale using the letters from A to G.

The article stipulates that the letter A is for 'zero-emission buildings'. A clear equivalence is therefore established in the legal framework between the definition of ZEBs and the attribution of class A. The definition of a ZEB includes criteria that go beyond energy performance. Notably, it requires the absence of on-site carbon emission production from fossil fuels and zero or a very low amount of operational greenhouse gas emissions; energy demand must be below a given threshold and total primary energy use on an annual basis must be covered by a closed list of energy sources. These criteria are set out in Article 2 and are further specified in Article 11 of the EPBD, while the guidance in Annex 7 on zero-emission buildings provides detailed clarifications on these provisions.

This means that even buildings whose energy consumption is within the range set at national level for class A in kWh/(m^2.y) would also need to meet the other ZEB requirements in order to be labelled as class A.

As a consequence, if a building has an energy performance level that meets the threshold set at national level for class A but does not meet the other ZEB requirements, for instance because the building is heated by a gas or oil boiler and hence has on-site carbon emissions, it should be attributed a lower-class B.

In the assessment, therefore, the EPC-certifier must consider the other mandatory criteria for ZEBs, such as the absence of emissions from technologies that use fossil fuels for heating and cooling.

For the purpose of establishing EPC class A, Member States need to use the maximum energy demand threshold for ZEBs in place when the new EPC scale is introduced. The maximum threshold should be used to set the maximum value of energy performance for class A (the minimum being equal to zero). While the maximum threshold must be revised every time the cost-optimal levels are revised (every five years), there is no obligation to update the EPC class A and rescale it every time the cost-optimal levels are revised.

Under Article 19(2), Member States that already designate zero-emission buildings as defined in Article 2 and Article 11 as class 'A0' before 29 May 2026, may continue to use this instead of class 'A'. The remaining classes would then be 'A' – 'G'.

2.3. **Definition of class G**

Under Article 19(2), letter G represents the lowest step of the scale and corresponds to the *very* worst-performing buildings in the national building stock when the scale is introduced. The definition of class G should not set a highest maximum energy use; only the threshold corresponding to the 'border' with class F should be defined. The worst-performing buildings are those with the poorest energy performance and therefore with the highest value for primary and final energy use (kWh/m^2.y) in the national building stock. Member States have to provide a definition of worst-performing buildings in their national building renovation plans.

The stipulation that only the *very* worst-performing buildings should be rated as G class means that Member States should make sure class G is not populated by an overly large share of the building stock. A very large share of the overall building stock categorised as class G might jeopardise proper monitoring of the building stock and would make it difficult to track and document improvements to its energy performance. Moreover, it would make it more difficult to put in place measures specifically targeting the buildings segment(s) with the lowest energy performance. In addition, if too many buildings are categorised as very worst-performing, there will be less differentiation within the other classes.

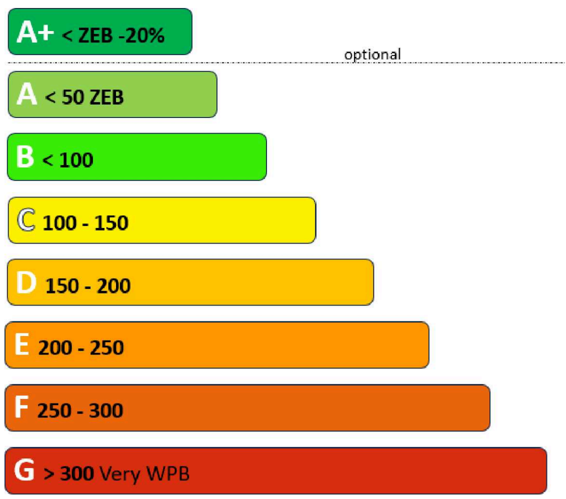
As a benchmark for defining energy performance under class G, Member States are encouraged to consider the threshold used in the EPBD for the purpose of establishing minimum energy performance standards for non-residential buildings established under Article 9. This threshold matches the maximum level of energy performance of the lowest 16 % of the building stock (by number of buildings or floor area). Accordingly, a benchmark inside the range of 14-18 % of the building stock (residential or non-residential) would be considered ideal. Alternatively, Member States could also link class G to both their 2030 and 2033 targets for non-residential buildings. This would result in a class G for residential buildings representing 26 % of the building stock. While this gives a comparatively large G class for a relatively short period of time, it also provides longer term stability for the EPC classification. The total number of buildings in G class should not exceed 26 % to avoid overcrowding class G.

2.4. **Distribution of classes B-F**

While energy performance classes A (plus A0 and A+) and G are defined by specific criteria, under Article 19(2) the remaining classes B to F (or when 'A0' is used, A to F) have to be distributed appropriately. 'Appropriate' in this case is understood as meaning not resulting in artificially small or large classes. This may be achieved by a more or less 'even bandwidth' – a similar-sized range of energy performance indicators for each class – allowing proportionate steps from the upper limit of class G until the energy performance level representing the lower bound of class A.

Figure 1

Example of even bandwidth energy performance classes in primary energy use in kWh/(m^2.y)



This approach has the advantage of simplicity as even ranges between the scales are easy to understand. Each class represents a clear and equal step in the scale. Another advantage is its consistency, as with an even bandwidth the difference between adjacent scales (e.g. B to C or D to E) remains constant.

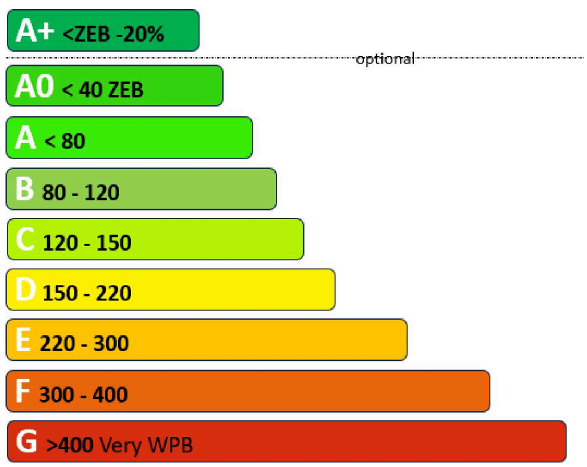
Such a classification system will be able to show the improvement in energy performance over time by changes in the population of the classes in a clear way. However, it will result in different populations of buildings in each class. If some classes are disproportionately populated, the bandwidth may be adapted to avoid empty classes across the scale. At the same time, it is expected that some classes will be emptier than others. For example, class A and B will be less populated than class D or E. Member States therefore have to decide on how an appropriate distribution of scales can be best applied to their national building stock, taking account of the current energy performance.

Figure 2 shows an example using an appropriate bandwidth with not evenly distributed scales. It also shows a case with an A0 class in the scale.

For residential buildings, Member States may consider the potential synergies of distributing the scales in such a way that, together, EPC classes E, F, and G cover the worst-performing 43 % of buildings, a figure significant for the purposes of Article 9(2). This would mean that the lower boundary of the primary energy performance indicator for the letter 'E' would have to be the same as the threshold for the worst-performing buildings. According to Article 9(2), 'Member States shall ensure that at least 55 % of the decrease in the average primary energy use referred to in the third subparagraph is achieved through the renovation of the 43 % worst-performing residential buildings'. This correspondence would make it easier for building owners and authorities to identify the worst-performing buildings for implementation of Article 9(2) on residential buildings.

Figure 2

Example of a varying bandwidth energy performance classes with the optional 'A0' class (primary energy use in kWh/m² per year)



2.5. Class A+

Article 19(2) allows Member States to establish an A+ energy performance class. Class A+ is therefore voluntary and, when introduced, will represent the very top of the scale.

If Member States decide to introduce such a class, it will become an integral part of their EPC system. The A+ energy performance class defined by Member States must meet the following criteria:

(1) the buildings' energy demand should must be at least 20 % lower than the maximum threshold for ZEBs under class A;

(2) in line with Article 11, buildings using any amount of fossil fuels while otherwise complying with the energy demand indicators would not qualify for class A or A+;

(3) buildings must generate more renewable energy on site annually than their total annual primary energy demand;

(4) in addition to energy performance, class A+ is relevant to life cycle global warming potential (GWP) because Article 19 requires Member States to ensure that for existing buildings renovated to A+ class, the life-cycle GWP is estimated and disclosed in the building's energy performance certificate. It should be noted that the Union framework for the methodology for life-cycle GWP calculation, set out by the European Commission in the delegated act to be adopted by 31 December 2025, in accordance with Article 7(3), is designed only for the purpose of life-cycle GWP calculations of new buildings. To estimate the life-cycle GWP in relation to existing buildings undergoing renovation, Member States are free to adapt the methodology with the necessary steps or to use their own calculation methodology, in accordance with the relevant standards.

Criterion 3 is the one that most clearly identifies a building as being 'positive'. It requires the building to generate more renewable energy on site than the total amount of energy that it would demand from the grid. In this calculation, special care must be taken when considering renewables. The following numerical examples clarifies the concept.

Example A: the threshold for primary energy demand is set at 65 kWh/(m^2.y) ([1]).

A building has the following energy needs (before system inefficiencies or primary energy factors (PEFs) are accounted for):

Total energy required by the system (before renewable energy sources (RES) are taken into account)	
Heating	55
Domestic hot water (DHW)	15
Others (e.g. ventilation, lighting)	5
Total	**75**

The building analysed uses a heat pump and has photovoltaic (PV) panels installed. The distribution of energy would be as follows:

Energy required by the system (per carrier)	Energy use (FE)	Energy carrier	PEF	PE
Heating (HP - electricity)	11,0	Electricity	1,5	16,5
Heating (HP - ambient)	44,0	Ambient	0,0	0,0
DHW (HP - electricity)	3,8	Electricity	1,5	5,6
DHW (HP - ambient)	11,3	Ambient	0,0	0,0
Others (e.g. ventilation, lighting)	5,0	Electricity	1,5	7,5
RES (PV - used on site) (*)	15,0 (*)	Electricity (*)	0,0 (*)	0,0 (*)
RES (PV - exported)	5,0	Electricity	- 0,9	- 4,5

(*) PV electricity generated and used on site would displace grid electricity before the PEF=0 is applied (an equivalent approach would be to make PEF=(- 1,5) for PV electricity generated and used on site).

Total energy demand (before PV exported)	7,1
Total energy generated on site	- 4,5
Energy balance	2,6

([1]) This applies to examples A, B, C.

In the scenario above:

— the building would comply with criterion 1 related to the threshold for energy demand (Building ED 7.1 < (65-65*20 %));

— the building would comply with the no-fossil fuel on-site criterion (heat pump installed);

— the building would not comply with the requirement on energy generation (criterion 3) as the energy demand is more than the RES generated on site.

In order to fulfil the A+ criteria the building could increase the amount of PV generated on-site or reduce the energy demand. The following examples B and C both comply with criteria 1-3.

Example B: increasing PV generated on-site.

Energy required by the system (per carrier)	Energy use (FE)	Energy carrier	PEF	Primary energy PE
Heating (Heat pump HP - electricity)	11,0	Electricity	1,5	16,5
Heating (HP - ambient)	44,0	Ambient	0,0	0,0
DHW (HP - electricity)	3,8	Electricity	1,5	5,6
DHW (HP - ambient)	11,3	Ambient	0,0	0,0
Others (e.g. ventilation, lighting)	5,0	Electricity	1,5	7,5
RES (PV - used on-site)*	15,0*	Electricity*	0,0*	0,0*
RES (PV - exported)	10,0	Electricity	- 0,9	9,0

Total energy demand (before PV exported)	7,1
Total energy generated on-site	- 9,0
Energy balance	- 1,9

Example C: reducing energy demand.

Energy required by the system (per carrier)	Energy use (FE)	Energy carrier	PEF	PE
Heating (HP - electricity)	9,0	Electricity	1,5	13,5
Heating (HP - ambient)	36,0	Ambient	0,0	0,0
DHW (HP - electricity)	3,8	Electricity	1,5	5,6
DHW (HP - ambient)	11,3	Ambient	0,0	0,0
Others (e.g. ventilation, lighting)	5,0	Electricity	1,5	7,5
RES (PV - used on-site)*	15,0*	Electricity*	0,0*	0,0*
RES (PV - exported)	5,0	Electricity	- 0,9	- 4,5

Total energy demand (before PV exported)	4,1
Total energy generated on-site	- 4,5
Energy balance	- 0,4

3. PROVISIONS ON QUALITY, RELIABILITY AND AFFORDABILITY OF EPCS

Article 19(4) requires Member States to ensure the quality, reliability and affordability of EPCs.

3.1. Affordability

Measures to ensure that EPCs are affordable for building owners may depend on specific national or local circumstances and therefore Member States are recommended to assess whether in specific circumstances EPC market prices are too high. To reduce the costs for owners, measures could be taken either to reduce the amount of work involved for assessors (thus limiting the cost of producing EPCs), or to avoid market imbalances and speculation. Alternatively, dedicated support for vulnerable households could be considered.

The use of standard protocols with default values, or virtual means (see also Section 3.2) could reduce the time needed to produce and issue an EPC and therefore its costs. In relation to those measures, Member States are recommended to strike a balance between costs and quality of EPCs based on their national circumstances.

Price caps could also be set at national level with the aim of keeping the costs for building owners within limits and avoiding speculation. In this case too, the price caps should allow for the issuance of a quality EPC. Experience with the use of price caps in some Members States has shown the importance of regularly indexing the price caps.

Article 19(4) specifically requires Member States to consider whether to provide financial support for vulnerable households to make EPCs more affordable. Member States might for instance consider setting up specific support measures for low-income households or extending financial schemes supporting energy renovations to cover the cost of EPCs (e.g. before and after a renovation) for low-income building owners.

3.2. On-site checks complemented by virtual means and visual checks

Article 19(4) requires Member States to ensure that EPCs are issued on the basis of an on-site visit, which may be carried out, where appropriate, by virtual means with visual checks. In either case, the quality and reliability of EPCs must be ensured.

Physical on-site visits are preferred because they allow for a seamless assessment and a direct interaction between the independent expert and the building owner/representative. Nevertheless, experience has shown that virtual visits can, if appropriately carried out, be a valid alternative to physical visits. They could improve the affordability of EPCs especially in cases where on-site visits would require disproportionate logistical efforts (e.g. in remote areas). Member States may want to lay down criteria and conditions for the cases in which virtual checks can replace on-site visits.

As a general rule, a virtual building visit would be considered appropriate if the independent energy expert is able to carry out the same type of assessment based on the same level of access to the building as they would have during a physical visit and if it results in the same level of quality. A virtual visit could also be used to confirm the validity of data obtained through other means (e.g. plans, drawings, technical specifications). Access should include all relevant parts of the building or building unit, including for instance the cellar, the heating system, the roof, the garden or yard, and at least one flat, as well as a clear view of details of the windows/doors.

The issuance of an energy performance certificate by virtual means with visual checks would typically be based on a building visit in an online environment. In practical terms, to accomplish a virtual building visit, the building owner or their representative (building manager, construction supervisor, etc.) on-site would connect virtually with the independent energy expert, for example via a video-call platform. For residential buildings, these virtual visits could be organised via virtual platforms commonly available and familiar to the public. For big non-residential buildings it might be more appropriate to use special video platforms that allow for a 360° video conferencing. From a technological point of view, the building owner or building representative would need to provide a stable internet connection and an electronic device (smart phone, tablet, laptop etc.) with a camera of sufficient quality.

Where necessary and appropriate, a virtual building visit should be supported by additional documents and photos, collecting and showing specifications of selected building systems such as heating or ventilation systems. EPC experts/assessors might draw up checklists to inform building owners about the necessary preconditions and/or additional data needs.

If the technical preconditions are not met and the assessment cannot be carried out at a sufficient level of quality, the virtual inspection would need to be repeated or complemented by a physical visit.

The independent expert/assessor is ultimately responsible for determining the validity of a virtual visit for the purposes of producing an EPC. If the independent expert determines that a virtual visit may result in an EPC of insufficient quality (e.g. the expert is not capable of identifying key parameters through the virtual visit), then the expert will need to proceed with an on-site visit. Similarly, an on-site visit cannot be used by the independent expert to justify errors or inaccuracies in the EPC.

3.3. **Accessibility, legibility and machine-readable format**

Article 19(4) establishes that 'the energy performance certificates shall be clear and easily legible, available in a machine-readable format', while Annex V specifies that 'persons with disabilities shall have equal access to the information in energy performance certificates'. As Article 20(1) of the EPBD establishes that EPCs should be issued in a digital format, unless a paper version is requested, the following recommendations mostly refer to digital documents.

Machine-readable

Directive (EU) 2019/1024 on open data and the re-use of public sector information defines the concept of machine-readability at EU level as a format structured in such a way as to allow software applications to easily identify, recognise and extract specific data from it ([2]). Some examples of machine-readable formats are CSV, JSON or XML. Data that are coded in a file format which limits their extraction or automatic processing cannot be considered machine-readable ([3]). For example, printed or hand-written documents that have subsequently been digitalised are not machine-readable, but the equivalent text in a simple ASCII text file can be processed by a machine ([4]).

Accessibility and legibility

The introduction of accessibility and legibility requirements for EPCs has been recognised as an significant step towards inclusion for people with disabilities ([5]). EU legislation contains not only accessibility requirements for the built environment but also for (digital and non-digital) information, including websites. The legislation is supplemented by recommendations for which accessibility requirements to use in specific circumstances.

Relevant requirements on the accessibility of products and services (and the built environment in which the services are provided) for people with disabilities are also provided in Annexes I and III of Directive (EU) 2019/882 on the accessibility requirements for products and services (European Accessibility Act) ([6]). While EPCs as such fall outside the material scope of that Directive, the annexes to the Directive nonetheless lay down requirements that are relevant to the information provided in the EPC's ([7]).

To be accessible, non-digital EPCs should comply with the following requirements.

— Labels and instructions should be made available via more than one sensory channel, presented to users in ways they can understand and perceive, with fonts of suitable size and shape, with sufficient contrast and adjustable spacing between letters, lines and paragraphs.

([2]) Directive (EU) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector information (recast) [2019] OJ L172/56, available at: https://eur-lex.europa.eu/eli/dir/2019/1024/oj (last accessed 12 June 2024), art 2(13) and recital 35.

([3]) ibid.

([4]) https://opendatahandbook.org/glossary/en/terms/machine-readable/

([5]) Marie Denninghaus, 2024, *Energy Performance of Buildings Directive – first EU legislation to address accessibility of buildings*, available at: https://www.edf-feph.org/energy-performance-of-buildings-directive-first-eu-legislation-to-address-accessibility-of-buildings/.

([6]) Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services [2019] OJ L151/70, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019L0882.

([7]) ibid. Article 2.

To be accessible, digital EPCs should:

— (i) be made available via more than one sensory channel;

— (ii) be presented in an understandable way, for example, using the same words in a consistent manner or in a clear and logical structure so that persons with intellectual disabilities can better understand them;

— (iii) be presented to users in ways they can perceive, for example, EPCs should be designed to allow for additional contrast in foreground images so that people with low vision can see them; colour should not be used as the only way of conveying a certain piece of information (e.g. in the energy label illustration);

— (iv) be presented in fonts of suitable size and shape, taking account of foreseeable conditions of use and using sufficient contrast, as well as adjustable spacing between letters, lines and paragraphs;

— (v) with regard to content, be made available in text formats that can be used for generating alternative assistive formats to be presented in different ways and via more than one sensory channel; for example information provided by voice or Braille using screen readers;

— (vi) be accompanied by an alternative presentation of any non-textual content; for example, diagrams (such as the energy label illustration) should be accompanied by a text description identifying the main elements or describing key actions ([8]).

Moreover, when providing EPCs on paper, the option for printing in Braille should be made available ([9]).

4. RECOMMENDATIONS

The EPBD recast introduces several novelties as regards the EPCs recommendations for improving the energy performance of a building. The recommendations were already a mandatory part of an EPC but the EPBD recast has enlarged their scope. Recommendations in the EPC are expected to be concise, while a renovation passport (Article 12) is a more suitable place to explain in detail what specific improvements can be made to the building, providing much more comprehensive technical and practical information, including on the sequencing of steps.

This section covers the most relevant new requirements, which are also highlighted in the table below next to existing ones.

Table 1

Mandatory and voluntary elements for recommendations for improvements

Elements / scope	Mandatory	Voluntary
	Cover measures to improve energy performance	Provide an estimate for the range of payback periods or costs and benefits over its economic life cycle **(new)**
	Cover measures to reduce GHG emissions **(new)**	Provide information on available financial incentives, administrative and technical assistance **(new)**
	Cover measures to improve indoor air quality **(new)**	Provide information on the financial benefits broadly associated with achieving the reference values **(new)**
	Provide an estimate of energy savings and the reduction in operational GHG emissions **(new)**	Provide other information on related topics, such as energy audits, incentives (financial and other) and financing possibilities, or advice on how to increase the climate resilience of the building

([8]) ibid., Annexes I and II.
([9]) ibid.

	Cover both (a) measures carried out in connection with a major renovation of the building envelope or technical building system or systems and (b) measures for individual building elements	
	Include an assessment of whether the heating, ventilation, air conditioning and domestic hot-water systems can be adapted to operate at more efficient temperature settings **(new)**	
	Include an assessment of the remaining lifespan of the heating system or air-conditioning system. Where relevant, the recommendations must indicate possible replacements for the heating or air-conditioning system, in line with the 2030 and 2050 climate targets, taking account of local and system-related circumstances **(new)**	
	Provide an indication as to where the owner or tenant of the building or building unit can receive more detailed information, including as regards the cost-effectiveness of the recommendations made in the energy performance certificate	
	Contain information on the steps to be taken to implement the recommendations, contact information for relevant one-stop shops and, where relevant, financial support options	

4.1. **General aspects**

Under Article 19(5), EPCs must include recommendations for:

— making cost-effective improvements to the energy performance of the building;

— reducing operational greenhouse gases emissions; and

— improving the quality of the indoor environmental.

These last two have been added to the existing requirements on recommendations.

Another novelty is that the provisions on recommendations do not apply to buildings that already achieve energy performance class A. In the EPC of class A buildings (and by extension also A+ buildings) the section on recommendations could therefore be left empty.

The recommendations must address two types of measures: (a) measures carried out in connection with a major renovation of the building envelope or technical building system or systems and (b) measures for individual building elements independent of a major renovation of the building envelope or technical building system or system. This differentiation has not changed from the existing requirements.

The recommendations may also include an estimate for the range of payback periods or costs and benefits over the economic life cycle of the building and information on available financial incentives, administrative and technical assistance, as well as financial benefits which are broadly associated with the achievement of the reference values.

Finally, if the EPC is issued together with or close in time to a renovation passport, under Article 19(6) the recommendations can be replaced by the renovation passport.

4.2. **Operational greenhouse gas emissions**

Under Article 19(5), EPCs must include recommendations for a cost-effective reduction in operational greenhouse gas emissions. Operational greenhouse gas emissions are defined as ‘greenhouse gas emissions associated with the energy consumption of the technical building systems during the use and operation of the building’ (Article 2(23)). This is new; the provisions on recommendations which were in force before the recast concerned only cost-effective measures to improve energy performance.

Measures for reducing operational greenhouse gas emissions combine those for improving energy performance through energy efficiency measures and those relating to the use of renewable energy produced on site. Therefore, all measures improving the energy performance of buildings also reduce in parallel operational greenhouse gas emissions. As the type of measures to improve energy performance and reduce GHG emissions are the same, what is required in the recommendations is to provide a clear ranking and to include in them the quantifiable impacts of the measures recommended in terms of reducing operational GHG emissions. To this end, Article 19(7) further specifies that the recommendations must include an estimate for the energy savings and the reduction of operational GHGs emissions.

4.3. **Indoor environmental quality**

Indoor environmental quality (IEQ) is defined as ‘the result of an assessment of the conditions inside a building that influence the health and wellbeing of its occupants, based upon parameters such as those relating to the temperature, humidity, ventilation rate and presence of contaminants’ (Article 2(66)).

Article 19(5) provides that EPCs must include recommendations for the improvement of IEQ of a building or building unit. This new requirement links with other new measures in the EPBD recast targeting thermal comfort and IEQ (in particular Article 5(1), Article 8(3), and Article 13).

It will often be possible to recommend measures that improve energy performance and IEQ at the same time, but in other cases recommendations to improve IEQ should be specific and tailored to the use of the building (residential or non-residential).

Where existing and relevant, recommendations could make reference to the voluntary national requirements mentioned in Article 13 for the implementation of adequate IEQ standards in buildings to maintain a healthy indoor climate.

IEQ recommendations may include, depending on the specific conditions and use of the buildings:

— improvement of thermal insulation which will also reduce draughts and local thermal discomfort, both in winter and summer;

— passive cooling solutions, such as installation of solar shading devices, optimisation of ventilative cooling, and improvement of building thermal mass to address overheating issues; active cooling solutions (e.g. radiant or air-based systems, fans) can be used to cool when passive systems are insufficient to ensure comfort and health;

— upgrading of the current heating and/or cooling system or replacing it with a more energy-efficient one, e.g. with better thermal regulation;

— installation of a ventilation system, using heat recovery;

— measures to improve thermal comfort (e.g. adjusting the air temperature or improving the humidity level);

— installation of self-regulating devices for the separate regulation of the temperature in each room or in a designated heated or cooled zone of the building unit;

— installation of sensors that monitor the IEQ;

— installation of fixed controls that respond to the levels of IEQ;

— filter replacement, installation of air cleaners or components for air disinfection (where relevant);

— improvement of the performance or replacement of the existing ventilation system;

— if IEQ is already monitored in the building (voluntary indicator in Annex V.2) ([10]), the recommendations for improvement can/should be based on it, if appropriate.

Although this is a new requirement in the EPBD, some Member States already have elements related to IEQ in their EPCs. For instance, in Greece, there is a specific box for 'comfort conditions and quality of indoor air'. Summer comfort issues are included in the Romanian EPC ([11]). In Portugal, for each of the recommended measures to improve energy performance, the EPC can indicate if they have other benefits like thermal comfort, indoor air quality or acoustic comfort improvements ([12]).

4.4. **More efficient temperature settings**

Article 19(8) requires that the EPC recommendations also include an assessment of the potential for heating, ventilation, air conditioning and domestic hot-water systems to operate at more energy-efficient temperature settings. This assessment includes evaluating the feasibility of low-temperature emitters for water-based heating systems, which are designed to optimise energy efficiency and support the integration of renewable energy sources. This new element in the EPC recommendations also has links with other requirements in the EPBD recast for technical building systems, minimum energy performance requirements and inspections ([13]), and is complemented by specific indicators in the EPC template ([14]).

In the following subsections, clarifications of the relevant terminology and concepts related to low-temperature heating in hydronic systems are provided, together with the recommended assessment steps needed to determine the potential of heating systems to achieve energy-efficient performance within residential buildings. These sections are part of a broader technical report which will be issued separately from this guidance document.

4.4.1. *Terminology for hydronic heating systems and key parameters*

The following terms describe the temperature regimes in hydronic heating systems.

— The *system temperature* is the average of the supply and return temperatures in a heating system.

— The *supply temperature* refers to the temperature of the fluid supplied from the heat generator (e.g. boiler, heat pump) to the emitters.

— The *return temperature* is the temperature of the fluid returning from emitters to the generator.

— *Delta T (ΔT)* refers to the difference between supply and return temperatures, impacting system efficiency.

— The *excess temperature* is the difference between the average emitter fluid temperature and the ambient temperature, used for calculating emitter heat output.

([10]) Annex V.2 includes two voluntary indicators in relation to IEQ: 'the presence of fixed sensors that monitor the indoor environmental quality', and 'the presence of fixed controls that respond to the levels of indoor environmental quality'.

([11]) Buildings Performance Institute Europe (BPIE), 2018, *The inner value of a building. Linking indoor environmental quality and energy performance in building regulation*, https://bpie.eu/wp-content/uploads/2018/10/The-Inner-value-of-a-building-Linking-IEQ-and-energy-performance-in-building-regulation_BPIE.pdf.

([12]) CA EPBD (CT5) Certification and Training, *Status in 2022*. https://www.ca-epbd.eu/Media/638373594077934858/CT5-Certification-and-Training-Status-in-2022-with-annex.pdf; https://www.sce.pt/wp-content/uploads/2018/06/ADENE_certificado_energ%C3%A9tico_habita%C3%A7%C3%A3o.pdf.

([13]) Article 5(1) stipulates that 'Member States may set the requirements for building elements at a level that would facilitate the effective installation of low-temperature heating systems in renovated buildings.' As the systems are part of the technical building system, they are also mentioned in Article 13(2): 'Member States may set specific system requirements for technical building systems in order to facilitate the effective installation and operation of low-temperature heating systems in new or renovated buildings.' According to Article 23(4), inspections are required to 'assess the feasibility of the system to operate under different and more efficient temperature settings, such as at low temperature for water-based heating systems, including via the design of thermal power output and temperature and flow requirements, while ensuring the safe operation of the system.'

([14]) The EPC template in Annex V includes as a mandatory indicator (e) 'a yes/no indication whether the heat distribution system inside the building is capable to work at low or more efficient temperature levels, where applicable'. It also includes a voluntary indicator assessing the 'feasibility of adapting the heating system to operate at more efficient temperature settings'.

Characterising the precise temperature regime of an existing heating system is complex and cannot rely on sporadically recorded low temperatures. Therefore, only two main parameters, the system design temperature and the seasonal average system, supply and return temperatures, are useful indicators of the heating system's operational regime and help to assess potential performance improvements in the energy performance certificate.

For existing buildings, determining these values involves assessing the current heat load and installed emitter capacity. Calculation tools, using data like climate zone, heat generator specifications and distribution flow data, can be used to estimate achievable system temperatures.

4.4.2. *Defining 'low-temperature heating'*

Low-temperature heating is typically recognised in standards such as EN 14825:2022 (for heat pumps) and EN 442:2014 (for metallic radiators and convectors). These standards classify heating systems by design temperatures:

— low temperature: ≤ 35 °C for design supply temperature;

— intermediate: ≤ 45 °C;

— medium: ≤ 55 °C;

— high: ≤ 65 °C.

For EPBD purposes, the following definitions are proposed:

— medium-temperature regime: system design temperature ≤ 55 °C, seasonal average ≤ 50 °C;

— low-temperature regime: system design temperature ≤ 45 °C, seasonal average ≤ 42 °C.

4.4.3. *Assessment steps proposed*

To assess whether heating systems can be adapted to operate at more efficient temperature settings, the EPC expert/assessor could follow the simplified steps outlined below when there is an existing emitter and distribution system, without considering limiting factors such as generators, circulators or room temperature control systems.

(1) Calculate the heat load and heated surface of the building or building unit, and the reference room, using data such as final energy used for space heating, year of construction and insulation conditions.

(2) Determine the emitter capacity in the reference room, including floor area, type and installation settings.

(3) Determine the maximum flow rate of the distribution pipes.

(4) Calculate the achievable system temperatures based on the acquired data.

The data collected from the steps outlined above could be entered into a dedicated simple calculation tool which could be used for step 4 ([15]).

Several actions could be included in the recommendations to help reduce system temperatures further in the reference room, for instance, additional insulation on outer walls, floors and ceilings. These improvements in insulation and airtightness are crucial for decreasing the heat load. Other measures include upgrading glazing and window frames to materials with higher insulating capacities, sealing gaps to enhance airtightness and replacing extract ventilation with heat recovery ventilation systems to optimise energy efficiency and heat retention. These recommendations might overlap with those aimed at improving the overall energy performance of the building.

([15]) This tool is made available in a separate document and generates outputs to assess whether the dwelling and its heating system are compatible with low- or medium-temperature operation.

Beyond reducing heat load, the recommendations could suggest increasing emitter capacity by replacing standard emitters with low-temperature ones of similar size or increasing the number or size of emitters. This modification supports more effective heat distribution at lower temperatures, ensuring compatibility with a low-temperature regime. The optimisation of flow rates within the distribution system by either maximising the flow in existing pipes or upgrading to one-size larger pipe dimensions could also be an effective measure. These adjustments further improve the system's efficiency, enabling it to operate effectively even under reduced temperature conditions.

Additionally, the assessor is recommended to check if other system properties could affect the implementation of lower system temperatures, in order to formulate specific recommendations for energy improvements. This involves:

(1) determining the type of room temperature control system;

(2) identifying the type and capacity of the generator and circulator/pump;

(3) checking the heat load/emitter capacity-ratio in other critical rooms.

Once again, these steps help determine the best achievable flowrates and system temperature given the existing distribution system.

4.5. Remaining lifespan of heating or air-conditioning systems

Another new recommendation pertains to the 'mandatory assessment of the remaining lifespan of the heating or air-conditioning system' (Article 19(9)). This provision is linked to others in the EPBD recast: the projected lifespan of the heating systems has to be included in the data on the building system (Article 16(1)). Linked to those, a voluntary indicator in the EPC template (Annex V, 2.m) focuses on 'expected remaining lifespan of the heating or air-conditioning systems and appliances, where applicable'.

The remaining lifespan is an important indicator for building owners, which helps raising awareness on the expected end of life of such installations, so that replacements are planned in advance and supported by comprehensive information on the options available, instead of being driven by force majeure when a heating or air-conditioning system breaks down.

The remaining lifespan of heating and air-conditioning systems varies and depends mainly on its age. In some countries values for lifespans are standardised in national legislation. Based on existing literature ([16]) and manufacturer's information, the following general indications can be used to assess it.

— A heating system can last from 7 to 25 years (average lifespan) depending on the type of heating system and specific technology, sometimes even longer.

— A modern heat pump has an average lifespan of 20-25 years, older models have an average life expectancy of 10-15 years.

— The average lifespan of an air-conditioning system ranges from 10 to 15 years

Several factors beyond the age of the heating or air-conditioning system influence the expected lifespan:

— the quality of installation;

— the regularity and quality of maintenance (e.g. regularly scheduled inspections in accordance with Article 23, filter replacements, cleaning, immediate repair of defective parts);

— the conditions of use (frequency and intensity, proper sizing).

([16]) Including: European Commission: Directorate-General for Energy, *Ecodesign impact accounting annual report 2021 – Overview and status report*, Publications Office of the European Union, 2022, **https://data.europa.eu/doi/10.2833/38763**.

To assess the remaining lifespan, the EPC expert/assessor must weigh the relevant factors above, based on the specific characteristics of the individual heating or air-conditioning system assessed.

Article 19(9) also requires that, where relevant, the recommendations must 'indicate possible alternatives for the replacement of the heating system or air-conditioning system'. This has to be in line with the 2030 and 2050 climate targets and also has to take account of local and system-related circumstances. If the EPC expert/assessor concludes that the remaining lifespan of the heating or air-conditioning system is quite short (e.g. approx. two years), alternatives to the existing system must be identified and indicated. In line with 2030 and 2050 climate targets and taking account of the lifespan of the new equipment, these alternative systems should be highly energy-efficient and non-fossil-fuel-based. It would also be very relevant to consider possible specific indications on boilers replacements in national legislation ([17]), ([18]).

5. VALIDITY OF EPCS AND SIMPLIFIED CERTIFICATION PROCEDURES

5.1. Validity of EPCs

The recast EPBD has not changed the period for which the EPC is legally valid, which remains 10 years.

Given the long period of validity of the EPC, new EPCs will coexist with EPCs issued before the entry into force of the new requirements (by end of May 2026).

The EPBD provides flexibility on how to address this issue. Member States can decide which approach they want to follow. The main issues to evaluate when considering the validity of an EPC following rescaling are the following:

— clarity and understanding – how clear it is for the general public to understand the difference between old and new EPC scales;

— relationship with obligations – whether there are any relationships between the current EPC scales and obligations. This can affect minimum energy performance requirements (e.g. new buildings need to be at least 'X' on the EPC scale) or minimum energy performance standards if these are already in force in a Member State (e.g. buildings with EPC G need to be renovated by 2030);

— effects from other changes (e.g. calculation methodology) – whether there are changes to other EPBD requirements that could influence the EPCs. The clearest link is with the calculation methodology. Changes in the calculation methodology may result not only in differences in the value of the main indicator in the EPC (e.g. from 100 to 93 kWh/(m^2.y)) but also in the meaning behind the number (e.g. previously EPCs reported on non-renewable primary energy, while the new scale reports on total primary energy);

— support measures and financial instruments – if financial support under a specific scheme is linked to or dependent on a particular EPC classification, then changes in a building's classification may result in a change of beneficiaries which might not be in line with the initial objectives of the funding scheme. For example, if a scheme required an improvement of at least 1 or 2 classes, it may be necessary to provide guidelines on how this is addressed. Similarly, if there are changes to the number or indicator (due to changes in the methodology), then a direct comparison may not be feasible without some processing of data;

— storage of EPCs – how EPCs are currently stored. If EPCs are stored in a database it is feasible to carry out certain measures (e.g. re-issuing them or re-calculating a class), which may not be feasible if they are not stored in a database, for instance.

([17]) In Denmark, EPC issuers must always consider the replacement of boilers that are older than 10 years. Handbook for Energy Consultants (HB2023), Appendix 4.4.7, paragraph 2; https://www.hbemo.dk/haandbog-for-energikonsulenter-hb2023.

([18]) In Germany, for example, all efficient heating systems that run on fossil fuels must be replaced as soon as they are 30 years old. This applies to all systems that heat with oil or gas and were installed before 1991. §72 of the 2024 *Gebäudeenergiegesetz* . https://www.recht.bund.de/bgbl/1/2023/280/VO.html.

The different options which could be considered are the following.

(a) *Old EPCs continue to be valid until the validity of the EPC expires following 10 years from their issuance.*

New and old EPCs will operate and coexist until all old EPCs are expired, which will depend on when the scheme is updated. This could be by 2036 if EPC schemes are updated on the transposition date (see Article 35) or later if Member States have already updated their EPC schemes recently and make use of the exception under Article 19.

This option is simple in that the old EPCs continue to be valid and are unchanged. However, as multiple EPCs will coexist for a number of years, it is critical that the administration communicates what are the effects when it comes to obligations (e.g. minimum energy performance standards or funding schemes).

(b) *Old EPCs remain valid only until a given date.*

Old EPCs remain valid, but Member States provide an earlier date to end their validity. For example: all EPCs issued before the transposition date are valid until 1 January 2030. This approach is essentially similar to option A (validity until expiry), but it limits the period in which both schemes coexist and the negative impact this may have.

As with option (a), it is critical that the administration clarifies the effects in terms of obligations and funding schemes. Also, it is important that building owners are aware that old EPCs may not be valid for the full 10-year duration.

(c) *Old EPCs are no longer valid.*

Under this option, old EPCs expire once the new scheme is introduced. This option is simple from an administrative perspective and eliminates confusion in terms of coexistence of both old and new system. However, this option would make many EPCs issued recently no longer valid and cause significant added costs to building owners.

(d) *Old EPCs are rescaled to its new label or value.*

Old EPCs are automatically, or upon request, updated to their new value. Old EPCs that are not updated (either because it is not possible technically or because the update is not requested) expire.

This can be done centrally, particularly if EPCs (and input data used for the calculation of the energy performance class) are stored and available through databases. Under this option, the EPC managing authority establishes equivalences between the old and new EPC classes (e.g. an EPC with 150 kWh/(m^2.y) was a D in the previous labelling system and is now an E under the new system) or the new energy performance value (e.g. an EPC with 70 (kWh/(m^2.y) non-renewable energy was a D in the previous label and it is now 150 kWh/(m^2.y) total primary energy with an E label).

This option requires work from the EPC managing authorities, but it reduces the complexity that would ensue from the lack of coexistence of both systems. It also generates no additional costs for building owners, although they should be communicated of the new EPC values.

In this case, the validity of old EPCs is not extended following the re-classification. The validity of the EPCs would continue to be 10 years from the date of the issue of the original EPC.

Options (b) to (d) are provided as examples, whereas option (a) describes what will happen if no specific or additional measure is taken at national level beyond transposition of the requirements in Article 19. Member States may also choose different options for different building categories (e.g. option (a) for residential buildings and option (d) for non-residential). Under all options, communication to building owners, independent experts, building designers and the building sector as a whole remains the most important aspect.

It should be borne in mind that the EPC database and the storing of input data could support and facilitate the dynamic updating of EPCs (or some of their elements and indicators) over time, as in option (d). EPCs are generally understood as the result of an analysis at a given moment (a snapshot of the energy performance and other qualities and characteristics of a building). Storing EPCs in a database makes it possible to use the input data for an EPC to keep the building rating up to date, and so to show changes in the buildings' energy performance over time when this depends on external/exogenous factors and the technical characteristics of the buildings itself are largely unchanged.

For example, due to the expected pace of decarbonisation of the electricity grid, significant changes in primary energy factors are expected in the coming years. Changes in the primary energy factor for electricity applied at national level could have an effect on a building rating. When the EPC is based on data stored in a database and certain parameters are updated, the EPC will have an evolving value over 10 years (the value of the EPC is the value provided when checking on the database). The validity of the EPC would still be linked to the date of the original input data, unless the input data are also updated.

5.2. **Simplified update procedures**

Article 19(14) requires Member States to introduce simplified update procedures in specific circumstances.

The aim of this provision is to facilitate the updating of the EPC when only limited changes are made to a building or when data and information are available from other reliable and relevant sources.

Member States should describe in their legislation which changes are eligible for simplified procedures and how these changes should be reflected in the EPC and the EPC databases.

The simplified procedure should be reflected in lower EPC-related costs for the building owner, given the reduced resources required to update the EPC compared to a full new EPC.

The validity of the EPC would depend on how Member States apply the simplified procedure. If the simplified procedure also requires the validation of existing input data (i.e. verification that there have not been any changes) then the validity of the EPC would be set from the moment the EPC is updated. If the simplified procedure does not require the validation of existing input data (i.e. the expert only vouches for the value of the element updated), then the validity of the EPC would remain linked to the date of the original input data.

Article 19(14) identifies three cases in which simplified procedures for updating an energy performance certificate have to be made available by Member States:

(a) *Updating an energy performance certificate when individual elements are upgraded*

Upgrading individual elements, by means of single or stand-alone measures, may not have a decisive impact on the calculation and composition of a building’s overall energy performance and may therefore be handled differently from major renovations.

The simplified procedure for updating an energy performance certificate based on improvements to individual elements limits the assessment and issuing procedure only for these improved individual elements. For example, if the basement ceiling was insulated as an individual measure, although the full requirements for issuing an energy performance certificate (e.g. an on-site visit in accordance with Article 19(4)) still apply, the update of the energy performance certificate would focus exclusively on this aspect.

This focus may include a reassessment and revision on the updated energy performance certificate, of the energy performance indicator and class, indicator and class for operational greenhouse gas emissions, or indoor environmental quality. The revision might also result in the removal of a renovation recommendation, which might be related to the single or stand-alone measure that was implemented, from the list of recommendations in the updated energy performance certificate, or in an updating of any other information listed in Annex V to the EPBD and included in the national EPC template, which may have changed following the single or stand-alone measure.

(b) *Updating an energy performance certificate when measures identified in a renovation passport are put in place*

A simplified procedure may not be appropriate to update an energy performance certificate after the implementation of recommended measures in the existing energy performance certificate. This is because the recommendations contained in the energy performance certificate and their related information on their energy savings are not detailed and precise enough to be used for a recalculation of the energy performance certificate.

The situation will be different if a building renovation passport has been issued for the building in question, as this contains a ready-to-use, personalised renovation plan with all the measures to be carried out, including the expected benefits such as energy savings and reduced greenhouse gas emissions. If the measures in the building renovation passport are implemented as recommended, it can be assumed that the energy savings will be achieved as indicated. If these measures lead to a major renovation of a building, it will usually be necessary to update the energy performance certificate. Provided no major renovation is involved, the simplified procedure can be followed.

A simplified procedure in this case has to include a compliance check of recommended measures in the building renovation passport compared to the measures actually implemented. This must be carried out as part of an on-site visit in accordance with Article 19(4), by the energy expert responsible for issuing the energy performance certificate. If the energy expert concludes that the measures have been carried out in accordance with the recommendations of the building renovation passport, the corresponding data can be used to issue the updated energy performance certificate.

(c) *Updating an energy performance certificate when a building digital twin, other certified methods, or data from certified tools determining the energy performance of a building are used.*

If new figures on the building's performance indicators are available, these can be used to update the energy performance certificate. New data may result if a digital twin has been set up for the building, and data included in it are changed following, for example, the implementation of renovation measures or other changes to building data relevant for the energy performance certificate, or if the energy performance has been determined on other occasions (e.g. sustainable building certifications) using certified methods or certified tools.

A simplified procedure in this case would involve adopting the determined data from the digital twin or certified method or tool for the EPC. Further calculations or on-site visits would only be required if data were missing or the energy expert discovered discrepancies.

5.3. **Renovation advice to building owners**

The recast EPBD introduces a new requirement to ensure that owners of buildings issued an EPC below level C are invited to a one-stop shop at the following points:

— when the EPC expires;

— when the EPC has reached 5 years after the last issuance.

The aim of the visit is to provide renovation advice to the building owner and encourage them to act upon it. This information could cover technical administrative and financial issues (see the guidance on Article 17 and Article 18 in Annex 2 for more information on the scope of activities which could be covered and the options for inviting the building owners).

5.4. **Communication of revised EPC schemes**

The recast EPBD introduces significant changes to the EPC scheme. The rescaling is one of the most obvious, but the changes also affect the content of EPCs (e.g. template, recommendations), when the certificate must be made available, access to information through databases, quality elements, etc. The communication of all these changes will be a key aspect for the acceptance of the revised scheme.

It is therefore recommended that the revision of the EPC classes is communicated in detail and clearly, comparing the old and new provisions. Appropriate information campaigns and online frequently asked questions (FAQs) can support the swift acceptance of the new scale. Most Member States already have experience with a rescaling of the energy performance classes or introducing changes to their schemes.

Promotional campaigns lead to greater awareness among stakeholders and market players, but also among the public. Member States should consider launching separate campaigns, differentiating based on the target audience, e.g. campaigns for professional and stakeholder groups, and campaigns for end users such as building owners or tenants. These campaigns should convey the information in a manner commensurate with the target audience's level of knowledge. The Member States should consider adopting a clear comparative approach, to showcase the differences associated with the rescaling of the energy performance classes ([19]). The Member States could also consider collaborating with social partners, non-governmental organisations and other stakeholders to streamline the dissemination of information among different audiences within the general public.

6. ISSUING AND DISPLAYING EPCS

6.1. Trigger points

Article 20(1) requires new EPCs to be issued for:

(a) buildings or building units when they are constructed, when they have undergone a major renovation, when they are sold, when they are rented out to a new tenant, or for which a rental contract is renewed; and

(b) existing buildings owned or occupied by public bodies.

The recast Directive therefore introduces more trigger points for the issuance of EPCs, including major renovations and the renewal of a rental contract. Moreover, it also expands the scope of the EPC requirement to encompass all existing buildings owned or occupied by public bodies ([20]), independently of the building's surface area.

In relation to major renovations, Article 2(22) provides two options for the Member States. As such, a renovation may be considered 'major' if:

(a) the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25 % of the value of the building, excluding the value of the land upon which the building is situated; or

(b) more than 25 % of the surface of the building envelope undergoes renovation.

As regards buildings not owned or occupied by public bodies, the requirement for the issuance of an EPC is also triggered by the construction, major renovation, selling or renting out of a building or the renewal of a rental agreement for it. Furthermore, no new EPC need be issued if there is already an available and valid certificate, issued in accordance with either Directive 2010/31/EU or the EPBD recast.

As under the current rules, Member States will be able to exempt the categories of building referred to in Article 5(3)(b), (c) and (e) ([21]) from the requirement to issue of an EPC. As regards residential buildings which are used or intended to be used for less than four months of the year or, alternatively, for a limited annual time of use and with an expected energy consumption of less than 25 % of what would be the result of all-year use (Article 5(3)(d)), Member States which chose to exempt these buildings by 28 May 2024, may continue to do so.

Article 20 also provides greater clarity on the requirements relating to the availability of EPCs and checks or other controls to ensure that EPCs are available online and offline in advertisements of buildings on sale or rent, including in property search portal websites. These aspects are addressed in section 8 of this guidance on Annex VI.

([19]) For example, the French website: https://rt-re-batiment.developpement-durable.gouv.fr/dpe-logement-a786.html?lang=fr.

([20]) 'Public bodies' means public bodies as defined in Article 2(12), of Directive (EU) 2023/1791 (Energy Efficiency Directive), which reads as follows: '"public bodies" means national, regional or local authorities and entities directly financed and administered by those authorities but not having an industrial or commercial character.'

([21]) '(b) buildings used as places of worship and for religious activities'; '(c) temporary buildings with a time of use of two years or less, industrial sites, workshops and non-residential agricultural buildings with low energy demand and non-residential agricultural buildings which are used by a sector covered by a national sectoral agreement on energy performance;' and '(e) stand-alone buildings with a total useful floor area of less than 50 m^2'.

6.2. Display of EPCs

Article 21 of the EPBD recast widens the existing obligation to display EPCs to all buildings occupied by public bodies and buildings frequently visited by the public, irrespective of their size. In addition, non-residential buildings which have a valid EPCs are also required to display it in a prominent and clearly visible place.

For buildings occupied by public bodies and frequently visited by the public and non-residential buildings, obligatory EPCs issued pursuant to the EPBD (irrespective of whether based on the previous or the recast EPBD) will need to be displayed. Where a building was not obliged to have an EPC under the previous EPBD, it would only be obliged to display the EPC once it is obliged to have an EPC. As an example, a shop which has an EPC issued in 2019 after a sale would need to display an EPC for as long as the EPC is valid (2029).

7. ANNEX V - TEMPLATE FOR ENERGY PERFORMANCE CERTIFICATES

Annex V, in reference to Article 19, provides a template to be used for EPCs in all Member States. Annex V includes a list of indicators that must be displayed in the EPC (Annex V 1.) and a list of voluntary indicators (Annex V 2.) for which Member States can choose whether to include them or not and in which circumstances. A few additional mandatory indicators are also indicated in Article 19(1). Additionally, Annex V specifies the data that have to be displayed on the energy performance certificate's front page.

Several of the indicators are to be read and interpreted in close connection to the requirements in Annex I which provides the general framework for calculating the energy performance of buildings.

While there are no specific requirements on the layout and how to present the assessed indicators, to improve the accessibility of EPCs, diagrams with a textual description of the main elements or a description of key action points are generally recommended to accompany the values of the indicators (see Section 3.3 of this guidance).

7.1. Mandatory elements

The following section provides an overview of the mandatory elements to be displayed in the EPC. Tables 2, 3 and 4 list the indicator itself, the unit in which it has to be displayed, plus a reference where information is provided on how to calculate the indicator or where to find the information for the indicator.

Table 2

Mandatory elements on the energy performance certificate's front page

	Indicator	Unit	How to / Source
(a)	Energy performance class	A+, A-G	To be calculated according to the national methodology established following the requirements in Annex I and based on the requirements in Article 19-20 ([22]).
(b)	Annual primary energy use — *displayed per energy carrier*	kWh/(m^{2}.y)	National calculation methodology established based on Annex I
(c)	Annual final energy use — *displayed per energy carrier*	kWh/(m^{2}.y)	National calculation methodology established based on Annex I
(d)	Renewable energy produced on site as a percentage of energy use	%	National calculation methodology established based on Annex I

([22]) See sections 2.2 to 2.5 of this guidance.

	Indicator	Unit	How to / Source
(e)	Operational greenhouse gas emissions — *based on energy use*	$kgCO_{2eq}/(m^2.y)$	National calculation methodology established based on Annex I
(e)	Value of the life-cycle GWP (if available)	$kgCO_{2eq}/(m^2)$	To be calculated and reported in accordance with the Delegated Act referred to in Article 7(3)

The elements in the following table are mandatory but do not have to be displayed on the energy performance certificate's front page.

Table 3

Mandatory elements on the energy performance certificate (Annex V)

	Indicator	Unit	How to / Source
(a)	Annual primary and final energy consumption — *displayed per system*	kWh / MWh	National calculation methodology established based on Annex I
(b)	Renewable energy production — *if applicable*	kWh / MWh	National calculation methodology established based on Annex I
(b)	Main energy carrier and type of renewable energy source — *if applicable*	e.g. electricity and PV	National calculation methodology established based on Annex I
(c)	Energy needs *Energy need is the energy that needs to be delivered to maintain the requirements for indoor environmental quality regardless of its source or the efficiency of systems.* *Displayed per system*	$kWh/(m^2y)$	National calculation methodology established based on Annex I
(d)	Indication of whether the building has a capacity to react to external signals and adjust the energy consumption *For example, whether the building is equipped with sufficient (digital) demand response and demand management capabilities*	Yes / No, description	To be indicated in accordance with Article 13
(e)	Indication of whether the heat distribution system inside the building is capable of working at low-temperature levels, where applicable	Yes / No, description	Linked to the requirements relating to the recommendations, see Section 4.4 of this guidance
(f)	Contact details for the relevant one-stop shop for renovation advice	e.g. name, address, webpage	One-stop shops as defined in Article 18

Not explicitly mentioned in Annex V, but required by Article 19(1), the energy performance certificate must include reference values such as minimum energy performance requirements, minimum energy performance standards, nearly zero-energy building requirements and zero-emission building requirements that enable owners or tenants to compare the energy performance of their building or building unit with the requirements for those at the top of the scale. The EPC assessor should identify which requirements are most relevant for the building being assessed.

In addition, under Article 19.5, the recommendations for improvement must be included in the energy performance certificate. The table below summarises the mandatory elements under Article 19.

Table 4

Mandatory elements on the energy performance certificate (Article 19)

	Indicator	Unit	How to / Source
	Nearly zero-energy building requirements — *for new and existing buildings*	Maximum threshold	As set in Article 2(3), link to Article 5
	Zero-emission building requirements — *for new and existing buildings*	Maximum energy demand threshold; GHG emission threshold	Link to Article 11
	Minimum energy performance standards — *if applicable*	Final or primary energy threshold	Link to Article 9(1) for non-residential buildings or to national policies
	Minimum energy performance requirements — *where relevant*	Maximum thresholds	Reference values for major renovations, buildings elements or technical building systems in terms of U-value (W/m^{2}K) derived from the latest cost-optimal methodology. Link to Article 5
	Recommendations for cost-effective improvement of the energy performance, reduction of operational GHGs emissions and improvement of indoor environmental quality of a building or building unit — *unless the building or building unit achieves at least energy performance class A*	Description	

7.2. **Voluntary elements**

In addition to the mandatory indicators, Annex V provides a list of voluntary indicators that can be displayed on the EPC. Member States can either decide which of the voluntary indicators have to be included on the EPC or leave the decision on which to include to the issuer of the certificate. In general, the EPC is compliant without these voluntary indicators.

As for the mandatory indicators, the following table lists the indicator itself, the unit in which it has to be displayed in the energy performance certificate, plus a reference where information is provided on how to calculate the indicator, the legal basis or where to find the information for the indicator.

For some voluntary indicators, an accompanying text can be useful to describe the reasons for and the significance of the indicator.

Table 5

Voluntary elements of the energy performance certificate (Annex V)

	Indicator	Unit	How to / Source
(a)	Energy use — *displayed for each of the uses: space heating, space cooling, domestic hot water, ventilation and in-built lighting*	kWh/(m^2y)	On-site visit, manufacturer's information
(a)	Peak load — *displayed for each of the uses: space heating, space cooling, domestic hot water, ventilation and in-built lighting*	kW	On-site visit, manufacturer's information
(a)	Size of generator or system — *displayed for each of the uses: space heating, space cooling, domestic hot water, ventilation and in-built lighting*	kW	On-site visit, manufacturer's information
(a)	Main energy carrier and main type of element — *displayed for each of the uses: space heating, space cooling, domestic hot water, ventilation and in-built lighting*	Description	On-site visit, manufacturer's information
(b)	Greenhouse gas emission class — *if applicable*	e.g. from A to G	Only applicable if the Member State has introduced GHG emission classes
(c)	Information on carbon removals associated with the temporary storage of carbon in or on buildings	t CO_{2eq}	The CRCF Regulation ([23]) can be used as a credible standard for declaring the carbon removal indicator on the EPC. It ensures that carbon removals are quantified and verified using established methodologies and third-party verification
(d)	Indication of whether a renovation passport is available for the building	Yes / No	Information from the building owner
(e)	Average U-value for the opaque elements of the building envelope	W/(mK)	On-site visit or through the energy performance calculation methodology
(f)	Average U-value for the transparent elements of the building envelope	W/(mK)	On-site visit or through the energy performance calculation methodology
(g)	Type of most common transparent element	e.g. single, double or triple glazing	On-site visit, manufacturer's information

([23]) The Carbon Removals and Carbon Farming (CRCF) Regulation (EU/2024/3012); Carbon Removals and Carbon Farming - European Commission.

	Indicator	Unit	How to / Source
(h)	Results of the analysis on overheating risk (if available)	Description	Link to Article 13
(i)	Presence of fixed sensors that monitor the indoor environmental quality	Yes / No	On-site visit, link to Article 13
(j)	Presence of fixed controls that respond to the levels of indoor environmental quality	Yes / No	On-site visit, link to Article 13
(k)	Recharging points for electric vehicles	Number and type	On-site visit, manufacturer's information, link to Article 14
(l)	Energy storage systems	Presence, type and size (in kWh)	Manufacturer's information, link to Article 13
(m)	Expected remaining lifespan of the heating or air-conditioning systems and appliances, where applicable	Years	On-site visit, manufacturer's information if available. Link to Article 13 and Article 19
(n)	Feasibility of adapting the heating system to operate at more efficient temperature settings	Description	Relation to Section 3.3 of this guidance, technical report, link to Article 13
(o)	Feasibility of adapting the domestic hot-water system to operate at more efficient temperature settings	Description	See Section 3.3 of this guidance, technical report. Link to Article 13
(p)	Feasibility of adapting the air-conditioning system to operate at more efficient temperature settings	Description	Link to Article 13
(q)	Metered energy consumption	kWh / MWh	To be metered as set out in Annex I, national calculation method
(r)	Whether there is a connection to a district heating and cooling network, and, if available, information about a potential connection to an efficient district heating and cooling system	Yes / No, plus further information	Local overview of district heating or cooling systems
(s)	Local primary energy factors and related carbon emission factors of the connected local district heating and cooling network	Numerical factor, e.g. 1	Local database on energy and carbon emission factors
(t)	Operational fine particulate matter ($PM_{2.5}$) emissions	$\mu g/m^3$, μg/kWh or g of PM2.5, which could inform an A to G rating	See Annex A7 of the report on increasing policy coherence between bioenergy and clean air policies and measures which provides a practical proposal on how to measure and assess buildings on the basis of their $PM_{2.5}$ emissions

In addition to the indicators, information about links to other initiatives can be given, if these are relevant in the Member State.

	Indicator	Unit	How to / Source
(a)	A smart readiness assessment has been carried out for the building	Yes / No	Link to Article 15, Annex IV
(b)	Value of the smart readiness assessment	[-]	Link to Article 15, Annex IV
(c)	A digital logbook is available for the building	Yes / No	

8. IMPLEMENTATION OF OBLIGATIONS UNDER ANNEX VI

Member States must bring into force the laws, regulations and administrative provisions necessary to comply with Annex VI by the transposition deadline of 29 May 2026.

The third paragraph of Article 19(2) allows Member States that rescaled their energy performance classes between 1 January 2019 and 28 May 2024 to postpone the rescaling of the EPC classes. This derogation does not apply to the implementation of obligations related to the independent control system; therefore, the transposition deadline of 29 May 2026 cannot be postponed.

8.1. Definition of a valid EPC

Annex VI(1) requires Member States to set out a clear definition of what is considered a valid EPC in their EPC scheme.

The definition of a valid EPC must cover the elements listed in points (a) to (d) of Annex VI(1) of the EPBD. These points are described in Chapters 8.1.1 to 8.1.6.

Information relating to the definition of a valid EPC, including all the criteria and elements identified in Chapter 8.1 should be communicated and be made readily available to independent experts and all other relevant stakeholders. This information is also part of the obligation on public disclosure in Annex VI(5).

8.1.1. *Validity of the calculations*

This refers to the calculation methodology and the calculation itself used to produce an EPC. Although it is technically possible to produce an EPC by hand, in most cases independent experts rely on calculation tools. For an EPC to be valid, it must have been produced using a calculation tool which is in line with the calculation methodology specified by the relevant Member State.

Member States use a variety of approaches with regard to the calculation tools available in their territories. Some Member States produce an official tool whose use is mandatory. Other Member States instead make use of commercial tools that are certified to be in compliance with their calculation methodology. Some Member States use a mixed approach, issuing an official tool, but also allowing for the use of certified commercial tools. These different options have their advantages and disadvantages, but are all valid and Member States may choose the approach they believe is best suited.

Regardless of the approach used, Member States must ensure that valid EPCs have been produced using a calculation tool valid in their territory and that there has been no tampering with the calculation engine. Member States may do so, for example, by ensuring that calculation tools are protected from modifications or by carrying out individual checks.

8.1.2. *Minimum number of elements differing from default or standard values*

Member States must ensure that the definition of a valid EPC includes information on which variables must be filled in and with a value different from default or standard.

The calculation of EPCs and their input data may vary depending on the type of building. For example, EPCs for small existing buildings commonly require fewer elements or details than a large and complex new building. It may also depend on the complexity that the calculation allows for. EPCs across the EU vary quite significantly with regard to the number of elements considered in the calculations, ranging between 30 and 750 variables. Most EPC schemes are in the range between 100 to 200 variables ([24]).

It is common that calculation software pre-fills in some of these variables with standard values, which are pre-defined, typical or common values. Default or standard values are used in most calculation methodologies and calculation tools. For example, the calculation software may already have a pre-filled in value for the transmission performance of the wall in new buildings. Another example is where a calculation engine pre-fills in information about the type and performance of a heating system. In the case of existing buildings, the standard value may be set up to reflect typical building construction characteristics.

In the case of calculation methodologies that use a reference building, these standard values should not be confused with the values provided for the reference or notional building. In this approach, the performance of the building is evaluated by comparing the actual building to a theoretical building (known as the 'reference building', hence the name of the approach) which shares the same geometrical characteristics of the building but uses a given set of performance characteristics (e.g. wall insulation).

To ensure that an EPC is representative of its building, the building model and its characteristics require a minimum level of detail. Otherwise, important information may be missing. Member States should therefore ensure that a minimum number of building characteristics or specific characteristics are used in a calculation. These minimum characteristics must be different from default or standard values.

This could include, for example, building type and use, location, climate, the physical characteristics of the building (e.g. size, geometry, U-values) and its systems (e.g. performance).

8.1.3. *Validity checks on input data*

This refers to the input data used in the calculation methodology. For an EPC to be valid, the input data used in an EPC must accurately represent the building, including its type, use, location, climate and characteristics (see Chapter 8.1.2). Otherwise, the model will not be representative, and the results of the assessments will be incorrect.

When carrying out the independent control of EPCs, Member States must verify that the input data reflects the building through a validity check.

The Commission recommends that the validity check is linked at least to those elements that are considered part of the minimum assessment (see chapter 8.1.2) or that are considered the most important contributors to the performance of a building (e.g. insulation values and performance of technical building systems).

Member States should specify how this validity check is to be carried out and what proof(s) will be deemed acceptable. For example, this could include provision of documentation (regarding plans, product specifications or certificates or on-site tests (e.g. blower door test)), random on-site checks, automated checks in calculation software or a mix of options.

Member States should communicate with experts about the validity check process and how their work on EPCs will be evaluated in this regard. This could be done through training, regular updates on expert databases, directly in the calculation software, etc.

([24]) Source: CA EPBD (CT5) Certification and Training status report (2022) - (CT5) Certification and Training – Status in 2022 - CA EPBD.

8.1.4. *Maximum deviation from the energy performance of a building*

The most visible and direct approach to evaluate if an EPC is valid or not is through the main indicator (kWh/(m^2 y)). For this evaluation, it is necessary to compare the EPC value as assessed by the expert and the EPC value independent control system. Because this value may change depending on the stage or who is assessing the EPC, it is important to clarify the terms used henceforth:

— 'Assessor value': this is the value provided by the Independent Expert that has produced the EPC

— 'Control value': this is the value provided by the Independent Control System

— 'Recorded value': this is the value as recorded in the EPC at any given time

Member States must set the maximum deviation of the 'assessor value' from the 'control value'. This assesses how far a given EPC can be from its control value before it cannot be considered a valid EPC any longer.

Article 19(1) requires that EPCs express the energy performance of a building by a numeric indicator of primary energy use in kWh/(m^2/y). Pursuant to Article 19(1), it is preferable for the maximum deviation of a building's energy performance to be based on this indicator. Additional indicators may also be used.

There are multiple ways in which the maximum deviation of a building's energy performance can be set. The EPBD allows Member States some flexibility on how to evaluate the maximum deviation of the energy performance (i.e. which indicator is used) and how precise the evaluation of the performance needs to be (i.e. the tolerance).

The most common options for setting the maximum deviation are described in the following paragraphs.

Maximum deviation based on fixed amount

This defines the maximum deviation as a fixed amount of the unit used to measure the energy performance. For example, in the case of primary energy use, the maximum deviation could be set at ±10 kWh/(m2.y).

This criterion is clear and easy to understand for independent experts and stakeholders. Depending on the range (tolerance) provided, it is particularly suitable for detailed calculations and when the characteristics of the building and its systems are well known. This is typically the case for new builds or major renovations, where the independent expert can rely on available and up-to-date plans or specifications and where it is easy to verify the details on site. However, if the range (tolerance) is limited it may be problematic for existing buildings, where the information is not available or it is difficult to check the construction details on site.

It is therefore very important to set the tolerance for the maximum deviation at the correct level. Member States could set different tolerance levels based on the type of building, its use or when an EPC is produced. Member States could set different levels of tolerance depending on these elements.

In the example of a Member State that sets up a deviation of ±10 kWh/(m2.y):

— An EPC where the assessor value is 85 kWh/(m2.y) and the control value is 93 kWh/(m2.y), would be valid.

— An EPC where the assessor value is 85 kWh/(m2.y) and the control value is 100 kWh/(m2.y) would be not-valid.

Maximum deviation based on a proportional value

This defines the maximum deviation as a proportion of a building's energy performance. For example, in the case of primary energy use, the maximum deviation could be set at ±5 % of the energy performance of a building (in kWh/(m2.y)).

This criterion is clear and easy to understand for independent experts and stakeholders. Since it is proportional, it provides flexibility for different levels of performance. Its use is well suited to existing poorly performing buildings or when there is limited information about the building. However, given that it is proportional to the value of the performance, it may become too strict when the value of a building approaches 0 (kWh/(m2.y)). In this scenario the tolerance becomes very tight and small differences in the assessment could make an EPC invalid. Given that calculation methodologies have an embedded level of flexibility, it is important to ensure that the maximum deviation allows also for a degree of flexibility.

Member States could set different tolerance levels according to the level or type of EPC. It should be noted that, for buildings approaching energy performance close to 0, the range (tolerance) may need to be higher, which can be counterintuitive and difficult to communicate.

In the example of a Member State that sets up a deviation of ±5 % of the energy performance (in kWh/(m2.y)):

— An EPC where the assessor value is 96 kWh/(m2.y) and the control value is 100 kWh/(m2.y), would be valid.

— An EPC where the assessor value is 90 kWh/(m2.y) and the control value is 100 kWh/(m2.y) would be not-valid.

Maximum deviation based on whether a building is in the correct class (Y/N assessment)

This criterion only evaluates whether a building has been assigned the correct class. The differences in the value of the indicator (kWh/(m2.y)) are not considered.

This criterion is very direct and easy to communicate and apply. It provides a sufficient level of information at the level of the EPC scheme (e.g. X % of EPCs correct/incorrect), although its value at individual EPC level is more limited.

However, it is subject to the energy classes and how these are defined. It can become very strict for buildings that have a performance close to the class limits.

Due to its limitations, the Commission does not recommend this approach.

Maximum deviation based on a mixed approach

As its name suggests, this approach relies on using at least two of the criteria previously described.

For example, the maximum deviation could be based on a fixed amount for buildings with good or very good performance (e.g. classes A, B and C) while using a proportional approach for worse performing classes (e.g. D, E, F and G).

The nature of the assessment of buildings performance may result in differences in the level of accuracy that can be achieved. For certain buildings (e.g. new buildings or major renovations), the independent expert may rely on readily available and detailed information, while for other buildings this information may be more difficult or costly to obtain. This limited access to information tends to be more prevalent in poor performing buildings.

Because it combines the benefits of the different approaches, a mixed approach is suitable to multiple situations. However, due to the use of a mix of criteria, it can be more prone to confusion. Nevertheless, given their qualifications or certifications, independent experts should be able to manage the different criteria. Member States that use this approach would need to ensure that the criteria are adequately communicated in order to avoid confusion.

8.1.5. *Additional elements*

In line with the last sentence of Annex VI(1), Member States may introduce additional elements into the valid EPC definition, such as boundaries for specific input data values or other specific requirements.

This could include, for example, maximum deviation values (i.e. tolerance) for the physical characteristics of a building and its systems.

When setting requirements, Member States may also consider the type of building, use and purpose of the EPC. This could include, for example: building typology, orientation, geometry, location, climate data and the performance of its building elements or systems.

Member States have some discretion in setting the boundaries of these values. They may adjust these boundaries, for example, depending on the building characteristics (e.g. its size), its typology (e.g. residential, office, school) or its state (e.g. new construction, renovated or existing). For example, quality criteria could be stricter for new buildings, where information and access to the building is easier.

Member States may also introduce requirements in terms of the information necessary for the processing of the EPC. This could include, for example, complete address, cadastre reference, on-site photographs, plans, etc. While these elements may not directly affect the calculation of the energy performance of the building, they are still relevant for administrative and quality purposes. Proper reference to the building (address or cadastre reference), for example, is important to ensure that the EPC is correctly attached to the building or to integrate with databases. On-site photographs or plans can confirm the presence of the independent expert (where relevant) or provide necessary information for the independent control system.

Member States may also apply validity requirements to the recommendations included in an EPC. These could include, for example:

— minimum number of recommendations;

— recommendations appropriate to the building;

— recommendations covering multiple building elements or technical building systems;

— recommendations covering a mix of short, medium and long-term measures.

8.1.6. *Validity and rating of an EPC following an assessment by the independent control system*

The purpose of the independent control system is to evaluate if an EPC is within the boundaries established by the definition of valid EPC. It is expected that there will be differences between the 'assessor value' for an EPC and the 'control value' determined by the independent control systems. This may create confusion as to which value is considered the correct one and which value is indicated in the EPC (the 'recorded value'). Member States should specify what happens in these situations. The Commission recommends the following approach for different scenarios.

The EPC is produced by an expert and it is not evaluated by the independent control system.

In this scenario, the independent expert produces an EPC. The EPC may have gone through some automated checks or verification (e.g. to determine that it has fulfilled the minimum number of filled in values), but it has not been evaluated by the independent control system.

The 'assessor value' is considered valid and it will become the 'recorded value' in the EPC.

The EPC is produced by an expert and is evaluated by the independent control system as valid.

In this scenario, the independent expert produces an EPC, which then goes through verification and control procedures by the independent control system. This procedure identifies that the 'assessor value' is valid.

The 'assessor value' is considered valid and it is recommended that it becomes the 'recorded value' in the EPC, even if there are differences between the 'assessor value' and the 'control value'.

The EPC is within boundaries and therefore there is no need to change it. This may be particularly relevant if the EPC rating has a bearing on the building's legal status (e.g. for new buildings) or where it is linked to subsidies or financial schemes (e.g. when the EPC is used to demonstrate improvement). By keeping EPC rating EPC as originally assessed, the independent control system introduces no changes in any of these situations, therefore avoiding possible complications (e.g. recalculation of the value of a subsidy).

The EPC is produced by an expert and the independent control system identifies this as a non-valid EPC.

In this scenario, the independent expert produces an EPC, which then goes through the verification and control procedures by the independent control system. This procedure identifies that the 'assessor value' is non-valid.

If the EPC is deemed non-valid, then the Commission recommends that the control value become the rating of the building or that the original EPC is considered void (i.e. the building does no longer have an EPC rating). This may, of course, have consequences for the building and the building owners, for example the need to look for a different expert to issue the EPC. It is recommended that Member States abide by the principle of proportionality and consider the consequences in different circumstances. For example:

— EPC for new buildings or buildings undergoing major renovation: if, following the independent control system, the building does not comply with the relevant legislation (e.g. ZEB or minimum energy performance requirements), the owner or developer of the building could be asked to rectify the situation and produce a new EPC afterwards;

— EPC for buildings that are receiving subsidies: Member States may use the control value to recalculate the effects on subsidies or ask for a repeat of the assessment following remedial works. Member States may apply similar rules for other subsidy schemes where the subsidy is proportional to a set of criteria.

— EPC for buildings that are being sold or renovated: if there are limited legal or economic consequences, Member States could make the recorded value equal to the control value. For example, if there are no minimum energy performance standards (obligation to renovate based on the EPC rating) or if the differences in the EPC rating do not represent a significant difference in the value of the building or subsequent running costs.

In all cases where the EPC is deemed non-valid, the owner or tenant of the building should be notified of the error, including the rating evaluated by the control system. This will allow them to carry out corrective measures, ask for any relevant compensation or simply be aware that the EPC may no longer be valid.

When considering the consequences of valid or invalid EPCs, Member States should also consider the level of responsibility of the independent expert and any legal consequences that they may face (see Chapter 8.3.5 Enforcement and penalties).

8.2. **Analysis of the quality of the independent control system for EPC schemes**

Annex VI(2) of the recast EPBD introduces a new requirement to ensure that at least 90 % of EPCs are valid. It also introduces random sampling as the way to assess whether the overall EPC scheme complies with the 90 % valid EPC criteria.. Finally, the EPBD requires Member States to regularly publish the results of the quality assessment. The objective of this approach is to ensure a high level of quality in EPC schemes while also providing information for the public and users, therefore supporting the perception of quality of EPCs.

The following sections describe the different steps of the process.

8.2.1. *Definition of quality objectives in Member States*

Annex VI(2) requires Member States to ensure at least 90 % of EPCs are valid in their EPC schemes.

In their definition of quality objectives, Member States may go beyond this minimum level or include additional objectives. This could include elements that Member States consider relevant for quality purposes, but that are not strictly part of the definition of valid EPCs. For example, Member States could include quality objectives relating to the level of quality in recommendations (if these are not part of the definition of a valid EPC), number of complaints from users or number of available assessors proportional to the building stock.

In the relevant national implementing (‘transposition’) measures, Member States must clearly state the quality objectives applicable to their schemes.

8.2.2. *Evaluation of the quality level through sampling*

To ensure the quality of an EPC scheme, it is important to be able to assess the scheme as a whole. This would involve establishing if the scheme is reliable or not, and identifying how far from or close to the objectives the scheme is and what areas, if any, need improvement. However, evaluating 100 % of the EPCs issued in an evaluation period would be very complex, costly and could delay the process for issuing an EPC. A typical approach in quality systems is to instead rely on samples, which must comply with a number of criteria.

This is why the recast EPBD requires Member States to evaluate the overall quality level in an EPC scheme (defined in Chapter 8.2.1) through random sampling. To ensure that the sampling is sufficiently representative of the EPCs that have been issued during the evaluation period, the recast EPBD also requires that the random sampling is carried out with a minimum 95 % statistical confidence level.

The size of the random sample is determined by:

— the total number of EPCs issued for the evaluation period (usually a year). This will depend on the Member State and the level of EPC activity;

— the definition of a valid EPC. This will depend on the definition in force in the Member State and it mostly refers to the maximum deviation of the value of the indicator (primary energy in kWh/(m2.y));

— the confidence level for the sample. This is set at 95 % by Annex VI(2).

Evaluating the quality levels of an EPC scheme can be made very complex by the choice of elements to be considered for the sampling process and the nature of the assessment of performance in buildings.

As indicated above, multiple elements determine what constitutes a valid EPC. If all the elements were taken into consideration for the calculation of the sample size, this would result in a complex assessment and a disproportionately large sample size. The aim of the provision in the EPBD is to provide a straightforward assessment of the overall level of quality of the EPC scheme. For this reason, the Commission recommends that only the maximum deviation of the main indicator (primary energy in kWh/(m^2.y)) be taken into consideration. See Chapter 8.1.4 'Maximum deviation of the energy performance of a building'. This simplification ensures a sampling process that is proportionate to the objectives of quality assurance, without introducing an undue burden into the process. This simplification should not apply to the rest of the independent control system.

For example: a Member State uses multiple criteria to define the validity of an EPC, including maximum deviation for multiple indicators (e.g. total primary energy, GHG emissions, RES generation and individual U-values). To evaluate the quality level, Member States could consider just the main indicator (total primary energy) as the factor identifying if an EPC is valid or not. This would apply to both the calculation of the sample size and the obligation to ensure that 90 % are valid. The remaining elements would still need to be taken into consideration for the purposes of the independent control system.

As indicted in Chapter 8.1.4, it is possible for Member States to use different criteria for the maximum deviation from the energy performance. To simplify the process of calculating the sample size, it is recommended that, for that purpose, Member States assume a constant maximum deviation equal to the one used for the better performing energy classes.

For example: a Member State uses a maximum deviation of ±10 kWh(m^2.y) for classes A-C, a maximum deviation of ±20 kWh(m^2.y) for classes D-E and a maximum deviation of ±30 kWh(m^2.y) for classes F-G. In this scenario, the Member State could calculate the sample size assuming a constant maximum deviation of ±10 kWh(m^2.y) throughout the whole scheme, basically assuming a worst-case scenario. This simplification only applies to the calculation of the sample size. The criteria for evaluating the validity of an individual EPC must remain the same.

The recast EPBD requires that the evaluation period of the EPC scheme must not exceed one year. Member States may decide on the start and end of the evaluation period, which must be clearly identified and communicated. Member States must select the random sample from the EPCs issued during the evaluation period.

Given the number of EPCs commonly issued and current quality levels (e.g. maximum deviation) available in Member States, the size for the sample will typically range from:

— 100 to 150 EPCs sampled for Member States with lower EPC numbers and milder quality criteria;

— 300-350 EPCs sampled for Member States with large EPC numbers and stricter quality criteria.

Even if a selection is made randomly, it is worth nothing that it may not be fully representative. Some differences are to be fully expected, but the nature of random selection may result in some categories or types of EPCs being over-represented. If the sample is of sufficient size, this issue should be relatively minor, but it may still happen especially when there are EPC types/categories which are much smaller than other types/categories or when the sample size is relatively small. To ensure that a sample is representative, following selection, Member States should check that the distribution of building categories, types of EPC (e.g. new build or existing) and ratings are within reasonable boundaries. If the sample is considered not representative Member States may:

— discard the first selection and re-select the full sample;

— discard EPCs from over-represented categories and introduce new EPCs from under-represented categories. The selection of the individual EPCs to be discarded or introduced should be random.

For example, a Member State forms a random sample of 300 buildings. In this sample, it is detected that hospital buildings are over-represented (45 buildings or 15 % of the sample, when they only represent 5 % of the total EPCs issued in the evaluation year). In this case, the Member State could choose to deselect 30 of the hospital buildings (chosen randomly) and select 30 new EPCs from other categories (chosen randomly from under-represented categories).

Most Member States evaluate the quality of EPCs on an ongoing basis. This means that the random sample may not be selected at a specific moment, but the selection will instead take place overtime. For Member States that evaluate on an ongoing basis, the Commission recommends that, during the overall evaluation period, the independent control system make an evaluation at multiple instances to verify that the random selection is approximately representative of the overall population. After each of these evaluations, the independent control system could adjust which categories random EPCs are selected from, if needed.

Member States may choose other methods provided they ensure a random selection that is representative of the overall number of EPCs issued in the evaluation period.

8.2.3. *On-site visits for verifying input data*

In many EPC schemes, the independent control systems check the validity of the input data against documentary evidence (e.g. plans or specifications). In some cases, this input data verification goes a step further by including an on-site visit to verify that the documentation provided reflects that actual building. This is because buildings undergo multiple changes and modifications during their lifetime, from the design stage, to construction, maintenance, renovation and normal use. The documentation available for a building may not always reflect these changes, so on-site verification is needed.

Annex VI(2) requires that, for on-site verification of input data, Member States select 10% of EPCs from the random sample taken for the quality evaluation of the EPC scheme (see Chapter 4.2.2). The selection of this 10 % sub-sample should also be done randomly.

In most cases, on-site visits will require the authorisation of the building owner and/or tenant to access the building. Building owners and/or tenants may not want to give access to the building for a variety of reasons. Access to a building must always follow relevant national legislation, and any personal rights must be respected.

The fact that buildings must be selected randomly but building owners and/or tenants may not provide access may make it difficult to ensure a random selection. In this case, a best-effort approach is warranted. The Commission recommends that, if access to a building is denied, the EPC for that building is discarded from the sub-set of 10 % of buildings that undergoes an on-site visit (it may still be part of the overall random sample). An EPC with a similar profile could be selected from the overall random sample to make up for it. For example: the owner of a residential building with a rating of E does not provide access to the independent control system. In this case, the independent control system could choose another residential building with an E rating and request access to it.

While this approach may not ensure a fully randomised sample, it would still ensure a representative sample, which is the aim of the recast EPBD.

Member States could offer incentives to building owners and/or tenants that provide access to their buildings. For example, Member States could offer free energy advice, a building renovation passport, or monetary compensation. Member States can choose whether or not they offer compensation and, if they do, what type of compensation.

The verification of input data via on-site visits may be carried via virtual means where appropriate. In this case, the criteria for virtual means set out in section 3.2 would apply.

8.2.4. *Delegation of EPC schemes and independent control systems*

Article 27 allows Member States to delegate responsibilities for implementing the independent control system. Member States may decide how to apply the random sampling to measure the overall level of valid EPCs in the EPC scheme.

Member States may opt to evaluate a random sample and request EPCs from delegated bodies on the basis of total number of EPCs issued by each body.

Member States may also decide to delegate evaluation through random sampling. In this case there would be 2 options:

(a) national authority fully delegates the evaluation of the quality level and assigns a quota of EPCs to be randomly checked by each delegated body;

(b) national authority fully delegates the evaluation of the quality level and requires a separate random sampling (based on number of EPCs issued by delegated body and 95 % confidence) to each delegated body.

To ensure quality levels and clarity of responsibility, the Commission recommends the use of option (b).

If independent control systems are delegated to non-governmental bodies, Annex V(2) requires that at least 25% of the random sample must be evaluated by a third party. This third party can be a governmental body (e.g. a national agency) or another non-governmental body. Member States could require that the third-party verification is carried out by a company certified to carry this type of assessment.

8.3. **Quality management of EPC schemes**

The evaluation tool described in Chapter 4.2. is a typical assessment tool applied in many quality systems. However, random sampling only measures if a quality level has been achieved. On its own, it is generally insufficient as a way of *maintaining* a satisfactory level of quality.

To ensure the required level of quality, an overall quality management approach is needed. The approach should look after the overall EPC scheme and the process for issuing issue EPCs. In Annex VI(2), the recast EPBD indicates that Member State must take pre-emptive and reactive measures to ensure the quality of the overall scheme. It allows Member States some flexibility in deciding which measures are most suitable.

In their approach to ensure the required level of quality, the Commission recommends that Member States take into consideration all the elements described in Chapters 8.3.1 to 8.3.6.

8.3.1. *Qualification and certification*

Independent experts must have the necessary expertise to evaluate the performance of buildings. This level of expertise can be demonstrated thorough either qualification or certification schemes.

Member States should consider the importance of this when designing qualifications and/or certification of independent experts, following the requirements set out in Article 25 of the EPBD.

8.3.2. *Training*

Training covers both initial training (e.g. if required for certification) and ongoing training throughout the years. It is one of the most important components of quality assurance, but unfortunately it seldom receives the necessary attention.

Training must cover all the aspects of the EPC issuing and validation process:

— calculation methodology (e.g. understanding of the performance of a building, its different elements, and how the assessment is carried out);

— assessment tools (e.g. training on the use of a specific calculation tool);

— assessment to produce an EPC (i.e. how to carry out an EPC assessment);

— conditions for the validity of an EPC (independent experts must understand how their work will evaluated);

— administrative process – covering the non-technical aspects of issuing an EPC, such as documentation and uploading into the database;

— penalties/enforcement; independent experts must understand the consequences of issuing EPCs that are then evaluated as non-valid.

The Commission strongly recommends that independent experts are provided with updates to their training. Member States may decide if these updates could take place at regular intervals (e.g. every three years) or when the EPC scheme is amended. Member States may also decide if these updates become compulsory to maintain accreditation or are only voluntary.

8.3.3. *Embedded control and advice in calculation tools or EPB databases*

Independent experts may introduce errors during the evaluation process, especially given the number of variables to be considered. This can happen either by mistake or intentionally. A powerful technique for avoiding errors in the assessment is to embed control or advice in the issuing process itself, so that the independent expert receives a direct message. This can be done in the calculation tool or when the EPC is uploaded to the EPB database.

The advantage of this approach is that it works pre-emptively, helping the expert to avoid errors and facilitating the work of the independent control system. Usually, this approach results in a reduction of costs and administrative procedures. The Commission recommends its use where possible in the EPC issuing process.

For example, a calculation tool could generate messages for the independent expert indicating that one or more input/output values in the EPC are either incorrect or would need verification. Examples of messages could be:

— 'Clash in geometric values (e.g. the surfaces of the different building elements do not add up to the total, more PV area than roof area)';

— 'Out of range values (e.g. the U-value of the building is excessively low/high)';

— 'Missing technical information (e.g. the heating system is missing information about insulation values, the U-value of the window frame has not been introduced)';

— 'Missing or erroneous administrative information (e.g. the address is incomplete the cadastre reference number is incorrect)'.

These messages could require the independent expert to make a correction or confirm the value. The error messages would ensure that the independent expert is aware that something may be amiss and confirm or correct it.

When combined with other sources of information, these support tools can be very specific. For example, the tool could detect that the U-value is very low for a specific building typology (e.g. buildings built in the 1960s). The expert could then confirm the value (if they have measured the insulation and are sure of the U-value) or make a correction.

The embedded control and advice should clearly differentiate between those values identified in both 8.1.2 and 8.1.3 and the rest of the values.

8.3.4. *Ongoing quality control and verification*

In addition to the random sample required by the recast EPBD, Member States could introduce additional quality controls. As indicated above, random sampling is a key component for the evaluation of the overall EPC scheme, but on its own it may be insufficient to ensure and maintain the required level of quality. For this reason, Member States may consider the introduction of additional quality control measures.

There are multiple measures for quality control and verification that Member States may use.

— Additional random samples. A larger sample base ensures that more EPCs are evaluated, which will increase the level of quality by reducing the number of invalid EPCs. This is a valid reactive measure, although it may not be as cost-effective as other measures ([25]).

— Targeted quality control. In this case, the EPCs are not selected on a random basis, but instead, the independent control system selects EPCs with criteria which make them more likely to be incorrect. For example, Member States could concentrate on EPCs that are very close to the rating threshold or EPCs that are abnormally high/low performing for a given building category. Member States could also concentrate efforts on specific independent experts. For example, Member States could run more checks on those experts who issue an abnormally high number of EPCs. Specifically targeting EPCs that are more likely to be invalid makes the controls more cost-effective. On the other hand, this method may decrease the likelihood of spotting new types of errors or and is prone to selection bias.

— Partial controls. These are similar to targeted quality control but applied to specific parts of EPCs which Member States may find relevant. For example, independent control systems could concentrate on the U-value of buildings because they have detected that this is the area where most errors occur.

Typical errors detected through random, targeted or partial controls are good candidates for embedded controls or advice. The results of the controls may also be used to develop or update training material.

The introduction of one or more additional control measures (on top of the overall random sampling) makes experts more mindful of the multiple controls, which generally makes them more attentive to the assessment and less likely to make errors.

Member States may combine several of these measures and, because of their effectiveness, are strongly encouraged to do so.

8.3.5. *Enforcement / penalties*

In line with Article 34 (Penalties), Member States may introduce penalties for independent experts that fail to produce EPCs of sufficient quality, whether by error or intentionally. The application of penalties is a key part of ensuring a level playing field. Any penalties applied must be effective, proportionate and have a deterrent effect.

Member States have different options when applying penalties. They can:

— require re-issuing of the affected EPC;

— require re-issuing of a series of EPCs (if errors are suspected);

— require re-training or re-certification;

— impose a temporary ban (e.g. one-year ban on issuing EPCs);

— permanent loss of certification or qualification;

— monetary fines.

Member States should also consider the responsibilities of independent experts beyond enforcement and penalties. For example, in France the EPC can be legally challenged, which may result in economic compensation.

8.3.6. *Total quality management*

Single quality measures are unlikely to produce the required results. Targeted sampling on its own may be less cost-effective than training. Penalties without training would be unfair. And penalties without a strong detection mechanism are a weaker deterrent .

For this reason, it is recommended that Member States take a structured and organised approach to the independent control system.

([25]) Random sampling is a key component of the overall assessment.

Since its inception, the Concerted Action EPBD project (CA EPBD) has carried out extensive work analysing and discussing multiple quality approaches for EPC schemes. The Commission highly recommends consulting the CA EPBD's findings for the design of the independent control systems. These findings cover each of the elements described in Chapters 8.3.1 to 8.3.6.

There are also extensive quality management manuals and tools available, which Member States are encouraged to consider.

8.4. **Independent control systems and EPB databases**

Article 20(8) requires that all issued EPCs are uploaded into the databases for the energy performance of buildings. This includes the full EPC, with all its outputs and recommendations, and all the data (i.e. input data) needed to calculate the EPC. The independent control system requires this information to evaluate the validity of EPCs and the overall quality of the EPC scheme.

For quality and traceability purposes, Annex VI 2(8) requires that when a new or an existing EPC is amended or modified, the EPB database, national authorities (including the independent control system) are able to identify the expert that uploaded, amended or modified the EPC. This should also apply to EPCs that have been amended through the simplified updating procedure.

To make EPB databases more compatible with other databases, it is strongly recommended that all databases use individual identifiers for the building or building unit. These identifiers could be linked to the cadastre, for example.

The use of interconnected databases can also be used for quality assurance purposes. For example, by having the EPB database connected to the national cadastre database, Member States could ensure that certain building information or data are cross-checked or even filled in pre-emptively (e.g. year of construction, building area).

8.5. **Availability of EPCs**

The EPBD recast requires Member States to ensure that the EPC is available to prospective building owners and tenants. A primary function of the EPC is to enable people to take a budling's energy performance into account in their decision-making process when buying or renting a building. The point at which the EPC is made available is therefore very important. When checking for the availability of EPCs, Member States should check they are available at the right time. For example, it is common to check for an EPC when the deeds are exchanged in a sale or after a lease has been signed in case of a rental. However, this only guarantees that the EPC was provided at some point in the process, which may have been too late to have an effect on the decision process.

The EPBD requires that, when a building is offered for sale or rent, the EPC indicator and class is stated in advertisements. Annex VI specifically requires Member States to verify the visibility of the EPC. Having the EPC available in advertisements means that the prospective buyer or tenant will have access to the relevant EPC information from the start.

Due to the cost of verification, the Commission recommends focusing efforts on those areas where it is easier and more cost-effective to verify. For example, a Member State could concentrate on verifying the presence of EPC ratings in real-estate websites, news media or listings. Given the prevalence of websites as a way of looking for properties and the number of buildings usually found on these sites, this is a prime location for the use of automated verification mechanisms.

Member States may also use other tools like audits or inspection of advertising media, manual survey of real-estate locations or mystery shopping. These can provide effective alternatives when automated verification is not possible (e.g. in physical real-estate agencies) or to address specific identified gaps.

Article 19(3) requires Member States to ensure a common visual identity for EPCs. The Commission recommends that, together with this common visual identity in the EPC, Member States issue guidance, recommendations or obligations on the use of the EPC visual identity in advertisement media. The communication of a clear approach towards the use of a common visual identity would not only facilitate the use of automated verification mechanisms but would also provide clarity for advertisers and users, and avoid confusion.

8.6. **Public disclosure of information on quality levels**

Annex VI point 5 requires Member States to regularly publish information on the independent control system. The Commission recommends that this information be published following the evaluation period established in each Member State (e.g. at least yearly). The purpose of making this information available is to improve the perception of quality of EPCs. By providing up-to-date information on the evaluation process and its results, Member States can clarify some of the misconceptions about EPCs and their quality.

The EPBD requires at least the following information to be made available:

— definition of a valid EPC – this clarifies meaning of 'valid EPC' and what level of quality is expected for each EPC;

— quality objectives for the EPC scheme – this provides information about what the overall quality level of the scheme should be, including additional elements (see Chapter 4.1.5);

— results of the quality assessment – this provides information about the actual level of quality of the EPC scheme. The Commission recommends that Member States include the following elements:

— results of the random sample verification process (i.e. % of valid EPCs);

— summary description of all quality measures employed;

— summary of the results of the different quality tools used (e.g. % of valid EPCs in targeted sampling), including changes compared to previous years;

— contingency measures to improve the overall quality level of EPCs.

The information above may be published in different formats (e.g. report or updated webpage alongside the EPB database).

8.6.1. *Differences between the calculated/estimated and measured energy performance*

The differences between the calculated/estimated (asset rating) and measured energy consumption have been identified by Member States as a source of misunderstanding which affects the perception of the EPC system ([26]).

As an information tool, EPCs should enable comparisons between different buildings. Almost invariably, this requires an asset rating approach based on standardised values for multiple building characteristics and parameters, particularly those related to the building use, e.g. values relating to the number of occupants, occupancy patterns, and intensity of consumption for non-EPB uses. This is a similar approach to those used to compare different products (e.g. consumer products, motors or cars).

A common misconception about EPCs is that they must replicate exactly the actual energy consumption of any given building. This has given rise to the so-called 'performance gap' between the energy consumption indicated in EPCs and the measured consumption. In practice, the performance gap may be due to a number of reasons (in no particular order):

— influence of user behaviour (expected differences);

— errors in the EPC calculation;

— improper installation of building elements or systems (e.g. windows not adequately draft-proofed, missing insulation, systems not properly commissioned);

— systems not operating properly (e.g. boiler not working in condensing mode, heat pump working at higher temperatures);

— deterioration or faults in systems (e.g. boiler broken down, ventilation operating at reduced levels).

([26]) CA-EPBD-CT3-Certification_Control-system_Quality-2018.pdf (Section 3.2.2).

The Commission recommends that Member States address the misconceptions about the differences between the calculated/estimated (asset rating) and measured energy consumption in its public information on quality levels and in general communication on EPCs. Specifically, they should provide information and explanations on the characteristics of the EPC and how relevant differences may be detected and resolved. It is important that users understand the purpose of the EPC and are empowered to act accordingly.

For this, Member States could use one or more of the following options:

— publish information on the principles of asset rating, how it works and what type of differences could be expected (e.g. typical ranges for deviation in certain buildings);

— provide access to independent experts, one-stop shops or any other service that may provide energy advice;

— provide a way for building owners or tenants to object to or enquire about the results of an EPC;

— provide users with information on how to evaluate if any observed differences in performance are due to the use of the building. For example: a by 1 °C increase in heating temperature translates into a 5-10 % increase in energy consumption; an increase in the number of occupants increases consumption by x %. Conversely, not switching on the heating until November reduces consumption by x %. This type of information may also be used to raise occupants' awareness of the importance of user behaviour in building performance;

— introduce EPC tools that allow building users to modify certain parameters in an EPC and observe the differences;

— provide checklists of elements or systems to be checked in a building.

Member States may also use other relevant communication tools related to EPCs like websites, FAQ sections, EPB databases, manuals, information material and the EPC itself.

ANNEX 4

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Renovation passports (Article 12, Annex VIII)

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1. INTRODUCTION

The recast Energy Performance of Buildings Directive ('the recast EPBD') ([1]) sets out how the European Union can achieve a fully decarbonised building stock by 2050 via a range of measures that will help EU governments improve the energy performance of buildings in a structured manner, with a specific focus on renovating the worst-performing buildings.

The recast EPBD includes specific provisions on the establishment and operation of renovation passport schemes in Member States (Article 12 of the recast EPBD), which are the subject of this notice.

Member States are to introduce a scheme for renovation passports by 29 May 2026 (Article 12(1) of the recast EPBD), in line with the transposition deadline of the Directive.

2. PURPOSE

This annex provides guidance on Article 12 of the recast EPBD. The guidance aims to clarify the provisions of the Directive and to facilitate a more uniform and coherent application. It is addressed to the Member States and other relevant stakeholders.

3. IMPLEMENTING THE LEGAL PROVISIONS

This section clarifies the definition of the terms used in Article 12 of the recast EPBD and provides guidance on the interpretation and implementation of that Article and of Annex VIII.

3.1. Summary of the legal provisions

Article 12 requires Member States to introduce a renovation passport scheme and sets out the main provisions for implementing the scheme, including requirements on the content of renovation passports. Unless Member States decide otherwise, such a scheme is voluntary for building owners.

3.2. Definitions relevant to Article 12 and Annex VIII to the recast EPBD

The EPBD defines '**renovation passport**' in Article 2(19) as 'a tailored roadmap for the deep renovation of a specific building in a maximum number of steps that will significantly improve its energy performance'.

The roadmap is tailored both to the building needs, in terms of improving its energy performance through deep renovation, and to the building owner's needs. Renovation passports should target deep renovation – the ultimate goal of the renovation journey and therefore of the tailored roadmap is to transform the building into a nearly zero-energy building (before 1 January 2030) or a zero-emission building (after that date).

The term '**deep renovation**' is defined in Article 2(20) as 'a renovation which is in line with the 'energy efficiency first' principle, which focuses on essential building elements and which transforms a building or building unit:

(a) before 1 January 2030, into a nearly zero-energy building;

(b) from 1 January 2030, into a zero-emission building.'

Article 2(2) defines '**zero-emission building**' (ZEB) as a building with a very high energy performance, as determined in accordance with Annex I ([2]), requiring zero or a very low amount of energy, producing zero on-site carbon emissions from fossil fuels and producing zero or a very low amount of operational greenhouse gas emissions, in accordance with Article 11 ([3]);

Article 2(3) defines a '**nearly zero-energy building**' (nZEB) as a building with a very high energy performance, as determined in accordance with Annex I, which is no worse than the 2023 cost-optimal level reported by Member States pursuant to Article 6(2) and where the nearly zero or very low amount of energy required is covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or energy from renewable sources produced nearby.

([1]) Directive (EU) 2024/1275.
([2]) Annex I is the common general framework for the calculation of the energy performance of buildings.
([3]) Article 11 clarifies the requirements that apply to zero-emission buildings.

According to Article 11(4), when laying down the maximum energy demand threshold for zero-emission buildings, Member States may set an adjusted threshold for renovated buildings. As regards nearly zero-energy buildings, several Member States have established different thresholds for new and renovated buildings ([4]).

Other relevant definitions of relevance for this guidance include energy performance, building unit and building element, as defined in Article 2(8), 2(16) and 2(17) respectively.

3.3. **Interpretation and implementation of Article 12 of the recast EPBD**

3.3.1. *Introduction of renovation passport schemes*

Paragraph 1 of Article 12 sets out the requirement for Member States to introduce renovation passport schemes:

(1) *By 29 May 2026, Member States shall introduce a scheme for renovation passports based on the common framework set out in Annex VIII.*

The provision requires Member States to have in place, by 29 May 2026, a scheme which allows owners of buildings and/or building units to obtain a renovation passport.

This requirement applies to the entire national building stock in each Member State, regardless of region or geographical area. All residential and non-residential buildings and building units are to come under the scope of renovation passport schemes.

Article 12(1) does not further specify the arrangements for establishing and implementing the renovation passport scheme. Member States remain responsible for setting up the scheme and making it available. They may decide to operate the scheme directly or to delegate it to one or more private or public entities.

> Examples from Member States show that different set-ups can be used for an effective implementation of renovation passport or similar schemes. For instance, Electric Ireland Superhomes is a renovation one-stop shop established as a joint venture between Tipperary Energy Agency's Superhomes and Electric Ireland, an Irish utility company. Electric Ireland Superhomes offers a 'whole house retrofit service', which results in a home energy renovation plan.

A 'renovation passport' may have different names in different Member States, as long as the EPBD requirements are complied with. Examples of alternative names include 'energy renovation roadmap', 'energy renovation guide' or 'energy renovation compass'.

Regardless of the arrangements for implementing the scheme (e.g. national scheme, delegation of the operation, implementation at regional level), Member States are encouraged to ensure it is implemented consistently across their territories. For instance, to ensure equal access to the scheme across the national territory, the costs for issuing a renovation passport for buildings or building units with similar characteristics should not vary significantly depending on the location of the building.

Finally, renovation passports must be introduced for both entire buildings and building units. A 'building unit', as defined in Article 2(16), is 'a section, floor or apartment within a building which is designed or altered to be used separately'. For instance, owners of a non-residential section of a building (e.g. retail or offices) or owners of an apartment must be able to request a renovation passport individually.

([4]) A recent JRC study found all EU countries have an established definition for new NZEBs, while for existing buildings, 15 countries have a distinct definition, and 12 apply the same definition as for new buildings. In some cases, although the NZEB renovation is defined, there is no energy indicator requirement. Two countries do not have a legal definition for NZEB renovations.
Maduta, C., D`Agostino, D., Tsemekidi-Tzeinaraki, S. and Castellazzi, L., From Nearly Zero-Energy Buildings (NZEBs) to Zero-Emission Buildings (ZEBs): Current status and future perspectives, ENERGY AND BUILDINGS, 328, 2025, p. 115133, ELSEVIER SCIENCE SA, https://data.europa.eu/doi/10.1016/j.enbuild.2024.115133, JRC139203. Also available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC139203.

The Commission recognises that a deep renovation, defined in Article 2 as leading to ZEB level, may not be possible for certain buildings for technical or economic feasibility reasons. For that narrow category of buildings, Member States can still issue a renovation passport setting out the renovation steps that would result in at least a 60 % reduction in primary energy use [5] so that the building can still benefit from a renovation passport. Member States have flexibility to differentiate the approaches for preparing and issuing a renovation passport depending on the type of building and building unit addressed. The arrangements for addressing the residential and non-residential sectors (and categories therein, for instance offices or hotels and restaurants) [6] may differ in some respects. Some aspects of renovation passports may differ when addressing whole buildings or building units. For building units, certain renovation measures may be relevant mainly at building level (e.g. in relation to improving the energy performance of the envelope) and may require coordinated decision-making between the owners of the units making up the building. Because a renovation passport will often affect elements of common ownership (typically the building envelope) that require a collective agreement of co-owners, Member States should consider indicating which measures are likely to be subject to such a collective agreement.

Having separate types of renovation passport for residential and non-residential buildings may be beneficial given that financial support schemes for building renovation and methods for determining energy performance can vary between residential and non-residential buildings. Similarly, the best renovation steps to take and the order in which to take them may be influenced by different building typologies, possibly involving various ownership types and tenure statuses, and by the building owner's needs.

Member States may also consider treating different segments of the building stock differently according to energy performance. For instance, it may be particularly relevant to encourage renovation passports to be issued for buildings subject to minimum energy performance standards (MEPS). This could encourage the building owner to consider a deeper renovation than the one necessary to comply with the MEPS.

3.3.2. *Content of renovation passports*

The first paragraph of Article 12 requires that renovation passports issued in Member States under the Directive comply with a common framework.

This common framework is set out in Annex VIII to the recast EPBD, which comprises four sections:

1. a list of the elements that renovation passports must include (**mandatory elements**), for instance a graphical representation or graphical representations of the renovation roadmap and its steps for a staged deep renovation;

2. a list of the elements that renovation passports may include (**optional elements**), for instance information on how to access a digital version of the renovation passport;

3. the requirement to consider **the information contained in the energy performance certificate** of the building or building unit for which a renovation passport is issued, where possible, in order to assess the status of the building or building unit prior to renovation;

4. the requirement to rely on a set of **standard conditions** for the metrics used for estimating the impact of renovation steps.

Clarifications on those four sections are made in Section 3.4 of this guidance.

3.3.3. *Access of building owners and building unit owners to renovation passport schemes, including affordability*

Article 12(2) clarifies that renovation schemes are voluntary for the owners of buildings and building units. Owners must have the possibility to receive a renovation passport for their building or building unit on request. Article 12(2) provides that Member States are to take measures to make renovation passports affordable and are to consider providing financial support for vulnerable households.

Article 12 allows Member States to make renovation passports mandatory. If Member States decide to do this, the passports may be made mandatory for the whole building stock and all owners, or for specific segments of the building stock.

(5) Based on the rationale of Article 17(16).

(6) Annex I paragraph 6 provides a list of categories of buildings, which can be used as a reference.

Member States have discretion on the parameters that make the renovation passport mandatory: for instance, making renovation passports mandatory only for individual houses, only for the least efficient buildings or building units, only at specific points of the building life-cycle (e.g. 'trigger points' [7]), or depending on ownership (private or public).

Regardless of whether the scheme is made mandatory or voluntary, Member States are required to implement measures that ensure the affordability of renovation passports. Such measures may aim to:

(1) decrease the costs for producing the renovation passport, e.g. by linking renovation passports to existing schemes, such as energy performance certification, by providing digital support tools [8], or by aggregating demand for renovation passports (typically in the scope of large-scale renovation projects, e.g. at district level), in order to achieve economies of scale and reduce the costs of individual renovation passports; and/or

(2) decrease the costs for obtaining a renovation passport, e.g. by fully or partially covering the cost of a renovation passport for owners through dedicated subsidies.

The need to ensure the affordability of renovation passports applies in particular to vulnerable households [9]. In that regard, Article 12 requires Member States to consider providing financial support to this category of household for renovations.

Member States will have to consider providing financial support to vulnerable households wishing to renovate their buildings. The financial support for vulnerable households mentioned in Article 12 refers to the renovation passports themselves. Subsidies to cover the renovation passport costs in full or in part are the most relevant for that category of household, especially for energy-poor owners.

Besides the affordability of renovation passports, it is also worth considering coupling renovation passport schemes with financial support for renovation measures, in particular for households and owners of non-residential buildings that would not normally be able to afford the related costs. One idea could be to couple renovation passport schemes with renovation support measures already in place, while also strengthening financial, technical and administrative support for vulnerable households and building owners in general. This could make it more likely for owners to implement the renovation measures based on the renovation passport.

> For instance, the energy performance certification framework in Flanders (BE), which includes a building renovation roadmap element for residential and small non-residential buildings, is backed by financial support mechanisms to incentivise building renovation, including dedicated initiatives targeting vulnerable households.

3.3.4. *Coupling of renovation passport schemes with energy performance certification*

Article 12(3) emphasises the possibility for Member States to allow, where relevant, targeted coupling between renovation passport schemes and energy performance certificate (EPC) schemes.

3. *Member States may allow for the renovation passport to be drawn up and issued jointly with the energy performance certificate.*

Such a coupling can be beneficial in some situations, in particular:

— It decreases the cost of drawing up and issuing a renovation passport because part of the collection and processing of information for the energy performance certification (e.g. assessment of current energy performance) is also relevant for renovation passports. Where energy performance certification requires an on-site visit, the feedback from that visit would be used for both the EPC and the renovation passport.

([7]) As defined in Commission Recommendation (EU) 2019/786 of 8 May 2019 on building renovation.
([8]) See the example of as seen of the Woningpas in Flanders (BE), https://woningpas.vlaanderen.be/.
([9]) Article 2(28) of the recast EPBD defines 'vulnerable households' as households in energy poverty or households, including lower middle-income households, that are particularly exposed to high energy costs and that lack the means to renovate the building that they occupy.

— It allows renovation passport schemes to rely on some of the elements of the framework in place for EPCs: e.g. the recommendations of renovation measures that are also part of the EPC, the community of EPC assessors, accreditation schemes, assessment tools, data management infrastructure, etc.

However, where Member States decide to couple the schemes, they should carefully consider the following issues:

— Renovation passports and EPCs serve different purposes. A renovation passport offers a tailored roadmap for building renovation that serves to help owners and investors plan the best timing and scope for measures to take. The roadmap should therefore be tailored not only to the specific building, but also to the building owners' preferences, planning and financial situation.

— It is not always appropriate to issue a renovation passport at the same time as an EPC. For instance, in the context of a sale of a building, the EPC would be issued before the sale was advertised, while it would be more effective to issue the renovation passport after the sale was completed and considering the new owner's preferences and financial situation.

— While nothing prevents any valid and relevant EPC information being used to draw up a renovation passport, the audit for a renovation passport is typically more extensive than for an EPC and the exchange between the assessor and the owner is also more detailed. Thus, any past on-site visit for an existing EPC may not comply with the requirement to have an on-site visit for renovation passports.

— EPC assessors may not have the skills to draw up and issue a renovation passport. Additional training, accreditation or certification could be needed.

— The infrastructure for EPC schemes (digital tools for assessment of energy performance, collection, management and storage of EPC data, etc.) would have to be adapted in order to be fully effective for renovation passports.

On top of these considerations, Member States must take note of the requirement set out in Article 19(6):

6. *Where Member States provide for a renovation passport to be drawn up and issued jointly with the energy performance certificate pursuant to Article 12(3), the renovation passport shall substitute the recommendations pursuant to paragraph 5 of this Article.*

Compliance with this requirement can be ensured in different ways, for instance by including a relevant part of the building renovation passport in a substitution. An example would be the graphical representation of the roadmap and/or the concise description of the renovation steps – as required for renovation passports – together with a reference or link (e.g. QR code) to the full renovation passport.

3.3.5. *Requirements applying to arrangements for issuing renovation passports*

Article 12(4) and (5) clarify the requirements that apply to the issuing of renovation passports:

4. *The renovation passport shall be issued in a digital format suitable for printing, by a qualified or certified expert, following an on-site visit.*

5. *When the renovation passport is issued, a discussion with the expert referred to in paragraph 4 shall be suggested to the building owner to allow the expert to explain the best steps by which to transform the building into a zero-emission building well before 2050.*

On-site visit

The expert in charge of drawing up and issuing the renovation passport must make an on-site visit prior to issuing the renovation passport. The scope of the on-site visit is not further specified in Article 12, but in line with current practice, it could include:

— An assessment and visual check of the building or building unit and building elements, i.e. elements of the building envelope and technical building systems. This assessment can vary in terms of depth – it can be as elaborate as an energy audit, with on-site performance measurements and energy simulations, or it can be a more simplified check where the expert inspects the building and consults relevant documents.

— A discussion with the building owner, to better understand the specific needs and constraints applying to the renovation, in particular when it comes to renovation measures and financing. This input allows the expert to tailor the renovation passport to the owner's situation. While the roadmap in the renovation passport should be relevant regardless of the owner (e.g. when it comes to the sequencing of measures), in most cases the owner who requests the renovation passport will also be the one implementing the renovation measures. Taking into consideration the needs and situation of the owner ensures agreement with the suggestions in the renovation passport and their future implementation.

Member States are also encouraged to ensure that the on-site visits for issuing renovation passports are well-scoped and supported by appropriate guidance and material (e.g. assessment checklists). The material should provide a consistent framework for the collection of relevant data.

The requirement is to have at least one on-site visit before the renovation passport is issued. However, when laying down the detailed arrangements for drawing up and issuing renovation passports, Member States may decide to require additional visits, e.g. a Member State may decide to introduce mandatory updates to the passport after renovation measures have been carried out.

In accordance with Article 12(5), a discussion with the expert must be suggested to the building owner. This exchange must be proposed when the renovation passport is issued, once the expert has completed the assessment and drawn up an optimal renovation roadmap, in order to provide feedback and advise the owner on the first steps to take. This exchange is also an opportunity to discuss the steps towards transforming the building into a zero-emission building. This discussion between the building owner and the expert should help ensure that the owner embarks on a renovation with a clear understanding of the expert's conclusions and options for the steps to take.

Qualification or certification of experts

Article 12(4) requires the experts in charge of issuing renovation passports to be qualified or certified.

This requirement is also laid down in Article 25(1), which states that for the schemes under the recast EPBD (EPCs, renovation passports, smart readiness indicator, and inspection of heating, cooling and ventilation systems), assessments must be carried out in an independent manner by qualified or certified experts, who may operate in a self-employed capacity or be employed by public bodies or private companies.

In relation to the qualification or certification of experts under Article 12, further requirements from Article 25 must be complied with:

— According to Article 25(1), experts for the schemes must be certified in accordance with Article 28 of the Energy Efficiency Directive ([10]), which provides an EU framework for qualification, accreditation and certification schemes for energy efficiency-related professions.

— According to Article 25(2), information on training and certification relevant to the schemes, and up-to-date lists of qualified or certified experts (or companies) must be made publicly available.

These requirements on accreditation and certification and on making the relevant information publicly available, already apply to schemes implemented under the repealed EPBD (Directive 2010/31/EU) – for instance, energy performance certification schemes and inspection of heating, ventilation and air-conditioning (HVAC) systems. Member States are encouraged to rely on, adapt and/or expand the arrangements already in place for EPC and inspection schemes in order to make them fit for renovation passport schemes. For instance:

— the prerequisites that apply to the qualifications of EPC and/or HVAC inspection experts (e.g., certification requirements), are at least partly relevant for renovation passport schemes.

([10]) Directive EU 2023/1791.

— training and accreditation programmes for EPC and/or HVAC inspection experts can be used as a basis for similar programmes for renovation passport experts.

— the channels used to make public the information pertaining to training, certification, and qualified or certified experts for EPC and/or HVAC inspection schemes can also be used to make similar information available in relation to renovation passport schemes.

Format of renovation passports

Article 12(4) requires that renovation passports be issued in a digital format suitable for printing.

It is commonplace to provide any certificate or report in a digital format that allows for printing (e.g. PDF). It is recommended that the tools used by the renovation passport experts to issue the renovation passports allow them not only to generate a printable version of the passport, but also a machine-readable one. This would facilitate compliance with Article 12(7) which requires Member States to ensure that the renovation passport can be uploaded to the national energy performance of buildings database.

3.3.6. *Digital tools for drawing up, updating and simulating renovation passports*

Article 12(6) highlights the importance of providing digital tools that support the preparation (and, where applicable, updating) of renovation passports, as well as the simulation of draft simplified renovation passports:

6. *Member States shall strive to provide a dedicated digital tool by means of which to prepare and, where appropriate, update the renovation passport. Member States may develop a complementary tool allowing building owners and building managers to simulate a draft simplified renovation passport and for them to update it once a renovation takes place or a building element is replaced.*

Using digital tools is common practice among buildings experts (e.g. for energy performance assessments) as they make the assessment faster, more interactive and more reliable, by providing data entry, processing and calculation functionalities.

Article 12(6) requires Member States to demonstrate that they have made all reasonable efforts to make available a dedicated digital tool for use by qualified or certified experts to draw up and issue renovation passports. Such a tool can be an extremely effective way to ensure that the requirement to establish and operate a renovation passport scheme is met.

Making available a common tool that is endorsed by the national (or where relevant, regional) authorities is very useful because:

— it ensures the consistency and reliability of the information provided to owners (e.g. for the estimated impacts of renovation steps);

— it guarantees fair access, under uniform conditions, to a reference tool, and makes the preparation of the renovation passports easier for all experts in the territory concerned;

— it makes it easier for the authorities to ensure that the renovation passport is affordable throughout the national territory;

— it allows the authorities to ensure, through the design of the tool, that there is seamless integration with other digital tools (e.g. databases for the energy performance of buildings or digital building logbooks).

Member States need to assess the state of play in the light of these aspects and establish that the right conditions are met. If this is not the case, they should take appropriate measures (e.g. if the offer of such a tool is insufficient, or if the available tools do not enable the passports to be prepared and issued effectively). Whether the use of the renovation passport is voluntary or mandatory is also a relevant aspect of the assessment.

The specific arrangements for designing, developing and making available the digital tool are not specified in the Directive and are to be decided by Member States. One approach may be to delegate the development, maintenance and distribution of the tool to a third party, either public or private. In all cases, Member States are encouraged to involve building and energy efficiency experts in the development of the tool (e.g. through consultations), to ensure its comprehensiveness, ease of use, acceptance and endorsement.

The expected functionalities of the digital tool are not specified in the recast EPBD. However, a reasonable expectation is that the tool would assist the energy expert in two main domains: calculating the energy performance of the building, and developing the roadmap (including the renovation steps and measures), by incorporating the mandatory parameters according to Annex VIII(1) and on the basis of a set of standard conditions (Annex VIII(4)). Other relevant features could include the calculation of estimated renovation costs, co-benefits and/or automatic warnings of possible lock-in effects in consecutive measures.

Article 12(6) refers to two types of tool:

1. a digital tool for the preparation (and, where relevant, updating) of a renovation passport, as discussed above. This tool is implicitly meant to be used by the qualified or certified experts referred to in Article 12(4), and this is the one to which the previous comments apply.

2. an optional ‘complementary tool’, which could be used by building owners and managers on their own initiative to prepare a simplified renovation passport, for their own use.

Only the digital tool referred to in point 1 above is to be used by qualified or certified experts to prepare and generate fully fledged renovation passports.

If the Member State opts for the ‘complementary tool’ referred to in the second sentence of Article 12(6), this tool can be made more broadly available (e.g. in the form of an open online tool) to perform simplified simulations of renovation measures and roadmaps; it cannot lead to issuing an official renovation passport. Such a tool should also account for the lack of expertise of the building owners, which calls for user-friendly and straightforward interfaces, supported by a well-structured process (e.g., in the form of a step-by-step, simplified, questionnaire).

3.3.7. *Upload of renovation passports to energy performance databases*

Article 12(7) requires Member States to ensure that renovation passports can be uploaded to their energy performance databases set up in line with Article 22.

Article 22 requires Member States to set up an energy performance database to collect, store, and make available data on the national building stock and its overall energy performance. This includes buildings data collected under schemes implemented under the recast EPBD (EPCs, HVAC systems inspections, smart readiness indicator, etc.) is of relevance. It also applies to renovation passports, which include information on buildings that is useful from a policy monitoring perspective, all the more so if they are updated following the works. Specific guidance on the national database is provided in the guidance on Article 22 ‘National databases for the energy performance of buildings’.

Article 12(7) requires Member States to ensure that the information contained in renovation passports can be uploaded to the national energy performance database. Such uploads are useful only if the renovation passport information is formatted in a way that allows:

— seamless integration in the database;

— queries to extract meaningful, aggregated data.

The easiest approach to achieve this is to ensure that renovation passports can be uploaded in a machine-readable, standard format (e.g. XML) that is the same across the territory of application of the renovation passport. Member States are therefore encouraged, also in relation to Article 12(4) and 12(6), to ensure that the digital tools used to draw up and issue renovation passports can generate a machine-readable version. It must also be possible to upload the file generated to the energy performance database upon issuance of the renovation passport.

3.3.8. *Storage of, and access to, renovation passports in digital building logbooks*

Article 12(8) sets out the requirement for renovation passports to be stored in, or accessible through, digital logbooks (where they are available).

Digital building logbooks are not regulated under the EPBD and there is no requirement for Member States to deploy them for their building stock ([11]). Digital building logbooks are likely to include more data than just that to be stored in the national database and would not in all cases store the information when that information is available elsewhere. The logbook could simply allow resources to be downloaded from other databases and repositories e.g. for certificates or reports that are stored in the national energy performance database.

The European Commission conducted a study on the development of a European Union framework for buildings' digital logbook in 2020 which aims to support the widespread use of DBLs across Europe. The study provides a definition of the digital building logbook and an analysis of the state of play.

In addition, a technical study for the implementation of Digital Building Logbooks in the EU on behalf of the European Commission (DG GROW) was published in November 2023. The main outcome of the study was a set of guidelines for EU Member States to set up and operationalise DBLs under a common EU Framework.

Digital building logbooks ([12]) are tools intended to act as a main repository of all relevant building-related information, facilitating transparency, trust, informed decision-making and information sharing between all parties linked to a building.

The requirement laid down in Article 12(8) only applies when a digital building logbook is available for the building in question. In such case, the renovation passport must:

— either be stored (in a digital printable format, but if relevant, also in machine-readable format) in the digital building logbook; or

— if the renovation passport is not stored in the digital logbook, it must be made accessible through the digital logbook (for instance, through a clearly identified URL).

([11]) Digital logbooks are implemented in some countries and regions, for instance the Woningpas in Belgium (Flanders), https://www.vlaanderen.be/bouwen-wonen-en-energie/bouwen-en-verbouwen/woningpas.

([12]) Article 2(41) of the recast EPBD defines a 'digital building logbook' as a common repository for all relevant building data, including data related to energy performance such as energy performance certificates, renovation passports and smart readiness indicators, as well as data related to the life-cycle GWP, which facilitates informed decision making and information sharing within the construction sector, and among building owners and occupants, financial institutions and public bodies.

3.4. **Interpretation and implementation of the provisions laid down in Annex VIII to the recast EPBD**

3.4.1. *Mandatory elements*

Annex VIII(1) lists the items that must be included in building renovation passports issued under the EPBD.

3.4.1.1. Information on the current energy performance of the building

Annex VIII(1)(a) requires that the renovation passport includes information on the current energy performance of the building.

Information on the current energy performance of the building should be interpreted as including at least the energy performance of the building expressed by a numeric indicator of primary energy use per unit of reference floor area per year, in kWh/(m^2.y), in line with Annex I to the EPBD.

The energy performance should accurately reflect the current state of the building. This means that it should be calculated on the basis of the building at present, and not based on past calculations or assessments.

A reasonable expectation is that information on the energy performance of the building includes more details than only the primary energy use per unit. Having more detailed information (e.g. energy performance of individual building elements) can be useful, for instance for recalculating the energy performance at a later date (e.g. after some renovations have been carried out).

Member States should make clear what elements are to be included, and whether they are mandatory or optional. In doing so, Member States may find it beneficial to seek a degree of alignment with the mandatory and optional elements in energy performance certificates (Annex V(1) and Annex V(2) respectively). This applies in all cases, but most notably where energy performance certificates and renovation passports are issued jointly.

3.4.1.2. Graphical representation

Annex VIII(1)(b) requires that renovation passports include a graphical representation or graphical representations of the renovation roadmap and its steps for a staged deep renovation.

The objective of this requirement is to ensure that building owners get a clear and concise picture of the renovation process, with key information on related steps. The EPBD does not further specify the contents of the roadmap's graphical representation(s). Based on current practices, the following elements are relevant to include:

— the baseline energy performance (i.e. the energy performance of the building as it stands, which is the starting point of the roadmap);

— the long-term target energy performance (i.e. the ultimate objective of the roadmap once a deep renovation has been completed);

— the renovation steps, with related key information, e.g. list of renovation measures, estimated costs, estimated energy savings or energy performance class gains;

— additional information to address specific needs or concerns of the owner, such as estimated gains in terms of indoor environmental quality.

Member States should make clear what elements are to be included in the graphical representation(s), and whether they are mandatory or optional. Member States should also lay down requirements or guidelines on the design of the graphical representation(s), with due consideration for user-friendliness and conciseness.

The German ‘individueller Sanierungsfahrplan’ (iSFP) includes a one-page overview of the entire renovation process, using a colour gradient to indicate the gradual improvement of the building ([13]):

3.4.1.3. Information on relevant national requirements

Annex VIII(1)(c) requires that renovation passports include information on relevant national requirements such as minimum energy performance requirements for buildings, minimum energy performance standards and rules in the Member State on the phasing out of fossil fuels used in buildings for heating and cooling, including application dates.

The aim of this requirement is to provide background information that clarifies the consistency between the renovation roadmap for the building in question and the present and future legal requirements that the building needs to comply with. Information on national requirements can help to determine the optimal sequencing and timing of the renovation steps.

The information provided is expected to cover the main requirements that apply under the EPBD, which are given as examples: minimum energy performance requirements, minimum energy performance standards and measures on the phasing out of fossil fuels in heating and cooling. The information provided should be relevant to the specific building for which a renovation passport is issued, given that the requirements may vary depending on factors such as whether it is a residential or non-residential building, or the building category.

As the renovation passport’s objective is to convey information in a user-friendly manner, the information about such requirements should be clear, transparent and concise. One possible approach is to display the legal obligations the building must meet at present, and those it will have to meet in the future, on a timeline ([14]).

([13]) https://www.bmwk.de/Redaktion/DE/Downloads/S-T/sanierungsfahrplan-muster.pdf?__blob=publicationFile&v=6.
([14]) This is the approach followed in the digital tool developed by the iBRoad2EPC project (see https://ibroad2epc.eu/portfolio-items/training-toolkit/).

3.4.1.4. Explanation on the optimal sequencing of steps

Annex VIII(1)(d) requires that renovation passports include a succinct explanation on the optimal sequencing of renovation steps.

Sequencing of renovation steps (i.e. the order in which each renovation step will be performed) is an important aspect of renovation passports. It enables interactions between different works to be considered the sequence of works to be optimized and duplication to be avoided or at least limited. Overall, the aim is to ensure that each renovation step complements the others under the assumption that the bundling of renovation measures in each of the renovation steps creates synergies between renovation measures.

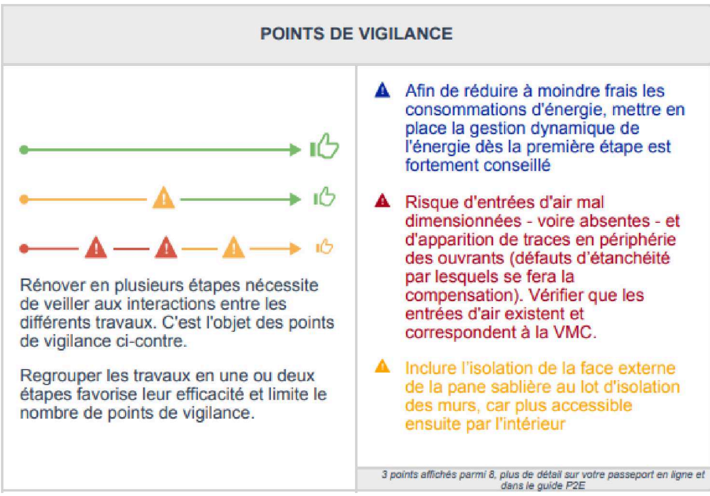
As set out in Recital 42, with an optimal sequencing of steps:

— the renovation can be less disruptive – reducing hassle for inhabitants - and more financially feasible (compared to renovating 'in one go');

— a situation is avoided where one step precludes necessary subsequent steps.

Usually, the roadmap and its graphical representation(s) as per Annex VIII(1)(b) would already display the optimal sequencing of renovation steps. The requirement of Annex VIII(1)(d) aims to ensure that the rationale for this sequencing is made clear to the owner. As for the previous point, this rationale should be clear, transparent and concise, flagging the main considerations that governed the definition of the sequencing.

For instance, the roadmap of the P2E project (France) specifically highlighted 'points of vigilance', drawing attention to the interactions between different works to optimise the sequence and limit duplication. The rationale for staging renovations in this way, as well as brief guidance on ensuring effective staging, was covered via these points of vigilance related to the sequencing of steps.



3.4.1.5. Information about each step

Annex VIII(1)(e) requires that renovation passports include information about each renovation step. This information must include:

(i) *the name and description of the renovation measures for the step, including relevant options for the technologies, techniques and materials to be used.*

To ensure consistency between the building renovation passports delivered in a given territory, it is recommended that the names used for renovation measures are harmonised (at least the most common) and not left entirely to the assessors. Examples of such measures include:

— replacement of windows;

— installation of thermal insulation on the façade;

— replacement or first-time installation of a space heat generator;

— replacement or first-time installation of a mechanical ventilation system;

— installation of a photovoltaic system;

— installation of self-regulating devices for the regulation of indoor air temperature.

Technologies can be understood as including the devices or systems that are used to perform functions while also improving the energy performance of buildings (e.g. heat pumps, building automation and control systems and solar panels).

Techniques can be understood as approaches or methods to improve the building's performance (e.g. window orientation to maximise programming of HVAC systems). Materials can be understood as components used in the retrofitting of a building, for example insulation materials and triple-glazed windows.

(ii) *the estimated energy savings in primary and final energy consumption, in kWh and in percentage improvement compared to the energy consumption prior to the step:*

Member States are encouraged to ensure that information in renovation passports pertaining to energy consumption and savings is consistent with the estimations that would be made for an energy performance certificate for the same building. This is because renovation passports must also include the estimated energy performance class of the EPC to be achieved following completion of the steps (point (v)). This could be achieved by aligning the methodologies for energy performance calculation in renovation passports and in EPCs.

(iii) *the estimated reduction of operational greenhouse gas emissions*

In the same way as for the estimation of energy consumption and savings, consistency is recommended with the greenhouse gas emission reductions as they would be estimated for EPCs. Once the primary energy consumption per energy carrier is available based on PEFs or weighting factors, the translation to CO_2 emissions can be done in a similar way, namely based on CO_2 emission coefficients per energy carrier.

(iv) *the estimated savings on the energy bill, clearly indicating the assumptions on energy costs used for the calculation*

In line with the previous points, it is recommended that the methodology used to estimate the improvements of energy performance and related energy cost savings be aligned with the energy performance methodology established at national level on the basis of Annex I. The same applies to the methodology used to calculate costs and savings of the measures included in the recommendations on the energy performance certificates.

The savings on the energy bill can be based on the estimated energy savings for each step according to Annex VIII(1)(e)(ii) (final energy consumption in kWh) compared to the energy consumption prior to each step, multiplied by the assumed energy price of the different energy carriers (price per kWh).

(v) *the estimated energy performance class of the energy performance certificate to be achieved following completion of the step*

The energy performance class resulting from a given renovation step can be deduced from the estimated primary energy savings (point (ii)) under the assumption that estimations of energy consumption and savings in the renovation passports are consistent with the same estimations in an EPC.

3.4.1.6. Information about a potential connection to an efficient district heating and cooling system

Annex VIII(1)(f) requires that renovation passports include information about a potential connection to an efficient district heating and cooling system.

Connection to an efficient heating or cooling system, as per Article 26(1) of the Energy Efficiency Directive, can be important in the scope of renovation passports. Efficient district heating or cooling systems can be used to cover the energy needs of zero-emission buildings, and energy from renewable sources produced nearby (as defined in Article 2(55) of the recast EPBD) are a permitted energy source for nearly zero-energy buildings.

The renovation passport should inform the owner: (i) whether an efficient district heating or cooling system exists or will be operational soon in the vicinity of the building; (ii) if so, whether it would be beneficial to consider a connection to that system – including, where relevant, as part of the renovation roadmap.

This information could include:

— information on whether an efficient district heating or cooling system exists or will be operational in the near future in the vicinity of the building.

— relevant information on the district heating or cooling plant (e.g. the type – cogeneration, heat pump, geothermal, etc.)

— information on the process for requesting a connection and related connection costs.

— information on the necessary technical set-up in the building to be able to make use of this network, and related estimation of costs.

— a cost-benefit analysis regarding a potential connection.

3.4.1.7. Estimated share of individual or collective generation and self-consumption of renewable energy

Annex VIII(1)(g) requires that renovation passports include the share of individual or collective generation and self-consumption of renewable energy estimated to be achieved after the renovation.

This is a requirement to include in renovation passports an estimate of the renewable energy produced on-site, i.e. in or on a particular building or on the land on which that building is located, as a percentage of energy use – the same way as for EPCs (see point 1(d) of Annex V). An estimate of the percentage of that renewable energy consumed on-site out of the renewable energy produced on-site is to be included. The distinction between individual or collective generation refers to whether the renewable energy sources are only linked to a given building or building unit, or whether they are shared. For example, the renovation passport could be for an apartment in a building that is equipped with collective renewable energy sources.

As previously, it is recommended that such estimations in renovation passports be aligned to the extent possible with similar estimations under EPCs.

3.4.1.8. Information about circularity, whole-life-cycle emissions and wider benefits

Annex VIII(1)(h) requires that renovation passports include general information on available options for improving construction products' circularity and for reducing their whole-life-cycle greenhouse gas emissions, as well as wider benefits related to health and comfort, indoor environmental quality and the improved adaptive capacity of the building to climate change.

The circularity aspect emphasises the importance of extending the lifespan of materials through practices such as reuse, recycling and efficient resource management, thereby minimising waste and conserving resources. It is recommended that renovation passports encourage the use of construction products that reduce environmental impact while enhancing the longevity and resilience of building components (e.g. bio-based durable components). Providing information on such products, in line with the renovation measures set out in the roadmap, will allow for well-informed investment decisions. On top of the explanation on the products themselves, it could also be considered to refer to construction design so that these products' lifecycle performance or the lifecycle of the building overall following the renovation can be optimised ([15]).

Wider benefits refer to benefits from renovation that go beyond energy aspects. It is well acknowledged that energy renovation comes with additional benefits, for instance in terms of comfort and well-being. Highlighting what wider benefits will result from the renovation measures in the roadmap can be an additional incentive to make the necessary investments. For example, air sealing solutions reduce the entry of air pollutants, and insulation improves thermal comfort and reduces noise transmission ([16]). Another example could be asbestos removal, which in some Member States is coordinated with the installation of solar panels on rooftops ([17]).

For this section, 'Level(s)' (the European framework for sustainable buildings) can be a useful reference ([18]).

3.4.1.9. Information on available funding

Annex VIII(1)(i) requires that renovation passports include information on available funding and links to the relevant websites indicating the sources of such funding.

It is recommended that this information be tailored to the specific building for which the renovation passport is issued (e.g. funding sources might differ depending on the type of building and location), and where possible to the specific renovation measures to be implemented as part of the roadmap. As an example, the German 'individueller Sanierungsfahrplan' (iSFP) includes funding opportunities as one of the elements described for each step in the roadmap.

The renovation passport should include all relevant information that would allow the owner to request funding (typically, the links to the websites where detailed information can be found, and where the application for funding should be made).

3.4.1.10. Information on technical advice and advisory services

Annex VIII(1)(j) requires that renovation passports include information on technical advice and advisory services, including contact details and links to the websites of one-stop shops.

In the same way as for the previous item, it is recommended that this information be tailored to the specific building for which the renovation passport is issued (for instance, local/regional services for the relevant location), and where possible to the specific renovation measures to be implemented as part of the roadmap.

The renovation passport should include all relevant information that would allow the owner to liaise with the relevant services (contact details, links to relevant online resources, etc.)

([15]) As an example, certain techniques allow for the materials to be disassembled and reused or recycled, or for the building's spaces and functions to be adapted more easily (e.g. using mechanical fasteners instead of adhesives).
([16]) Dorizas Paraskevi Vivian, De Groote Maarten, Volt Jonathan. The inner value of a building. Linking indoor environmental quality and energy performance in building regulation, BPIE, October 2018.
([17]) Maduta C., Kakoulaki G., Zangheri P., Bavetta M., Towards energy efficient and asbestos-free dwellings through deep energy renovation, EUR 31086 EN, Publications Office of the European Union, Luxembourg, 2022, doi:10.2760/00828, JRC129218. Available at: JRC Publications Repository - Towards energy efficient and asbestos-free dwellings through deep energy renovation.
([18]) https://environment.ec.europa.eu/topics/circular-economy/levels_en.

3.4.2. *Optional elements*

Annex VIII(2) lists additional items that may be included in building renovation passports issued under the EPBD.

A technical report for setting up national schemes of building renovation passports will provide additional examples of existing practice from Member States and EU-funded projects and will address this set of optional items.

3.4.3. *Information contained in the energy performance certificate*

Annex VIII(3) emphasises the requirement to use a valid energy performance certificate, where available, to assess the status of the building or building unit at the start of the renovation journey. This applies specifically to the first mandatory item in renovation passports – information on the current energy performance of the building – but would extend to any information from energy performance certificates that is of relevance when drawing up a renovation passport.

The requirement to 'consider' the information from the energy performance certificate leaves flexibility to Member States. In particular, the provisions do not require the information in the renovation passport to be aligned with that in the energy performance certificate. The preparation of a renovation passport generally includes an audit of the building or building unit, which could lead to conclusions on the status of the building or building unit, e.g. in terms of its performance, that differ from the ones found in the energy performance certificate. In such cases, and if the audit's conclusions are verified and confirmed, it would be acceptable to use the latter as a reference instead of the information from the energy performance certificate.

The spirit of the requirement is to emphasise that the information from energy performance certificates, where available and valid, should be considered and taken into account when drawing up renovation passports.

Section 5 of the Energy Performance Certificates and Independent Control Systems provides clarifications on the validity of an energy performance certificate.

3.4.4. *Standard conditions*

Annex VIII(4) provides that each metric used for estimating the impact of steps is to be based on a set of standard conditions.

In estimating the expected impact of renovation steps, Member States need to lay down the standard conditions under which the metrics used for estimations (including of energy savings) are determined and ensure that these are transparent, visible and realistic. The general principle is that any relevant, reliable and timely source of information can be used, with the aim of ensuring consistency of the assessment regardless of the assessor in charge.

It is up to Member States to clarify what these standard conditions are under their respective renovation passport schemes. They must also ensure that assessors duly consider them when estimating the impact of renovation steps, for example through appropriate training and accreditation. Some standard conditions such as occupancy and climate are set in the national methodologies for calculating the energy performance of buildings. Where this is the case, it is recommended to apply the same conditions for building renovation passports.

ANNEX 5

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Databases for the energy performance of buildings (Article 22)

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1. GENERAL CONSIDERATIONS

National databases for the energy performance of buildings are crucial to ensure the availability and usability of reliable and robust building data acquired at regional and national level. The databases will contribute to the reduction of administrative burden across the policy making process by becoming in time a main source of data for assessing, monitoring and communicating the impact of buildings policies.

They may also be used to facilitate the deployment of building renovation support programmes providing information and facilitating expert support through one-stop-shops. Lastly, the energy performance databases improve knowledge of the building stock status and progress on modernisation and can pass on relevant information to other interconnected databases. As a result, the information stored in a national database can be used by public and private stakeholders such as national, regional and local authorities, research institutions, public bodies, banks, real estate companies, professionals, as well as the media and the general public.

Article 22 of the recast Energy Performance of Buildings Directive (the 'recast EPBD') [1] focuses on several key functionalities of databases on the energy performance of buildings (referred to below as 'databases'), including gathering and storage in machine-readable format, aggregation and anonymisation of required information. It also addresses the availability of information to the public or specific categories of user through appropriate digital interfaces, in compliance with data protection regulations as well as interoperability with other databases and administrative registers. Additionally, the Article includes requirements relating to the transfer of information to the EU Building Stock Observatory.

Furthermore, Article 22 is closely linked to Article 16 of the Directive on data exchange, as the databases can facilitate access to a building's systems data for building owners, tenants and managers. More details are available in the guidance on data exchange in Annex 6.

2. IMPLEMENTATION TIMELINE

The national energy performance of buildings databases to be set up under Article 22 of the Directive must be in place by the transposition deadline for the Directive, which is 29 May 2026.

On 30 June 2025, the Commission adopted the first implementing act (EU) 2025/1328 establishing common templates for the transfer of information to the EU Building Stock Observatory [2].

3. INFORMATION TO BE STORED IN THE DATABASES

Article 22(1) of the Directive requires Member States to set up a national database for the energy performance of buildings 'which allows data to be gathered on the energy performance of individual buildings and on the overall energy performance of the national building stock'.

Furthermore, Article 22(1) indicates that the databases 'shall allow data to be gathered from all relevant sources related to energy performance certificates, inspections, the renovation passport, the smart readiness indicator (SRI) and the calculated or metered energy consumption of the buildings covered'.

Additionally, Article 22(1) allows data on operational and embodied emissions and life-cycle global warming potential (GWP) to be gathered and stored in the database. It also allows for building typologies to be gathered.

[1] Directive (EU) 2024/1275.
[2] OJ L, 2025/1328, 29.8.2025, ELI: http://data.europa.eu/eli/reg_impl/2025/1328/oj.

3.1. **Energy performance certificates (EPCs)**

Article 20(8) requires all EPCs issued to be uploaded to the national database referred to in Article 22. It specifies that these uploads must include 'the full energy performance certificate, including all necessary data required for the calculation of the energy performance of the building'.

Annex V to the Directive lists the compulsory and optional information to be included in the EPCs. This Annex should also be transposed by 29 May 2026. EPCs must include the following data:

— energy performance class;

— calculated annual final and primary energy use and consumption;

— calculated energy needs;

— renewable energy production (and the main energy carrier and type of renewable energy source) and share of renewable energy produced on-site;

— operational greenhouse gas (GHG) emissions, and, if available, the value of life-cycle GWP

— an indication of whether the building can react to external signals;

— where applicable, whether the building's heat distribution system is capable of working at low or more efficient temperature levels;

— contact information for the relevant one-stop shops for renovation advice.

All compulsory elements of the EPC must be uploaded to the national databases. Furthermore, if the EPCs include optional elements listed in Annex V or other additional ones, these elements must also be uploaded to the national databases. Therefore, the concept of 'full EPC' means that the entire EPC, including all the information required under Article 19 and Annex V to the Directive, as well as potential additional country-specific indicators, must be uploaded to the database. This will facilitate access for building owners and other entitled users to a full EPC that can be downloaded as a single document, for example in PDF format, potentially for further use, in property advertisements.

Article 22(1) states that the operational GHG emissions and life-cycle GWP *may* be gathered and stored. In isolation, this might be understood as meaning these elements are optional, but according to Article 20(8) and Annex V to the Directive this data *must* be included in the EPC where available. Therefore, it must be uploaded to the database as part of the full EPC. Additionally, according to Article 7(2) of the Directive, it will be mandatory to calculate the GWP and disclose it in the EPC from 1 January 2028 for all new buildings with a useful floor area larger than 1 000 m^2 and from 1 January 2030 for all new buildings. This interpretation is reinforced by Article 22(4), which stipulates that aggregated or anonymised data on energy performance, including energy consumption and, where available, the life-cycle GWP, must be publicly disclosed. The provision indicating that data on operational GHG emissions and life-cycle GWP *may* be stored in the database refers to data that is gathered outside the documents listed in the paragraph (EPCs, renovation passports, etc.), which may also be reported in the national database.

As provided by Article 20(8), 'all necessary data required for the calculation of the energy performance of the building' must be uploaded to the databases. The following information should be considered as the minimum 'necessary data' to be uploaded:

— Building or building unit category (or categories);

— Reference floor area of the certified building or building unit. Where the building includes very distinct uses (e.g. a mixed-use building with apartments on the upper floors and a commercial space on the ground floor), then the reference area uploaded should be broken down by type of use;

— Disaggregated energy needs by main type of use (space heating, space cooling, domestic hot water, lighting (where relevant) and other technical building systems (where relevant));

— Installed power of technical building systems (notably of space and water heating and space cooling systems);

— The performance (i.e. efficiency) of the technical building systems (notably of space and water heating and space cooling systems);

— Installed power of on-site renewable energy generators (e.g. installed power of rooftop photovoltaic panels, in kW);

— To the extent possible, the total area and thermal transmittance (U-values or, where relevant, thermal resistance R-values) of the main building components (e.g. windows, walls, roof, floor).

3.2. **Inspections of heating, ventilation and air-conditioning systems**

Article 24(3) requires that inspection reports on heating, ventilation and air-conditioning (HVAC) systems must be uploaded to the national energy performance database.

According to Article 23(1), regular inspections are required for systems with an effective rated output of over 70 kW. According to Article 23(3), systems with a rated output power higher than 290 kW must be inspected at least every three years, and systems with a lower rated output power at least every five years.

Therefore, the national databases must comprise information about inspections performed for at least two ranges of rated output power:

— between 70 kW and 290 kW;

— above 290 kW.

Article 23(2) introduces the possibility for Member States to establish separate inspection schemes for inspections of residential and non-residential systems. Therefore, and in order to maximise the usefulness of data, it is recommended that inspection results be stored in the database by type of building, e.g. residential and non-residential, and by type and energy sources of heating and cooling systems that data can be filtered accordingly thus maximising their relevance for further policy monitoring and related research and analysis. This distinction will provide more detailed information for further assessments, and it is recommended even where there is a common inspection scheme for both building categories.

Furthermore, Article 24(1) provides that an inspection report must comprise the result of the inspection performed and its recommendations. These recommendations must, 'where relevant, include the results from the basic assessment of the feasibility to reduce on-site use of fossil fuels. Therefore, it is recommended that inspection results be stored in the database broken down by type of energy carrier and type of system, notably for heating equipment.

HVAC inspection reports could provide additional useful information to support the drawing up of national or local plans for the decarbonisation of heating and cooling in buildings.

3.3. **Renovation passport**

Article 22(1) provides that data from building renovation passports must be gathered in the national energy performance databases. Furthermore, Article 12(7) indicates that Member States must ensure that renovation passports can be uploaded to the national database.

Annex VIII to the Directive lays down the compulsory and optional numerical and non-numerical elements of the renovation passport.

Furthermore, Article 19(6) of the Directive allows the renovation passport to be issued jointly with the energy performance certificate under specific conditions. In such circumstances, the recommendations from the energy performance certificate pursuant to Article 19(6) are replaced by the renovation passport becoming a necessary complement of the EPC. In this case (and for the purposes of Article 22), it is recommended that the complete renovation passport be uploaded to the database. As a minimum, the renovation steps must be uploaded to the database, along with any additional information corresponding to the information required for the EPC recommendations under Article 19(7)-(10). At least those elements must be available to the building owners, managers and tenants together with the full EPC and in place of EPC recommendations.

As a consequence of the above provisions, the renovation passport must be uploaded to or be available through the databases for the energy performance of buildings.

3.4. **Smart readiness indicator (SRI)**

Article 22 clearly refers to the SRI as one of the 'relevant sources' from which data should be gathered. Member States are therefore encouraged, in setting up their national databases, to consider including data from SRI certificates where such data is available.

The SRI was officially tested in 15 EU countries in 2024 ([3]). The scheme has not yet been implemented in any Member State, meaning that SRI certificates issued under the EPBD are not yet available. However, if a Member State did decide to implement the SRI, certificates would start being issued and related data could be gathered in the national databases.

In addition, by 30 June 2027 the Commission must adopt a delegated act 'by requiring the application of the common Union scheme for rating the smart readiness of buildings, in accordance with Annex IV, to non-residential buildings with an effective rated output for heating systems, air-conditioning systems, systems for combined space heating and ventilation, or systems for combined air-conditioning and ventilation of over 290 kW'. Therefore, the SRI will become mandatory for a segment of the non-residential building stock. Consequently, SRI certificates will gradually be issued, and data included in them could be uploaded to the national databases.

Therefore, though in Article 15 there is no strict obligation to upload the SRI certificates, it is recommended that the SRI be implemented in such a way as to ensure that SRI certificate data can be uploaded to the national databases. Related arrangements could largely rely on replicating the ones that apply to EPCs, given the similarities (in terms of implementation) between the two schemes.

3.5. **Calculated or metered energy consumption of buildings covered**

Article 22(1) also provides that calculated or metered energy consumption of '*buildings covered*' must be stored in the database. "Buildings covered" can be understood as meaning buildings for which data must be uploaded to the national databases which is contained in one of the Directive's instruments listed in the second paragraph of Article 22(1), namely EPCs, renovation passports, inspection reports for heating, ventilation and cooling equipment inspections and SRIs. However, not all these instruments include information about energy consumption. Consequently, '*buildings covered*' in Article 22(1) should be interpreted, as a minimum, as buildings covered by the listed obligations to the extent that these obligations result in available data about calculated or metered energy consumption.

([3]) More information at: SRI test phases (europa.eu).

3.6. **Information about building typologies and building stock**

Article 22(1) mentions the possibility to gather the information in the database by building typologies. Though not compulsory, registering data by building typologies is strongly recommended as it has several benefits. Firstly, it makes it possible to add datasets referring to building typologies from sources other than those specifically mentioned in Article 22. These datasets may cover, for instance, final energy consumption and operational (on-site) GHG emissions from the residential and services sector. They may derive from statistical data collection or from building-related scenarios and projections. A database structured using main building typologies can significantly reduce the administrative burden of the policymaking process, by reducing the need for additional data collection or estimates by building type, facilitating the decision-making process on certain building types (e.g. for dedicated support programmes) and providing the basis for a more detailed and accurate assessment of the energy performance of the building stock. Equally, it will help Member States to monitor the development of the building stock over time and the impact of building policies, as well as helping to shape adjustments to policies to increase their effectiveness.

Related to that, Member States are encouraged to maximise the benefits and synergies between the database and the monitoring and implementation tools required under Article 9. As an example, organising the database by the same building typologies to be used for the implementation of minimum energy performance standards in non-residential buildings would make it easier to monitor the achievement of the energy performance threshold for the worst-performing buildings in a typology. A statistically relevant dataset will make it easier to assess the average performance of buildings of that type, or to identify what building typology may have the highest consumption. As another example, it will be useful to have more precise and detailed information about a specific building type, e.g. multi-family buildings or educational buildings, in order to tailor support policies and programmes to further improve their energy performance in the most suitable and cost-efficient way.

Building typologies may be organised following the categories of buildings listed in Annex I, point 6, and corresponding aggregates from NACE codes ([4]) (the latter mainly for non-residential buildings):

(a) single-family houses;

(b) apartment blocks (or multi-family buildings);

(c) offices;

(d) educational buildings;

(e) hospitals (or health and social work buildings);

(f) hotels and restaurants (accommodation and food services);

(g) sports facilities;

(h) wholesale and retail trade services buildings;

(i) other types of energy-consuming buildings.

According to Article 22(2), aggregated and anonymised data on the building stock must be made publicly available. This means that the database must comprise at least general information regarding total number of buildings, building units and related floor area of the overall building stock. It is recommended that the information be organised by building type, following the above general typologies, or by residential and non-residential buildings as a minimum.

Linking the national energy performance databases to the building-related statistics codification where possible will provide additional advantages through stronger harmonisation and the possibility to exploit the full potential of the available data. Therefore, it is further recommended to interrelate the energy performance of buildings database with relevant information collected through statistical offices (e.g. energy consumption, building stock data such as floor area of households, number of dwellings). This could be automatic and dynamic, i.e. updated statistics are immediately reflected in the energy performance database. It will offer additional features and enrich the data available for policy assessment and monitoring.

([4]) NACE Rev. 2 - NACE Rev. 2 - Statistical classification of economic activities - Products Manuals and Guidelines - Eurostat (europa.eu).

The above are useful in particular to fulfil the requirement of Article 22(4) to make publicly available the share of buildings in the national building stock covered by EPCs, and aggregated or anonymised data on energy performance, including the energy consumption, and, where available, the life-cycle GWP of the buildings covered. Once the details of the building stock are integrated into the energy performance database, this requirement can be fulfilled by taking the ratio between valid EPCs and total number of buildings or building units or total floor area of the building stock. If the energy performance database is already structured by building typologies, then it will be possible to make public the share of EPCs in each typology.

Furthermore, it is recommended that the information be stored in the database so it can be retrieved at appropriate levels of government. More about this is set out below on the requirement of Article 22(3) that Member States 'ensure that local authorities have access to relevant data on the energy performance of buildings on their territory as required to facilitate drafting of heating and cooling plans and include operational geographic information systems and the related databases'.

4. ARCHITECTURE, INTEROPERABILITY, DATA STORAGE FORMAT, ACCESS TO DATA

4.1. Data structure, communication and access to data

According to Article 22(2), data stored in the energy performance of buildings database must be machine-readable and accessible via an appropriate digital interface. Article 2(13) of the Directive (EU) 2019/1024 [5] defines 'machine-readable format' as 'a file format structured so that software applications can easily identify, recognise and extract specific data, including individual statements of fact, and their internal structure'. Recital (35) of the above Directive further clarifies that 'documents encoded in a file format that limits automatic processing, because the data cannot, or cannot easily, be extracted from them, should not be considered to be in a machine-readable format'. Examples of machine-readable formats include comma-separated values (CSV), JavaScript Object Notation (JSON), and Extensible Markup Language (XML), Extensible Stylesheet Language Transformation (XSLT).

As indicated in Article 22(2), the data in the database must be accessible via an appropriate digital interface. This means that the national database must have appropriate communication modules for the wider public and targeted audiences such as buildings owners, tenants, building managers, investors, public research bodies and public administration. A well-developed and comprehensive database with a robust communication interface can also support one-stop shops to tailor advice based on concrete results and figures. It can also contribute to improved transparency about energy efficiency in building policies and facilitate access to building system data for building owners, managers and tenants as required by Article 16.

Article 22(5) provides that Member States must ensure that the information in the national database is transferred to the EU Building Stock Observatory (BSO) at least once a year. Member States may transfer the information more frequently. The national energy performance databases should therefore have a module that can be easily used and adapted for this transfer of information. The templates for transfer the information to the EU BSO will be laid down in an implementing act that the Commission must adopt by 30 June 2025 as provided in Article 22(6).

According to Article 22(2), aggregated and anonymised data of the building stock must be made publicly available. This means that the database must include general information regarding total number of buildings, building units and related floor area of the overall building stock. Additionally, as laid down in Article 22(4), Member States must make publicly available the share of buildings in the national building stock covered by EPCs, and aggregated or anonymised data on the buildings' energy performance, including energy consumption, and, where available, life-cycle GWP.

(5) Directive (EU) 2019/1024 on open data and the re-use of public sector information.

Importantly, publicly available data must be updated at least twice a year.

According to Article 22(2) of the Directive, the database must offer easy access to the full energy performance certificate free of charge ‘for building owners, tenants and managers and to financial institutions as regards the buildings in their investment and lending portfolios, and, upon permission from the owner, also to independent experts’. This means that the EPCs should be available through the database not only in machine-readable format but also for download and print in full in the standard format, with all required information according to Articles 19, 20, 21 and Annex V of the Directive.

If the EPC and renovation passport are issued jointly then the renovation passport can also be made available in full, or only the elements required for the EPC. In any case, Member States may decide to allow access to renovation passports in the same way as for EPCs.

Inspection reports on HVAC systems (Article 24) must also be uploaded to the database. Therefore, it is recommended that building owners and potentially other categories of user mentioned in Article 22(2) be given access to the inspection reports for their heating, cooling and ventilation systems (HVAC). HVAC inspection reports must be stored in the database and making them available to building owners and relevant users will improve the usefulness of the database. Where direct access is provided through the database, this is considered equivalent to handing over the report. This means that an expert carrying out an inspection may simply provide access to the report (as uploaded to the database) to the owner or tenant of the building instead of sending a copy of the report.

Energy performance of buildings databases must allow information to be gathered on the building renovation passport and the smart readiness indicator. In practice, this means that it must be possible to upload the renovation passports and the SRI into the databases. Member States may enable direct access to the renovation passport and the SRI through the database for the relevant parties (e.g. building owner).

In general, it is recommended that all information from EPCs, SRIs, renovation passports and inspection reports be directly available through the database. This enables the database to be the main source of information on building performance, giving it more visibility and relevance. The database will then effectively act as a central point of access to the main information on the energy performance of buildings.

Article 22(3) provides that local authorities must have access to relevant data on the energy performance of buildings on their territory to facilitate the drafting of the heating and cooling plans. Furthermore, it requires that data must include operational geographic information systems (GIS) and access to other relevant databases must be given, all these in accordance with Regulation (EU) 2016/679 ([6]). In practice, Article 22(3) means that the database should be organised such that local authorities can retrieve data at the appropriate level of granularity, i.e. also at regional and local level, with GIS identification. It should be interconnected with appropriate administrative and other databases that local authorities may draw on to draft and implement their heating and cooling plans.

Additionally, the provision indicates that local authorities must be supported at national level. Such support may be financial or may relate to human or other resources or to the infrastructure needed to access and use the information in the database.

Pursuant to Article 22(4), Member States must make anonymised or aggregated information available, on request, to public and research institutions such as national statistical institutes, universities or research-related units of national and EU administrations.

([6]) Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation, GDPR) Regulation - 2016/679 - EN - gdpr - EUR-Lex (europa.eu).

For national statistical institutes, the situation is more specific. They have dedicated use and processing rights to benefit from such source linkage to the extent possible, in compliance with applicable personal data protection rules, as set out at EU level in Article 17a of Regulation (EC) No 223/2009 on European statistics [7]. This does not impact the additional dedicated national laws in place in most Member States. In practice these legal bases will complement access modalities under Article 22(4) as outlined above specifically for national statistical institutes. On one hand, national databases to be setup under Article 22 of this Directive will be an important addition to the national data source environments for official statistics. On the other hand, national statistical institutes have the potential to add substantial value, for instance by mapping the building information with the highest accuracy available onto the housing stock (dwellings, living quarters), thus enriching information from national databases for energy performance of buildings but also for many other statistical products such as official statistics on housing or energy.

It is recommended that this information be aggregated at an appropriate level of granularity in respect of data protection and privacy. A good example in setting the procedure to offer access to public and research institutions is the Eurostat approach in sharing micro-data from the European statistics [8].

4.2. **Database architecture and interoperability with other databases**

The first subparagraph of Article 22(1) requires Member States to set up one integrated national energy performance database or a collection of interconnected databases.

Where possible, a single-database approach is recommended.

However, there may be situations where this is difficult due to the way the country is organised administratively. A set of interconnected databases may be a more appropriate the solution. For instance, it is possible to interconnect a set of regional/federal databases to form a national database in Member States with federal organisation or where the implementation of building policies is delegated and there are notable regional differences that prevent a smooth integration into one national database.

Another possibility is to integrate databases specific to each instrument concerned and link them in an overarching database. However, this latter option may come with additional costs and additional administrative burden.

In cases where a set of databases is the chosen solution, the databases should nevertheless be integrated to the extent possible at national level in one single public interface. To facilitate this integration, a consistent, logical and coordinated format for data processing and storage is recommended. A well-developed and forward-looking structure will ensure smoother integration with other databases at national and international level, where this is necessary to enhance the data repository and assessment capabilities based on it.

The above will facilitate the fulfilment of the Article 22(7) requirement that the national energy performance database must be interoperable and integrated with other administrative databases containing information on buildings, such as the national land register and digital building logbooks.

Interoperability allows data to be exchanged, merged and aggregated with other national databases, resulting in new data points to be used for the purposes described above, especially to support policymaking.

The use of unique identifiers (IDs) and geo-referencing in administrative databases can significantly facilitate the interoperability and future cross-exploitation of stored data. In order to maximise database capabilities, it is recommended that interoperability with other databases be considered since the beginning.

(7) Regulation (EC) No 223/2009 of the European Parliament and of the Council of 11 March 2009 on European statistics and repealing Regulation (EC, Euratom) No 1101/2008 of the European Parliament and of the Council on the transmission of data subject to statistical confidentiality to the Statistical Office of the European Communities, Council Regulation (EC) No 322/97 on Community Statistics, and Council Decision 89/382/EEC, Euratom establishing a Committee on the Statistical Programmes of the European Communities (Text with relevance for the EEA and for Switzerland) (OJ L 087 31.3.2009, p. 164).

(8) Eurostat provide access to micro-data from European statistics for scientific purposes. Based on prior registration as a research entity, micro-data can be shared with universities, research institutes or research departments in a public administration, banks, statistical institutes, etc. More information here: Overview - Microdata - Eurostat.

Other databases to be taken into account can be databases and repositories comprising additional building stock information, energy consumption profiles, real estate information (e.g. price evaluations), reliance on financial programmes, taxes and government incentives, urban licences or conservation status. Considering this additional information can provide further insight into the national building stock, the uptake of building renovation programmes, and the most efficient ways to support vulnerable and energy-poor consumers or to correct potential market failures.

To achieve a robust dataset with a higher degree of confidence, it is also recommended that the methodologies used for calculating and aggregating building data and other related information be harmonised where possible across the administrative databases, to make them compatible and avoid potential misalignments that may limit the data usage possibilities.

To the extent possible, the interconnected databases and registers could be made available through one portal, which would allow users to see data from all sources in one place.

A possible structure of the database can be seen in the figure below.

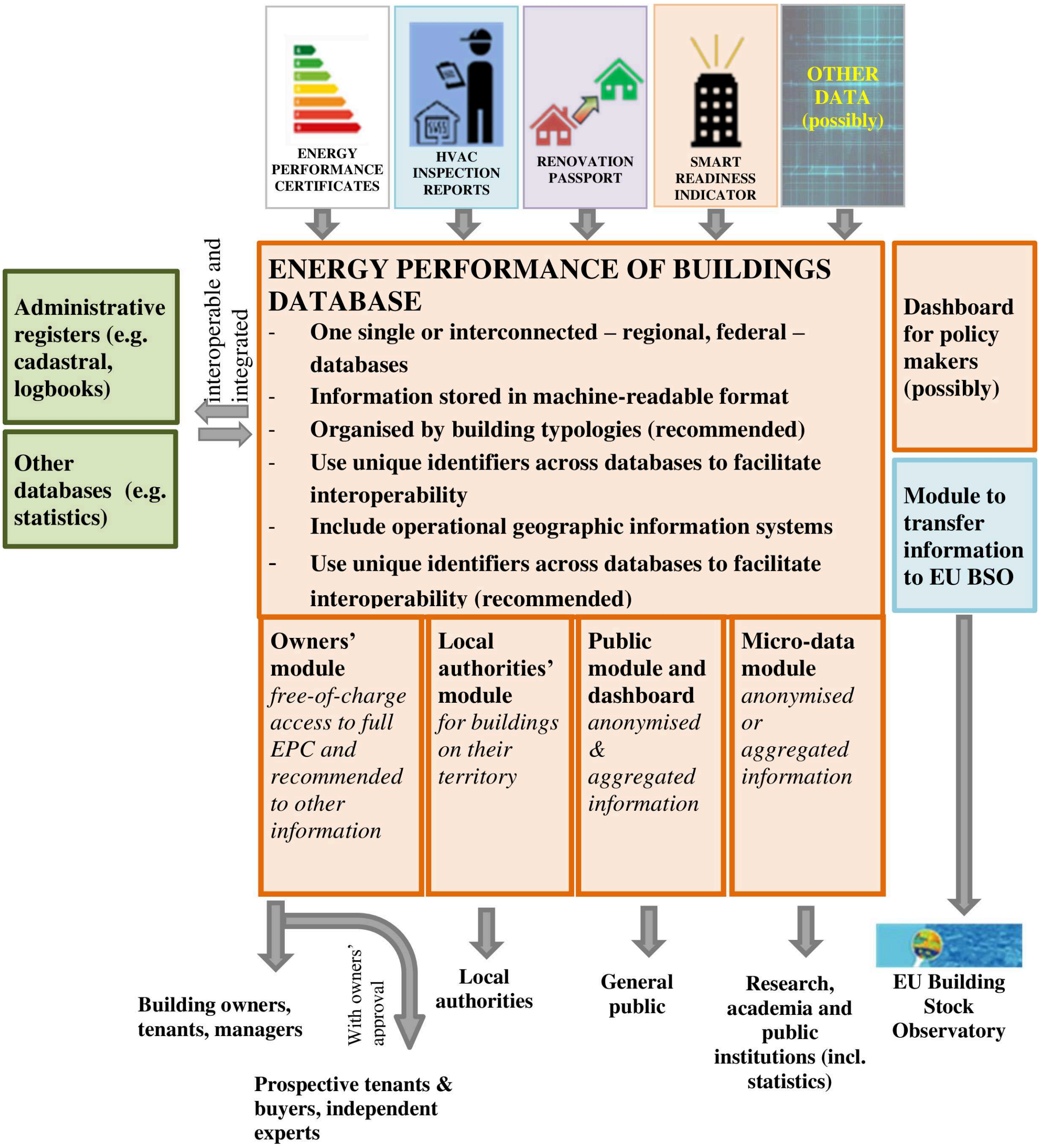

Figure 1: Possible architecture of an energy performance of building databases

5. DATA PROTECTION, ANONYMISATION AND SUFFICIENT AGGREGATION LEVELS

The level of access for the above-mentioned categories and database access protocols must be set in accordance with data protection legislation and in cooperation with national data protection authorities (DPAs).

In addition, Member States should be aware that the sharing of data from the national databases is covered by the Data Governance Act ([9]) (chapter II 'Reuse of certain categories of protected data held by public sector bodies'). Member States should ensure compliance with the relevant provisions and are encouraged to consult the national authorities responsible for enforcing the Data Governance Act in their country.

A clear privacy policy is recommended for access to information in the national database. If necessary, the policy currently in place can be reworked under the guidance of national DPAs. The policy should provide information and disclaimers about the personal data processing involved in implementing the database, as well as the contact details of the designated data protection office for further information or complaints.

From a personal data protection perspective, the integration of multiple registers gives rise to the following questions.

— Who should see the information stored within the database?

— What level of detail should be made available?

In that regard, the Directive provides that the database must make publicly available 'aggregated and anonymised' data, which does not fall under the scope of the GDPR. The aggregation can be done at appropriate levels (street, neighbourhood, district, etc.).

However, when considering making building-level data publicly available, it is advisable to assess the risk that cross-referencing between national registers would enable the owner to be identified. Based on this assessment, anonymised building-level data can be made publicly available where it is established that this poses no substantial risk to the protection of the building owner's privacy and personal data.

Certain types of users may require access to more detailed data, which may include personal data. As a general rule, the more detailed the raw building data, the higher the probability that it will contain information relating to an identifiable individual. To that end, it is recommended that Member States introduce a tiered-access approach, based on registration.

Providing access to raw building data has implications for individuals' right to protection of personal data. National law providing such access must comply with the GDPR. Guidance on EU data protection rules is provided by national DPAs and the European Data Protection Board. Member States should consult their national DPA when preparing legislation transposing the Directive.

For example, only the administrator of the database (national authority) and delegated authorities and the natural or legal person who enjoys a legal right in connection with a particular building should have access to the complete data for that dwelling.

Other parties, such as independent experts or prospective tenants or buyers, must also be granted access to the complete energy performance certificate, with the permission of the owner of the building, as envisaged in Article 22(2) of the Directive. When granting permission, the owner should have the option to provide only time-limited access, and possibly to restrict access to on-screen viewing of the certificate.

([9]) Regulation (EU) 2022/868 of the European Parliament and of the Council of 30 May 2022 on European data governance and amending Regulation (EU) 2018/1724.

The access of local authorities to the energy performance of buildings database must be in line with personal data protection legislation. Therefore, Member States must ensure that the data can only be seen by authorised staff. Specific security measures, such as access controls (authentication) or encryption are recommended. Access to non-anonymised data should be provided for a limited number of staff as in the case of other local administrative databases.

Another degree of access could be provided for research and statistical purposes. In such instances, Member States should ensure that direct identifiers relating to the building owners or occupants (e.g. full names) are redacted to the necessary degree and that data is shared at a sufficiently aggregated level.

For publicly available information, raw anonymised data could be made available in machine-readable format, facilitating its further use for specialised statistics and research. When developing the database, Member States should take account of the obligation to implement appropriate technical and organisational measures to ensure data protection by default and by design. They must ensure the security of the information stored within the database, in terms of confidentiality, integrity and availability.

Controls on access and roles can be used to ensure the confidentiality and integrity of the data and to ensure it cannot be seen, changed or removed without authorisation.

The availability of the data should also be ensured through back-ups and secure connections.

6. **REPORTING TO THE EU BUILDING STOCK OBSERVATORY**

As indicated by Article 22(6), the information from the national energy performance of buildings database must be transferred to the EU Building Stock Observatory at least once a year. The Commission will adopt implementing acts to further clarify the common reporting templates. On 30 June 2025, the Commission adopted the first implementing act (EU) 2025/1328 ([10]).

To enable transfer of information from national databases to the EU BSO, the Commission will develop a digital reporting interface and will provide appropriate explanations and information (workshops, user manual and technical assistance) to the authorities designated by the Member States to be in charge of reporting.

7. **EXAMPLES OF CURRENT DATABASES AND BEST PRACTICES**

Most of the publicly available national databases relating to the energy performance of buildings which were in place before the recast EPBD serve to ensure the availability and usability of EPC data acquired at regional and national level. Member States have developed EPC registers in a wide variety of ways, differing greatly in scope, format, procedures for data acquisition and processing ([11]). Among this range, it is possible to identify some best practices and examples to provide guidance for the development of such databases.

7.1. **Size of the database**

The size of the database is an important aspect, because it is directly connected to the amount of information that can be aggregated and generated. The information stored in the database can be used for a variety of purposes: to incentivise renovation (e.g. by providing information on applicable tax benefits or other financial incentives), to support the expertise developed in one-stop shops, or to promote initiatives like sustainable responsible investments.

([10]) OJ L, 2025/1328, 29.8.2025, ELI: http://data.europa.eu/eli/reg_impl/2025/1328/oj.

([11]) Ruggieri Gianluca, Carmen Maduta, and Giulia Melica, *Progress on the implementation of Energy Performance Certificates in EU*, Publications Office of the European Union (2023), available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC135473.

Given the wide variety of potential uses of the building information, the model database would be designed to host and collect as much information as possible, though the information collected is also important. It is thus recommended that Member States consider the integration of as many variables and as much data as possible. In this regard, the Portuguese and Danish EPC databases have been identified as examples of best practice:

— Portugal's database includes up to 250-300 variables for each building of different types: geographic information, technical systems, building identification, energy balance indicators, ventilation, envelope, building characterisation and improvement measures ([12]). It was created in 2007 and contained around 1.5 million EPCs by 2019. To ensure that the database can rapidly process large amounts of data, it was built from the outset to be able to work with big datasets. It does not store PDF versions of certificates but only contains the raw data that can be used to produce an EPC when needed ([13]).

— Denmark's database includes all EPCs generated since 2006, and it allows for a significant amount of data to be reused for the generation of new EPCs. This follows from a process including on-site data collection, data calculation by EPC software, data validation, submission and conversion to EPC. Data can also be used to carry out analyses based on the extensive knowledge of the building stock ([14]).

7.2. **Interoperability of databases**

An interoperable database allows data to be exchanged, merged and aggregated with other national databases. This gives rise to new data points that can be used for the purposes described above, especially to support policymaking at national level. A good practice in this regard can be identified in the Portuguese database. The information stored in each EPC aggregates up to 6 different IDs at building level, and 5 IDs at building unit level, resulting in a total of 11 IDs, which enable each building to be identified across different interfaces and databases, such as national land registers or utilities platforms ([15]). These different types of IDs include:

— the INSPIRE ID (European building identifier enabling environmental spatial information to be shared among public sector organisations, in order to facilitate public access to spatial information across Europe);

— national ID;

— utilities ID;

— fiscal ID;

— notary ID ([16]).

7.3. **Interface and functionalities of the database**

To ensure the widespread dissemination of information through EPC databases, Member States have often included services that allow for multiple uses of the data. To maximise the potential of EPCs, it is essential that they are made available to as many relevant stakeholders as possible ([17]). For example, the Danish EPC database is available through different channels:

— The EMOData service enables a full data file to be downloaded in xml format, with predefined search functions ([18]);

([12]) Libório, Paulo et al., *The logbook data quest: Setting up indicators and other requirements for a renovation passport* (2018), available at: https://www.oneplanetnetwork.org/sites/default/files/ibroad-the-logbook-data-quest.pdf; the Portuguese EPC database is available at: https://www.sce.pt/.

([13]) *Energy Performance Certificates across the EU – A mapping of national approaches* (2014), available at: https://bpie.eu/wp-content/uploads/2015/10/Energy-Performance-Certificates-EPC-across-the-EU.-A-mapping-of-national-approaches-2014.pdf.

([14]) The Danish EPC databases is available (based on free registration) at: https://emoweb.dk/emodata/test/#

([15]) Ibid 9.

([16]) Ibid 9.

([17]) Geissler, Susanne, Alexandros G. Charalambides, and Michael Hanratty, 'Public Access to Building Related Energy Data for Better Decision Making in Implementing Energy Efficiency Strategies: Legal Barriers and Technical Challenges' (2019) *Energies*, 12, 2019, available at: https://doi.org/10.3390/en12102029.

([18]) https://emoweb.dk/emodata/test/#.

— The energy performance certificate of a specific building can be accessed through https://old.sparenergi.dk/forbruger/vaerktoejer/find-dit-energimaerke or boligejer.dk;

— A map of energy performance certificates is also available at https://old.sparenergi.dk/demo/addresses/map (Figure 2).

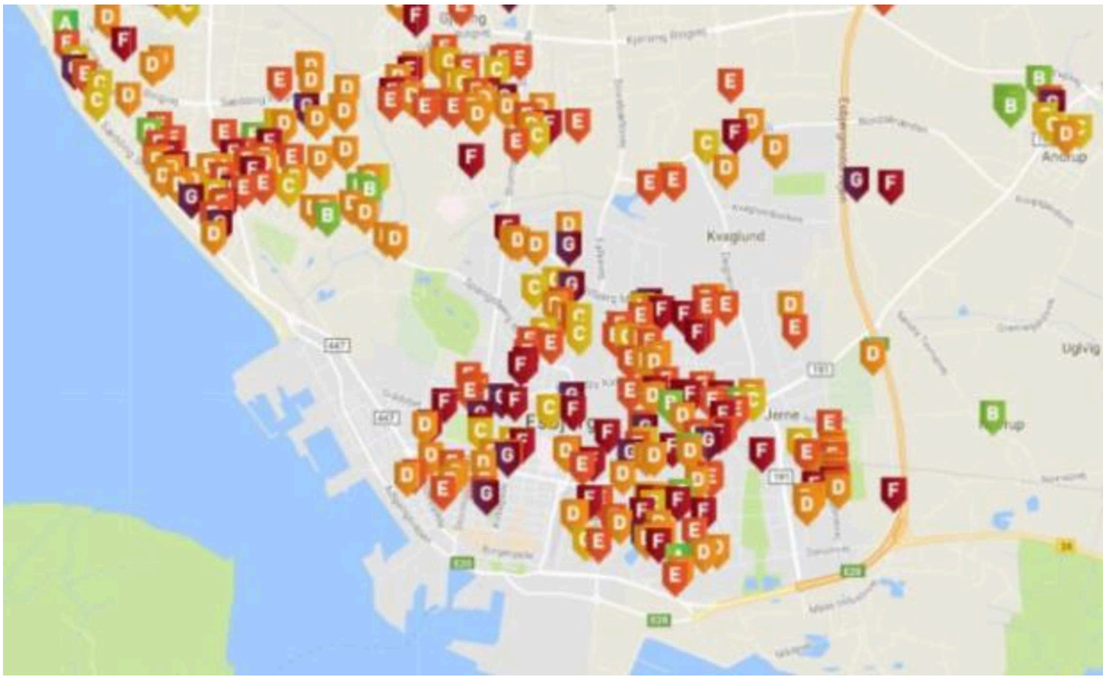

Figure 2: Mapping interface of energy performance certificates database in Denmark

The variety of services available in Denmark makes the database useful for stakeholders with different backgrounds, such as research institutes and universities, financial institutions, web services, public authorities, NGOs, real estate agencies or journalists, who are common users of this service. The map service makes it possible to see the energy performance class of different buildings within a perimeter, but also to search for your own personal EPC in digital format or to consult an overview of all the EPCs active in the database ([19]). Alternatively, the raw data available on the EMOD service can be used for specialised statistics and research purposes.

The databases can be used to encourage building owners to use EPC data, and to bridge the gap between owners and stakeholders on the renovation market. For example, the Portuguese database allows users to search directly for qualified experts and technicians ([20]). From a personal data perspective, this functionality requires the consent of the experts, who must explicitly agree to having their name and contact details publicly available on the platform. The portal also compiles information for investors, providing an overview of available benefits and incentives associated with energy certificates. Moreover, qualified technicians can access a reserved section with guidelines for their professional activities. Other stakeholders (such as municipalities, notaries or real estate agencies) also have their dedicated sections within the database.

([19]) Brand Kristen, Bernhard von Manteuffel, Andreas Hermelink 'Energy Performance Certificate Database in Denmark – Fact sheet' (2018), available at: https://www.euki.de/wp-content/uploads/2018/09/fact-sheet-energy-performance-certificate-database-dk.pdf.

([20]) https://www.sce.pt/pesquisa-de-tecnicos/.

Anonymised building stock information could also be presented in a user-friendly format that can be easily understood by the public.

A good example of presenting aggregated data is the map and analysis service included in the French portal Go-Rénove ([21]). This functionality allows users to filter perimeters by administrative clusters (e.g. departments, municipalities, districts). The map service is integrated with the national land register, providing information at building level. The synthesis function provides aggregated data, clearly illustrated through a dashboard interface. This approach is specifically recommended for providing the aggregated information required by Article 22(4) of the Directive 'on the share of buildings in the national building stock covered by energy performance certificates and aggregated or anonymised data on the energy performance, including the energy consumption, and, where available, the life-cycle GWP of the buildings covered'. Member States may consider implementing such functionalities to enable buildings in a specific perimeter to be compared through an accessible and easy-to-use interface.

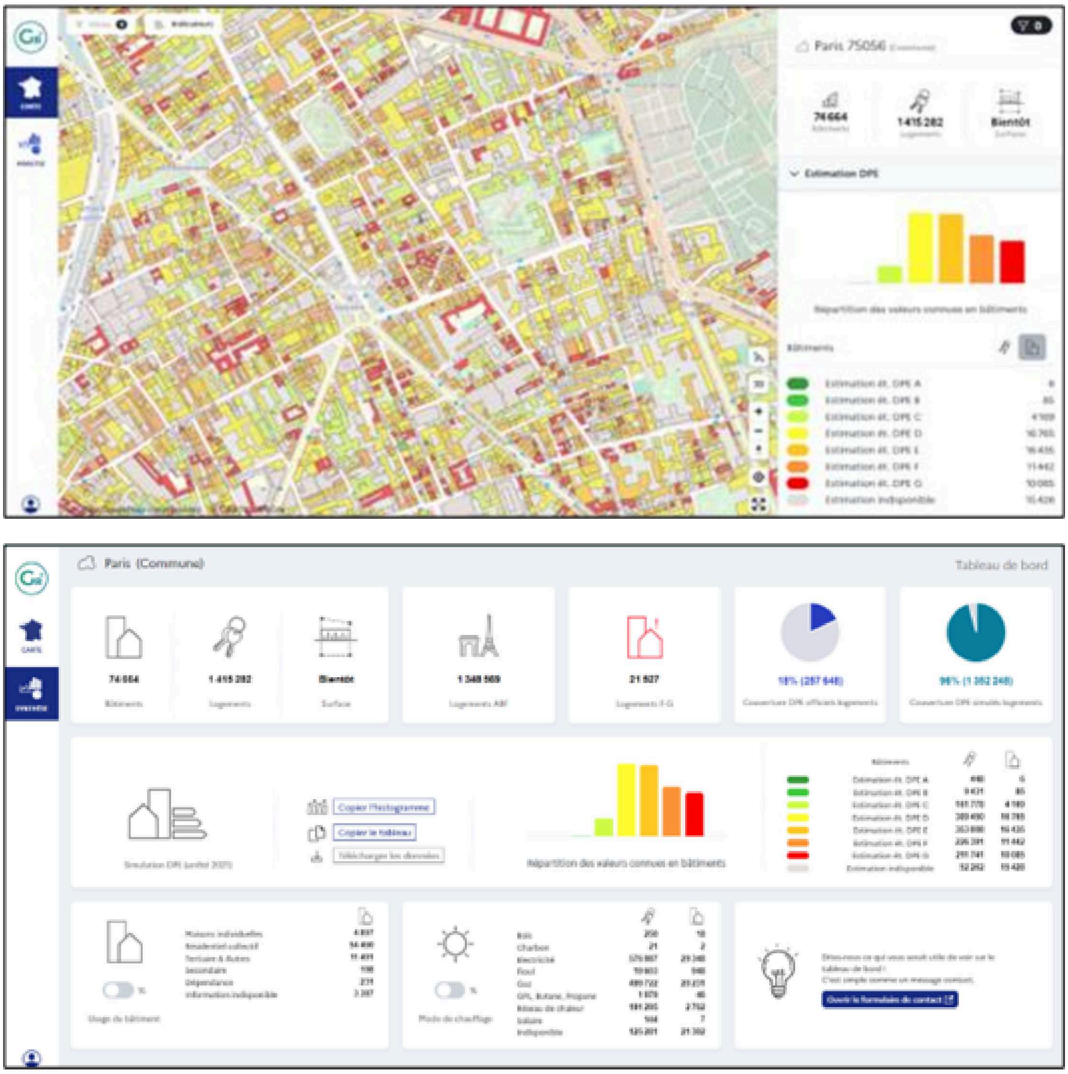

Figure 3: Captures from the public Interface of the French portal Go-Rénove

The database can also be designed to bring together multiple categories of stakeholder, providing specific sections and functionalities targeted for each, while bridging the gap between building owners, technical experts and the national authorities.

([21]) https://territoires.gorenove.fr/.

Another example of best practice is the portal of Flemish Region in Belgium, which collects all relevant information about a property centrally ([22]). Woningpas is a digital logbook owned by public entities in Flanders and is automatically available to building owners and housing companies. Data in Woningpas is connected to external platforms via application programming interfaces (APIs) and includes a digital vault for certifications, plans and relevant documents. It has a function for inputting data about renovation activities and a housing quality check tool. Since 2022 it has also been possible to share an individual Woningpas with authorised third parties and the public.

7.4. **List of identified national databases**

A recent Joint Research Centre report assesses progress on the implementation of the EPC in the EU ([23]). The report provides detailed information about the national systems, including national EPC registers and their main websites. The table below gives a list of EPC databases identified across the EU Member States. These databases may be a good starting point for developing energy performance databases as required by Article 22.

Table 1

National databases related to the energy performance of buildings, in place in the EU Member States

Austria	https://www.energieausweise.net/ (for Regions Burgenland, Kärnten, Niederösterreich, Tirol, Salzburg and Steiermark) https://www.wien.gv.at/wukseagis/public/ (for Region Wien) For Region Oberösterreich, the database is not publicly available: https://www.statistik.at/datenbanken/adress-gebaeude-und-wohnungsregister/energieausweisdatenbank-eadb/zugang-und-technische-informationen https://www.eawz.at/ (for Region Vorarlberg)
Bulgaria	https://portal.seea.government.bg/bg/IndustrialSystemsReport
Belgium	Brussels Capital Region: https://www.peb-epb.brussels/certificats-certificaten/ Flanders: https://authenticatie.vlaanderen.be/stb/html/ssologin https://woningpas.vlaanderen.be/ Wallonia: https://peb.energie.wallonie.be/bddpeb
Cyprus	https://epc.meci.gov.cy/
Croatia	https://eenergetskicertifikat.mgipu.hr/login.html
Czechia	https://www.mpo-enex.cz/Login.aspx?ReturnUrl=%2f
Denmark	https://emoweb.dk/emodata/test/ https://old.sparenergi.dk/forbruger/vaerktoejer/find-dit-energimaerke https://boligejer.dk/ https://old.sparenergi.dk/demo/addresses/map
Estonia	https://livekluster.ehr.ee/ui/ehr/v1
Finland	https://www.energiatodistusrekisteri.fi/ and for statistics: https://www.energiatodistusrekisteri.fi/tilastot?kayttotarkoitus=1&vuosimin=2&vuosimax=2020
France	https://observatoire-dpe-audit.ademe.fr/accueil https://territoires.gorenove.fr/
Germany	n/a

([22]) https://woningpas.vlaanderen.be/.
([23]) Progress on the implementation of energy performance certificates in EU - Publications Office of the EU (europa.eu).

Greece	https://bpes.ypeka.gr/?page_id=21
Hungary	https://www.e-epites.hu/e-tanusitas/
Ireland	https://ber.seai.ie/NAS/Login/UserLogin.aspx?ReturnUrl=%2fnas https://ndber.seai.ie/NDNAS/Login/UserLogin.aspx?ReturnUrl=%2fndnas%2f
Italy	Centralised national database: https://siape.enea.it/ Region Abruzzo: https://apeabruzzo.enea.it/ricerca.php Region Emilia Romagna: https://sace.regione.emilia-romagna.it/ElencoRicercaApeScaduti.aspx Region Friuli-Venezia Giulia: https://fvgenergia.it/extcenedfvg/html/public/visuraApe.jsf Region Lombardia: https://www.dati.lombardia.it/Energia/Database-CENED-2-Certificazione-ENergetica-degli-E/bbky-sde5/about_data Region Piemonte: https://servizi.regione.piemonte.it/catalogo/sistema-informativo-per-prestazione-energetica-degli-edifici-sipee Region Umbria: https://ape.regione.umbria.it/Account/Register/RSSNNA97L67A785I?returnurl=%2FHome%2FIndex Region Veneto: https://venet-energia-edifici.regione.veneto.it/ricerca_certificati.php For the other regions, building data must be requested from the authorities in writing.
Latvia	https://bis.gov.lv/bisp/lv/epc_documents
Lithuania	https://is.energis.lt/
Luxembourg	n/a
Malta	n/a
Netherlands	https://www.ep-online.nl/ https://www.energielabel.nl/woningen/zoek-je-energielabel/ https://public.ep-online.nl/swagger/index.html
Poland	https://rejestrcheb.mrit.gov.pl/
Portugal	https://www.sce.pt/ and https://www.sce.pt/estatisticas/ https://portalcasamais.pt/ https://portaldaenergia.azores.gov.pt/portal/Servicos/SCE-Acores/Indicadores?portalid=0
Romania	Information must be requested from the national authorities through this form: https://cauta.mdlpa.ro/upload_form.
Slovakia	https://www.inforeg.sk/ec/
Slovenia	https://www.energetika-portal.si/podrocja/energetika/energetske-izkaznice-stavb/register-energetskih-izkaznic/ https://ipi.eprostor.gov.si/jv/
Spain	EPC databases set at regional level https://analisis.datosabiertos.jcyl.es/explore/dataset/certificados-de-eficiencia-energetica/table/?sort=fecha_inscripcion (Castilla y Leon)
Sweden	https://sokenergideklaration.boverket.se/

ANNEX 6

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Data exchange (Article 16)

TABLE OF CONTENTS

1. SUMMARY OF THE LEGAL PROVISION

In order to facilitate a competitive and innovative market for smart building services that contributes to efficient energy use and integration of renewable energy in buildings and support investments in renovation, Member States should ensure direct access to building systems' data by interested parties. To avoid excessive administrative costs for third parties, full interoperability of services and of the data exchange within the Union is to be facilitated.

Article 16 of the recast Energy Performance of Buildings Directive (the 'recast EPBD') ([1]) sets the legal framework for accessing building systems data, ensuring notably that the building owner, tenant and manager can access this data.

It requires the adoption of implementing acts which detail interoperability requirements and non-discriminatory and transparent procedures for accessing the data.

2. RATIONALE FOR PROVISIONS ON ACCESS TO BUILDING SYSTEMS DATA

Data is an essential resource for cross-sectoral economic growth, competitiveness, innovation, job creation and social progress. The development of data-driven applications and services is beneficial to both citizens and businesses.

With the European Strategy for Data ([2]), the EU has put in place a comprehensive regulatory framework that ensures more data is available for use in the economy and society, while keeping the companies and individuals who generate the data in control. One of the main initiatives is the Data Act ([3]). ([4]), which sets out uniform rules on fair access to and use of data.

The Data Act (in particular Chapter II-IV) contains general rules on data access and use that are also applicable to the buildings sector. It is therefore highly relevant in relation to the EPBD and specifically to Article 16.

3. CONSIDERATIONS ON ARTICLE 16

3.1. Building systems data

Under Article 16, building systems data must include at least all readily available data related to:

— the energy performance of building elements,

— the energy performance of building services,

— the projected lifespan of the heating systems, where available,

— building automation and control systems,

— meters,

— measuring and control devices,

— recharging points for e-vehicles.

Article 16 covers access to data on non-connected products (e.g. energy performance of windows and roof) as well as basic/ static data on connected products (e.g. number and type of -vehicle recharging points, presence and type of building automation and control system, presence and type of sensors etc).

However, Article 16 does not cover access to data *generated by* connected products such as data from smart heating systems, as this would fall under the Data Act.

([1]) Directive (EU) 2024/1275.
([2]) https://digital-strategy.ec.europa.eu/en/policies/strategy-data.
([3]) 'Data Act' - Regulation (EU) 2023/2854 of the European Parliament and of the Council of 13 December 2023 on harmonised rules on fair access to and use of data and amending Regulation (EU) 2017/2394 and Directive (EU) 2020/1828.
([4]) https://digital-strategy.ec.europa.eu/en/policies/data-act.

As regards meters, Article 16 would not cover access to consumption data from regulated meters for the purpose of billing of electricity and gas consumption as this is covered by the Electricity and Gas Directives [5] [6]. However, Article 16 could cover information about the presence of other types of meters, for instance sub-meters for gas that are not used for the purpose of billing.

Covered in Article 16: Data about building systems (non-connected products and basic/static data about connected products)

Includes all data that give information about the building's characteristics – for instance, energy performance of buildings elements (e.g. U-value for the opaque and transparent elements of the building envelope), installed renewable production capacity (e.g. solar PV installed capacity), number and characteristics of recharging points for electric vehicles, etc.

They are relatively static in nature and characterise the building and its systems as they are, and they are not supposed to evolve over time unless the building or system is modified (e.g. following renovation or replacement of a system).

Data about buildings (static data) could require more specific measures to be implemented to ensure compliance with the recast EPBD (for instance, to ensure that authorised parties have access to data on their buildings that is stored in national energy performance databases).

Not covered in Article 16: Data generated by connected products and energy consumption meters

Includes all data that is generated by building systems that are connected products– for instance, on-site renewable energy production, heating setpoint temperature and indoor environmental parameters from sensors. They reflect the dynamic state of the building, and therefore, evolve over time. Covered by the Data Act.

Includes data collected from regulated utility meters (including smart meters) measuring electricity and gas consumption for the purpose of billing energy supply. Covered by the Electricity and Gas Directives [7].

3.2. **The Data Act in relation to Article 16**

The Data Act is a key piece of legislation when it comes to data access and use in the EU. Given its cross-sectoral nature, its provisions apply also to building systems data. It is therefore useful to highlight how the Data Act and the recast EPBD provisions are complementary.

The Data Act lays down uniform rules on [8]:

— making available product data and related service data to the user of the connected product or related service;

— data holders making data available to third parties on their request;

— data holders making data available to data recipients, when obliged to under EU law.

In particular, the Data Act (Chapter II to IV) provides for a comprehensive framework to ensure that data collected or generated by 'connected products' (as defined in the Data Act) are made accessible to the users of those connected products, and to authorised third parties, also clarifying the obligations that apply when making data available.

(5) Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast) Directive - 2019/944 - EN - EUR-Lex.

(6) Directive (EU) 2024/1788 of the European Parliament and of the Council of 13 June 2024 on common rules for the internal markets for renewable gas, natural gas and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC (recast) Directive - EU - 2024/1788 - EN - EUR-Lex.

(7) In the case of electricity, Article 23 of the Electricity Directive regulates the data management requirements, while Article 24 set the rules, through the adoption of implementing acts, for interoperable access to data. Implementing Regulation (EU) 2023/1162 'on interoperability requirements and non-discriminatory and transparent procedures for access to metering and consumption data' has been adopted. In the case of gas, Article 22 regulates data management for data coming from gas meters, including smart meters.

(8) The scope of the rules laid down by the Data Act is broader, but the two items highlighted here are the ones that are most relevant in the scope of the recast EPBD.

This is fully relevant to Article 16, since many building systems consist of such a connected product, or a combination of such connected products.

Article 2(5) of the Data Act provides a definition of a 'connected product' that includes connected products which are deployed in buildings:

'*"connected product" means an item that obtains, generates or collects data concerning its use or environment and that is able to communicate product data via an electronic communications service, physical connection or on-device access, and whose primary function is not the storing, processing or transmission of data on behalf of any party other than the user.*'

Essentially, any system operating in a building (including technical building systems, but not only), provided it can generate data and is capable of communicating it, can be considered to be a connected product or a combination of connected products (e.g. a smart ventilation or heating system).

Any requirement that applies to connected products under the Data Act would also apply to such a system (technical building systems, systems relevant for calculating smart readiness, and others, e.g. elevators).

In the same way, the same restrictions as under the Data Act would apply – notably, that highly processed, enriched data (e.g. emanating from an analytical software) would not be covered by the obligations to make it accessible.

The timeline for applying the Data Act is consistent with the one for transposing and implementing the recast EPBD, as the Data Act is in force and will apply from 12 September 2025, for most of its provisions (including those that are relevant to the recast EPBD and its Article 16).

3.3. **Other relevant pieces of legislation**

Other relevant pieces of legislation, in the scope of Article 16, include:

— The General Data Protection Regulation (GDPR) ([9]), as concerns data protection.

— The Data Governance Act ([10]), which defines the conditions for the re-use, within the EU, of certain categories of data held by public sector bodies. This act has a degree of relevance in the scope of the recast EPBD and Article 16, but also in relation to Article 22, for access to building stock data held by public authorities.

— The Electricity Directive ([11]), which includes specific provisions on smart metering and their functionalities, specifically for making available metering and consumption data for final customers (Article 20), on data management (Article 23) and on interoperability (Article 24).

— The Gas Directive ([12]), which includes specific provisions on data management (Article 22).

— The Renewable Energy Directive ([13]), which includes specific provisions on real-time access to basic battery management system information for domestic and industrial batteries (Article 20a).

— The Alternative Fuels Infrastructure Regulation ([14]), which includes specific provisions on data pertaining to publicly accessible recharging points and refuelling points for alternative fuels (Article 20).

([9]) REGULATION (EU) 2016/679 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

([10]) REGULATION (EU) 2022/868 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2022 on European data governance and amending Regulation (EU) 2018/1724 (Data Governance Act).

([11]) Directive (EU) 2024/1711 of the European Parliament and of the Council of 13 June 2024 amending Directives (EU) 2018/2001 and (EU) 2019/944 as regards improving the Union's electricity market design.

([12]) Directive (EU) 2024/1788 of the European Parliament and of the Council of 13 June 2024 on common rules for the internal markets for renewable gas, natural gas and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC.

([13]) DIRECTIVE (EU) 2023/2413 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652.

([14]) REGULATION (EU) 2023/1804 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU.

4. GUIDANCE ON IMPLEMENTING THE LEGAL PROVISION

4.1. Access to building systems data

Paragraph 1 of Article 16 sets out the requirement for Member States to ensure that owners, tenants and managers have access to their building systems data, and may grant access to this data to a third party:

Member States shall ensure that the building owners, tenants and managers can have direct access to their building systems' data. (…) For the purposes of this Directive, building systems' data shall include at least all readily available data related to the energy performance of building elements, the energy performance of building services, the projected lifespan of the heating systems, where available, building automation and control systems, meters, measuring and control devices and recharging points for e-mobility and be linked, where available, to the digital building logbook.

4.1.1. *Rationale*

The main aim of Article 16(1) is to ensure that parties with a legitimate interest in accessing building systems' data can do so. Under Article 16, legitimate parties are the owner, tenant, and manager of the buildings, who also may grant access to third parties.

The motivation for considering those parties as legitimate is the following:

— For owners, building systems data is a useful resource informing investment decisions (e.g. for renovation) and, when they also use the building, for optimising operation and management.

— Where there are tenants, they are entitled to get access to the information related to the building systems in the building or building unit that they rent, as they use the buildings and are in charge of day-to-day operation.

— Where the management of the building is delegated to a third party (the 'manager'), for instance a facility manager, they need to have access to buildings data in order to define and operate their management strategy.

4.1.2. *Clarifications of terms*

Most of the terms used in Article 16(1) are defined in Article 2, specifically: 'energy performance' (Article 2(8)); 'building envelope' (Article 2(15)); 'building element' (Article 2(17)); 'building service' (to be understood as 'EPB service', Article 2(56)); 'heating system' (Article 2(43)); 'building automation and control system' (Article 2 (7)); recharging point (Article 2(33)), and 'digital building logbook' (Article 2(41)).

Some other terms are defined under the regulatory texts referred to in section 6.3: 'data' (Article 2(1) Data Act); 'third party' (Article 2(10) GDPR); 'consent' (Article 2 (11) GDPR).

In addition, it is useful to clarify that, in the scope of Article 16:

— 'manager' is to be understood as any person or organisation to which the management of the building is delegated (e.g. a facility manager)

4.1.3. *Understanding of 'building systems data' under Article 16*

Though the recast EPBD includes a definition of 'technical building systems' (Article 2(6)), there is no definition of 'building system' that could be referred to, to support the understanding of Article 16(1) ([15]).

([15]) There is a definition of 'system' under the Smart Readiness Indicator Delegated Act (Commission Delegated Regulation (EU) 2020/2155), but that definition is only relevant for smart readiness rating.

However, it is clear from the list in subparagraph 2 that the understanding of 'building system' is broader than only technical building systems. Specifically:

— It includes a reference to 'building elements', which clarifies that elements of the building envelope also fall under the scope of Article 16(1).

— It includes references to systems and devices that are not part of technical building systems as defined under the recast EPBD: 'meters', and 'measuring and control devices'. In the presence of a 'building automation and control system' measuring and control devices are part of this system.

One additional observation is that 'building systems data' encompasses both:

(a) static information about the building elements and technical building systems (for instance, energy performance of buildings elements);

(b) data collected from systems and devices when the building is in-use (for instance, metering data, data from recharging points).

As mentioned earlier, it is important to make this distinction, since where the building system in question is a connected product, or a combination of connected products, the Data Act applies.

Finally, it is reasonable to assume that Article 16 covers data relevant to the subject matter of the recast EPBD (improving the energy performance of, and reducing greenhouse gas emissions from, buildings), and, more specifically, resulting from the implementation of the recast EPBD and related instruments (Energy Performance Certificates, inspections of technical building systems, smart readiness indicator, building renovation passport).

Based on the previous observations, 'building systems data' under Article 16 should at least encompass static information about the building and its systems, including:

— Energy performance certificate,

— Inspection reports on technical building systems,

— Smart Readiness Indicator certificate,

— Building renovation passport,

— Energy performance of building elements,

— Life-cycle Global Warming Potential (if available)

— Digital building logbook, where available.

One important comment is that the text refers to 'readily available' data. Based on the definition of 'readily available data' under the Data Act (Article 2(17)), this means that the data should be obtainable without disproportionate effort going beyond a simple operation. There are cases where the data would not be considered as readily available. For instance, for the expected remaining lifespan of the heating system, if the EPC does not include the item (as it is optional under Annex V), or if there is no EPC.

4.1.4. *Direct access*

Article 16(1) requires that Member States ensure that building owners, tenants and managers can have direct access to their building systems data.

This means that the owner, tenant, or manager is provided with the information that allows them to access the data, without the need for a prior request to the data holder (e.g. by providing them with an account to access their building's data in the database where it is stored, for instance the energy performance database as required under Article 22).

For managers a consent by the owner can be requested.

4.1.5. *Transposition and implementation*

In transposing and implementing Article 16(1), Member States are encouraged to differentiate between the two types of buildings data referred to in the previous sub-section:

Static information on the building and its system, Dynamic information from the building and its systems, based on data generated or collected from systems and meters when the building is in use.

Static information

Member States are required to take the necessary measures that will allow a building owner, tenant or manager to access the static information that is relevant under the recast EPBD. This information includes the reports and certificates issued under the recast EPBD, notably the EPC, and where possible, other relevant information on the energy performance of the building (for instance, inputs and outputs to/from energy performance calculations for the building in question). This can, for instance, be fulfilled through the digital interface to the energy performance database under Article 22.

Dynamic information

Where the building system in question is a connected product, or a combination of connected products, the Data Act applies. Under its Article 3(2), the seller, renter, or lessor of a connected product must make clear how the user [the owner of the connected product] can access the data generated by the connected product.:

Before concluding a contract for the purchase, rent or lease of a connected product, the seller, renter or lessor, which may be the manufacturer, shall provide at least the following information to the user, in a clear and comprehensible manner:

(a) *the type, format and estimated volume of product data which the connected product is capable of generating;*

(b) *whether the connected product is capable of generating data continuously and in real-time;*

(c) *whether the connected product is capable of storing data on-device or on a remote server, including, where applicable, the intended duration of retention;*

(d) *how the user may access, retrieve or, where relevant, erase the data, including the technical means to do so, as well as their terms of use and quality of service*

4.2. Access rights for third parties

Paragraph 1 of Article 16 sets out the requirement for Member States to ensure that owners, tenants and managers may grant access to this data to a third party.

(…) Upon their [building owners', tenants' and managers'] consent, the access or data shall be made available to a third party, subject to the existing applicable rules and agreements. (…)

In the same way as for the provisions discussed in the previous sections, it would be useful that Member States make a distinction between the two types of buildings data identified:

(a) Static information on the building and its system,

(b) Dynamic information from the building and its systems, based on data generated or collected from systems and meters when the building is in-use.

As regards a), the transposition of Article 16 into the national law must ensure that building owners, tenants and managers can grant access rights to a third party of their choice. The process can, for instance, be based simply on a request sent by the owner, tenant, or manager to the data holder (e.g. to the body responsible for the National energy performance database, where it applies) that identifies the third party of interest.

As regards b), Article 5(1) of the Data Act introduces rights for the connected product(s) user to share data with third parties ([16]):

Upon request by a user, or by a party acting on behalf of a user, the data holder shall make available readily available data, as well as the relevant metadata necessary to interpret and use those data, to a third party without undue delay, of the same quality as is available to the data holder, easily, securely, free of charge to the user, in a comprehensive, structured, commonly used and machine-readable format and, where relevant and technically feasible, continuously and in real-time. (…)

([16]) Conditions for data sharing are further elaborated in Articles 8 and 9 of the same Act.

4.3. **Compliance with applicable EU law**

Paragraphs 2 and 4 of Article 16 require Member States to ensure compliance with the applicable EU law in laying down the rules for access to, management, exchange and storage of, data:

2. *When laying down the rules regarding the management and exchange of data, taking into account the international standards and management format to data exchange, Member States or, where a Member State has so provided, the designated competent authorities, shall comply with the applicable Union law. (…)*

4. *The rules on access to data and data storage for the purposes of this Directive shall comply with the relevant Union law. The processing of personal data within the framework of this Directive shall be carried out in accordance with Regulation (EU) 2016/679 of the European Parliament and of the Council (30).*

These provisions are included to recall the need to comply, in transposing and implementing Article 16, with applicable EU law on data – one important area being data protection under the GDPR.

To ensure that the national rules are appropriate, the authorities responsible for the transposition and implementation of the recast EPBD should liaise and cooperate with the competent national authorities (e.g. national data protection authorities, and competent authorities under the Data Act), in transposing and implementing Article 16.

One specific point of attention is to ensure the protection of personal data, as Article 16 grants access rights to buildings data to the owner, tenant, and manager. When this data is personal, compliance with the GDPR needs to be ensured.

4.4. **Non-discriminatory and fair access to data**

Paragraphs 2 and 3 of Article 16 requires Member States to ensure non-discriminatory and fair access to data:

2. *(…) The rules on the access and any charges shall not constitute a barrier or create discrimination for third parties to access building systems' data.*

3. *No additional costs shall be charged to the building owner, tenant or manager for access to their data or for a request to make their data available to a third party subject to the existing applicable rules and agreements. Member States shall be responsible for setting the relevant charges for access to data by other eligible parties such as financial institutions, aggregators, energy suppliers, energy services providers and national statistical institutes or other national authorities responsible for the development, production and dissemination of European statistics. Member States or, where applicable, the designated competent authorities, shall ensure that any charges imposed by regulated entities that provide data services are reasonable and duly justified. Member States shall incentivise the sharing of the relevant building systems' data.*

4.4.1. *Free of charge access for building owners, tenants and managers*

Member States must ensure that no additional costs are charged to the building owner, tenant or manager for accessing their data. This means that, for those parties, direct access to their data is free of charge.

As regards static information about buildings, the data can be assumed to be stored in a database – specifically, for part of the data concerned, in database(s) managed or supervised by the national authorities (database for the energy performance of buildings to be established under Article 22).

The authorities should ensure that the building owner, tenant, and manager can download the data pertaining to the building they own, rent or manage without having to pay additional costs. Where the data is stored in databases managed by independent private companies (e.g. companies in charge of EPC assessment), the national law should mandate that, in the same way, free access is granted to the owner, tenant and manager for the data pertaining to the building they own, rent, or manage.

As regards dynamic information from buildings, Article 3 of the Data Act applies with regard to provisions on free access to buildings data for owner, tenants and managers; it requires, as of 12 September 2026, connected products to 'be designed and manufactured, and related services shall be designed and provided, in such a manner that product data and related service data, including the relevant metadata necessary to interpret and use those data, are, by default, easily, securely, **free of charge**, in a comprehensive, structured, commonly used and machine-readable format, and, where relevant and technically feasible, directly accessible to the user.' (Article 3(1) Data Act)

4.4.2. *Access by authorised third parties*

Member States must ensure that the rules defined for third parties to access data, and related charges, do not result in a barrier or create discrimination.

In this regard, the Data Act again constitutes a useful reference – notably its Articles 5, 8 and 9. Article 5 lays down an obligation on a data holder to provide access to data to a third party that an eligible user selects, while Articles 8 and 9 define the conditions under which data holders make data available to data recipients and the compensation for making data available as part of business-to-business relations.

As regards static information about buildings (1), the costs incurred by the data holder, if any, can be assumed to be minimal, given that the data is normally limited in size, there is typically no need for reformatting, and the data can be accessed by simple means (login / password, identification of the building in question).

In addition, Article 16 EPBD requires that no additional costs are charged 'to the building owner, tenant or manager (…) for a request to make their data available to a third party subject to the existing applicable rules and agreements'. The authorities are therefore encouraged to ensure, for the kind of data discussed, that access for authorised third parties is free of charge ([17]).

As regards dynamic information from buildings (2), the authorities may rely on the framework provided by the Data Act, notably its Articles 5, 8 and 9. As mentioned earlier, the authorities responsible for transposing and implementing the recast EPBD should liaise and cooperate with the competent national authorities (specifically competent authorities under the Data Act), in transposing and implementing those provisions of Article 16.

4.4.3. *Access by other eligible parties*

Under Article 16, Member States are responsible for setting charges for access to data by other eligible parties (e.g. financial institutions, or statistical institutes). Member States can choose that these charges are zero.

Eligible parties are not further defined in the text – this can be understood as bodies (public bodies, private companies, other organisations) that can have a legitimate interest in accessing building data.

The examples given in Article 16(2) are consistent with this notion of legitimate interest:

— financial institutions: accessing data on buildings in their investment and lending portfolios (in line with Article 22),

— aggregators: accessing data that is necessary to enable aggregation services,

— energy suppliers and energy services providers: accessing data that is necessary to enable energy services,

— national statistical institutes or other national authorities responsible for developing, producing and disseminating European statistics.

([17]) This can be done, for instance, by allowing owners, tenants and managers to give access themselves to the data pertaining to their building.

Further to the above, for national statistical institutes, the situation is more specific. They have dedicated use and processing rights to benefit from such source linkage to the extent possible, in compliance with applicable personal data protection rules, as set out at EU level in Article 17a of Regulation (EC) No 223/2009 on European statistics ([18]). This does not impact the additional dedicated national laws in place in most Member States.

If the data holder is a public sector body, the authorities are encouraged to assess (in cooperation with the competent national bodies under the Data Governance Act) whether access to building data under Article 16 could be covered by the provisions on the re-use of certain categories of protected data held by public sector bodies (Chapter II of the Data Governance Act).

In any case, in setting the rules for access to data by third parties, the authorities must ensure compliance with the GDPR, ensuring that personal data is protected as appropriate. For instance, using techniques such as pseudonymisation and aggregation.

4.4.4. *Incentivising the sharing of building systems data*

Under Article 16, Member States are required to incentivise the sharing of the relevant building systems data.

To this end, Member States are encouraged to implement measures that promote and support the availability of building systems data, for instance:

— Through the obligation in Art 22(2) that Member States must ensure easy and free-of-charge access to the full energy performance certificate for building, stored in the national databases for the energy performance of buildings.

— Promoting and establishing national policies to encourage broader sharing of data (i.e. 'data altruism', as per Article 2(16) of the Data Governance) in the buildings sector ([19]).

4.5. **Consultation strategy for the implementing acts under Article 16(5)**

Article 16(5) requires the Commission to adopt implementing acts detailing interoperability requirements and non-discriminatory and transparent procedures for access to the data by 31 December 2025. In line with Article 16(5), the following consultation strategy will apply for the development of the implementing acts:

4.5.1. *Consultation objectives*

The objective of the consultation is to gather input from experts in the field as regards interoperability requirements and non-discriminatory and transparent procedures for access to data under Article 16.

4.5.2. *Targeted stakeholders*

The targeted stakeholders are the members of the Data for Energy working group under the Smart Energy Expert Group ([20]) set up by the Commission. The mission of the Smart Energy Expert Group is to accelerate the digitalisation of the energy system and contribute to the smart energy transition.

([18]) Regulation (EC) No 223/2009 of the European Parliament and of the Council of 11 March 2009 on European statistics and repealing Regulation (EC, Euratom) No 1101/2008 of the European Parliament and of the Council on the transmission of data subject to statistical confidentiality to the Statistical Office of the European Communities, Council Regulation (EC) No 322/97 on Community Statistics, and Council Decision 89/382/EEC, Euratom establishing a Committee on the Statistical Programmes of the European Communities (Text with relevance for the EEA and for Switzerland) (OJ L 087 31.3.2009, p. 164).

([19]) In doing so, coordinating with the competent authorities at national level, as regards the registration of data altruism organisations under the Data Governance Act.

([20]) Commission Decision of 18.9.2023 setting up the group of experts on Smart Energy, C(2023) 6121 final.

The Expert Group has the following tasks:

— Assist the Commission in relation to the implementation of existing EU legislation, programmes and policies

— Assist the Commission in the preparation of delegated acts

— Assist the Commission in the preparation of legislative proposals and policy initiatives

— Coordinate with Member States, exchange of views

— Bring forward an exchange of experiences and good practices in the field of smart energy transition and on the digitalisation of the energy system; provide assistance and frame recommendations at the Commission's request in those fields

— Provide expertise to the Commission when preparing implementing measures, i.e. before the Commission submits these draft measures to a comitology committee

The group is composed of the Member States' competent authorities, other public bodies and organisations active in the areas related to energy or digitalisation that have been selected via a public call for applications.

4.5.3. *Consultation activities*

The consultation activities include presentation and discussion of draft implementing acts at the meeting of the Data for Energy working group and the possibilities for the members of the group to provide feedback also between the meetings.

ANNEX 7

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Zero Emission Buildings (Articles 7 and 11)

TABLE OF CONTENTS

1. ZERO EMISSION BUILDINGS (ZEB): DEFINITION AND RELATED PROVISIONS

Buildings are a major source of direct and indirect greenhouse gas (GHG) emissions and one of the hardest sectors to decarbonise. To meet the Union's longer-term climate neutrality goals, it is necessary to significantly reduce the operational energy consumption of buildings, while starting to consider buildings' full life cycle GHG emissions. Although improving the energy and climate performance of the existing building stock is key for this process, it is also important that new buildings being constructed have very low energy consumption and operational emissions from the start, avoiding the need for further intervention.

Therefore, the recast Energy Performance of Buildings Directive ('the recast EPBD') ([1]) introduces the requirement that all new buildings must be zero-emission buildings. Article 2(2) of the Directive defines a zero-emission building (ZEB) as a building:

— with a very high energy performance, as determined in accordance with Annex I,

— requiring zero or a very low amount of energy,

— producing zero on-site carbon emissions from fossil fuels,

— producing zero or a very low amount of operational greenhouse gas emissions,

— in accordance with Article 11.

Article 11 of the Directive sets out the detailed requirements for a ZEB, both new and existing.

Article 7 of the Directive indicates the timeline for the application of ZEB requirements to new buildings. In addition, it provides that several issues must also be addressed for new buildings, namely: optimal indoor environmental quality, adaptation to climate change, fire safety, risks related to intense seismic activity, accessibility for persons with disabilities and carbon removals associated to carbon storage in or on buildings.

Annex I to the Directive updates the calculation methodology for the energy performance of buildings.

2. ARTICLE 11(1) - ZERO ON-SITE EMISSIONS FROM FOSSIL FUELS

Article 11(1) states that a ZEB must 'not cause any on-site carbon emissions from fossil fuels'.

This means that the combustion of fossil fuels to generate energy on-site to supply the building needs within the recast EPBD scope ([2]) is not allowed. 'Fossil fuels' are defined in Article 2(62) of Regulation (EU) 2018/1999 ([3]) as 'non-renewable carbon-based energy sources such as solid fuels, natural gas and oil'. This definition is in line with the Eurostat definition ([4]): 'non-renewable energy sources such as coal, coal products, natural gas, derived gas, crude oil, petroleum products and non-renewable wastes'.

([1]) Directive (EU) 2024/1275.
([2]) The recast EPBD scope is defined in Annex I of the Directive and comprises the energy use for space heating, space cooling, domestic hot water, ventilation, built-in lighting and other technical building systems.
([3]) Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action Regulation - 2018/1999 - EN - EUR-Lex (europa.eu).
([4]) Eurostat, Glossary:Fossil fuel - Statistics Explained (europa.eu).

Examples:

— The use of on-site heating systems powered by natural gas, oil and petroleum products, or coal and coal products is not compliant with Article 11(1).

— The use of heat pumps, solar-thermal and bioenergy-based ([5]), ([6]) heating systems is compliant with Article 11(1).

3. ARTICLE 11(7) - SOURCES OF ENERGY SUPPLY

Total primary energy use of a ZEB must be fully covered on an annual basis by one or a combination of the following options:

(a) energy from renewable sources generated on-site or nearby, fulfilling the criteria laid down in Article 7 of Directive (EU)2018/2001 ([7]);

(b) energy from renewable sources provided from a renewable energy community within the meaning of Article 22 of Directive (EU)2018/2001;

(c) energy from an efficient district heating and cooling system in accordance with Article 26(1) of Directive (EU)/2023/1791 ([8]); or

(d) energy from carbon-free sources.

3.1. Renewable energy

The meaning of 'energy from renewable sources' is as defined in Article 2(14) of the Directive, mirroring the definition of Directive (EU) 2018/2001, i.e. 'energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogases'.

Furthermore, for the purpose of Article 11(7), the scope of energy from renewable sources must be narrowed to the eligible renewable sources defined by Article 7 of Directive EU/2018/2001. Notably, biofuels, bioliquids and biomass fuels that do not fulfil the sustainability and greenhouse gas emissions saving criteria laid down in Articles 29(2) to (7) and 29(10) of Directive (EU) 2018/2001 must not be considered.

3.1.1. *Renewable energy produced on-site and nearby*

Renewable energy produced on-site should be considered in relation to Article 2(54) that defines 'on-site' as '*in or on a particular building or on the land on which that building is located*'.

Recital 22 of the Directive provides examples of on-site renewable energy sources such as solar thermal, geothermal, solar photovoltaics, heat pumps, hydroelectric power, and biomass. Recital 22 also specifies that 'energy derived from combustion of renewable fuels is considered to be energy from renewable sources generated on-site where the combustion

([5]) The negative impact of bioenergy on indoor and outdoor air quality is regulated by the Directive (EU) 2024/2881 of the European Parliament and of the Council of 23 October 2024 on ambient air quality and cleaner air for Europe (recast) and by Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants.

([6]) While not a requirement under the EPBD, the amount of operational greenhouse gas emissions coming from bioenergy can inform on what harvesting needs and associated Land Use, Land Use Change and Forestry emissions this would entail. '[In the land use, land-use change, and forestry (LULUCF) sector] carbon removals have and continue to decline at a worrying speed in recent years. This negative trend is, to a large degree, due to a decrease in forest-related removals, mainly as a consequence of an increase in harvesting […] Climate change itself is having an increasing impact too. […]. There are many indications that, because of climate change, the future robustness of EU forest removals is far from guaranteed.' (The European Commission's Climate Action Progress Report 2024).

([7]) Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast). Directive - 2018/2001 - EN - EUR-Lex (europa.eu).

([8]) Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast). Directive - 2023/1791 - EN - EUR-Lex (europa.eu).

of the renewable fuel takes place on-site'. This makes it clear that the on-site use of systems powered by bioenergy is covered. Note that bioenergy produced outside the building's boundary will continue to be considered distant energy when calculating the energy performance and when setting the energy demand threshold of a ZEB, in accordance with Annex I of the Directive and the ISO standards indicated in Annex I (1).

Article 2(55) defines energy from renewable sources produced nearby as 'energy from renewable sources, produced within a local or district-level perimeter of a particular building, which fulfils all of the following conditions:

(a) it can be distributed and used only within that local and district-level perimeter through a dedicated distribution network;

(b) it allows for the calculation of a specific primary energy factor valid only for the energy from renewable sources produced within that local or district-level perimeter; and

(c) it can be used on-site through a dedicated connection to the energy production source, where that dedicated connection requires specific equipment for the safe supply and metering of energy for self-use of the building'.

An example of renewable energy produced nearby is a heating system powered by solar-thermal energy and/or bioenergy that produces the energy for a group of buildings located in the vicinity of each other, where there is a direct connection between the building and the system and where the renewable share and associated primary energy factor can be identified and calculated. A typical example of this is a hospital or university campus.

The definitions of renewable energy produced 'on-site' and 'nearby' are also aligned to EN ISO 52000-1 standard. They are relevant both to nearly zero-energy buildings (NZEB) and zero-emission buildings.

Since a ZEB may also be supplied by energy from carbon-free sources (see guidance below on this option), the definition of renewable energy from 'nearby' must be taken in its stricter sense and only renewable energy that is connected to the building by a 'dedicated connection to the energy production source' should be considered as generated 'nearby'. In this way, 'nearby' renewable energy can be precisely identified and metered and be distinct from (other) 'energy from carbon-free sources'. This clarification may encourage local authorities to prioritise a particularly high local renewable potential.

3.1.2. *Renewable energy from a renewable energy community*

As defined in Article 2(16) of Directive (EU) 2018/2001 and described in Article 22 of the same Directive, a 'renewable energy community' means a legal entity that fulfils three conditions, namely:

— 'which in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity;

— the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities;

— the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits.'

3.2. **Efficient district heating and cooling system**

Efficient district heating and cooling systems are described in Article 26(1) and (2) of Directive (EU) 2023/1791. Article 26(1) of that Directive sets out the conditions for district heating and cooling systems to be considered 'efficient'; this is based on a gradual increase of the share of renewable energy, waste heat and high-efficiency cogeneration ([9]) until 2050 as follows:

— 'until 31 December 2027, a system using at least 50 % renewable energy, 50 % waste heat, 75 % cogenerated heat or 50 % of a combination of such energy and heat;

([9]) High-efficiency cogeneration is defined in Article 2(40) of Directive EU/2023/1791 such as 'cogeneration meeting the criteria laid down in Annex III'. See Annex III to Directive EU/2023/1791 for the criteria defining high-efficiency cogeneration.

— from 1 January 2028, a system using at least 50 % renewable energy, 50 % waste heat, 50 % renewable energy and waste heat, 80 % of high-efficiency cogenerated heat or at least a combination of such thermal energy going into the network where the share of renewable energy is at least 5 % and the total share of renewable energy, waste heat or high-efficiency cogenerated heat is at least 50 %;

— from 1 January 2035, a system using at least 50 % renewable energy, 50 % waste heat or 50 % renewable energy and waste heat, or a system where the total share of renewable energy, waste heat or high-efficiency cogenerated heat is at least 80 % and in addition the total share of renewable energy or waste heat is at least 35 %;

— from 1 January 2040, a system using at least 75 % renewable energy, 75 % waste heat or 75 % renewable energy and waste heat, or a system using at least 95 % renewable energy, waste heat and high-efficiency cogenerated heat and in addition the total share of renewable energy or waste heat is at least 35 %;

— from 1 January 2045, a system using at least 75 % renewable energy, 75 % waste heat or 75 % renewable energy and waste heat;

— from 1 January 2050, a system using only renewable energy, only waste heat, or only a combination of renewable energy and waste heat.'

Article 26 (2) introduces alternative criteria for efficient district heating and cooling systems based on the gradual reduction of greenhouse gas emissions by 2050:

— until 31 December 2025: 200 grams/kWh;

— from 1 January 2026: 150 grams/kWh;

— from 1 January 2035: 100 grams/kWh;

— from 1 January 2045: 50 grams/kWh;

— from 1 January 2050: 0 grams/kWh.

The Commission Recommendation (EU) 2024/2395 [10] setting out guidelines for the interpretation of Article 26 of Directive (EU) 2023/1791 provides more details.

3.3. **Energy from carbon-free sources**

In line with the objectives shared by co-legislators, energy from carbon-free energy sources comprise renewables and nuclear energy [11].

Some examples of energy from carbon-free sources:

— renewables or nuclear from the electricity grid,

— renewables and waste heat from a district heating system that is not considered efficient under Article 26 of Directive (EU) 2023/1791.

When quantifying the amount of 'energy from carbon-free sources' delivered to an individual building, it is recommended that the share of carbon-free sources in the electricity mix of the grid and the share of carbon-free sources in the energy mix of a district heating system be considered.

[10] Commission Recommendation (EU) 2024/2395 of 2 September 2024 setting out guidelines for the interpretation of Article 26 of Directive (EU) 2023/1791 of the European Parliament and of the Council as regards the heating and cooling supply Commission Recommendation (EU) 2024/2395 of 2 September 2024 setting out guidelines for the interpretation of Article 26 of Directive (EU) 2023/1791 of the European Parliament and of the Council as regards the heating and cooling supply (europa.eu).

[11] Nuclear energy is a low-carbon energy source but its operational carbon emissions are considered zero in the GHG emissions inventory for the UNFCC, in a similar way as renewables. More details in Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change at ipcc_wg3_ar5_chapter7.pdf and in The IPCC Task Force on National Greenhouse Gas Inventories (TFI) at TFI — IPCC.

3.4. **Total primary energy use covered on annual basis and exemptions**

The calculation of the total annual primary energy use of a ZEB must be done following the methodology defined by Annex I to the Directive to determine the energy performance of the building. In particular, the approach must:

— be based on estimates and projections of the energy needs of the building and primary energy supply using monthly, hourly or even sub-hourly time calculation intervals in order to account for varying conditions;

— make use of primary energy factors or weighting factors, which in turn must be forward looking, be based on relevant information and take into account the expected energy mix on the basis of national energy and climate plans ([12]).

Article 11(7) provides that the total annual primary energy use of a new or renovated ZEB must be fully covered by the options listed in points (a) to (d) of that Article (while, as provided in Article 11(1), the on-site use of fossil fuels is clearly not allowed to cover the energy needs within the recast EPBD's scope).

One possibility is that the total primary energy use of a ZEB over a year is fully and continuously covered by one or more of the options under (a) to (d). However, a ZEB may also temporarily be supplied by other energy sources, including energy with carbon content, and compensate this non-compliant energy ([13]), on an annual basis, by the renewable energy produced on-site and either used on-site for non-EPB uses ([14]) or exported to the grid.

An example for compensating non-compliant energy used by the renewable energy produced on-site and either exported to the grid or used on-site for non-EPB uses is presented in below figures and tables. It is a building that uses 14 500 kWh/y over a year and within the recast EPBD scope, out of which 6 500 kWh/y is electricity and 8 000 kWh/y heat energy. The heat energy use is fully covered by an efficient district heating system with a primary energy factor (PEF) of 1.2. The building has an on-site photovoltaic system (e.g. on the rooftop, on the building's façade or on balconies) that produces 6 400 kWh/y out of which 2 000 kWh/y are delivered to the on-site EPB uses, 1 800 kWh/y to the on-site non-EPB uses and 2 600 kWh/y are exported to the electricity grid. The additional electricity need of the building is covered by electricity from the grid having a mix of 27 % renewables, 37 % nuclear and 36 % fossil fuels with an average PEF of 2.3, i.e. PEF=1 for renewables, PEF=3 for nuclear and PEF=2.5 for fossil fuels-based electricity (n.b. PEF_{el} = 0.27*1 + 0.37*3 + 0.36*2.5 = 2.3).

Therefore, when expressed in total primary energy, the building uses 4 050 kWh/y electricity of fossil fuels origin from the grid that is not compliant to the requirements of Article 11 (7) of the Directive. At the same time, from the on-site PV electricity production, 1 800 kWh/y are used by other on-site non-EPB uses and 2 600 kWh/y are exported to the electricity grid.

This means that when calculating the total primary energy use of the building on annual basis, the renewable energy produced on-site and exported to the electricity grid or used on-site for non-EPB uses amounts to 4 140 kWh/y and fully compensates the 4 050 kWh/y electricity of fossil fuels origin from the grid.

In below tables, the calculation of the total energy consumption of the building in primary energy use and the coverage of the total primary energy use of the building by options (a) – (d) from Article 11(7) of the Directive are performed in two boundary conditions: building assessment boundary and building site boundary. The results should be the same in both cases.

([12]) For more details, see guidance on Common general framework for the calculation of the energy performance of buildings in Annex 12 to the Commission Notice providing guidance on new and substantially modified provisions of the recast Energy performance of Buildings Directive (EU) 2024/1275.

([13]) Namely energy from sources other than those specified in Article 11(7).

([14]) Other on-site energy use that is outside the recast EPBD's scope as defined in Annex I(1) is use by consumers such as energy used for recharging e-vehicles, ICTs (other than those which are part of a technical building system), TV sets, washing machines, dishwashers, cooking appliances, etc.

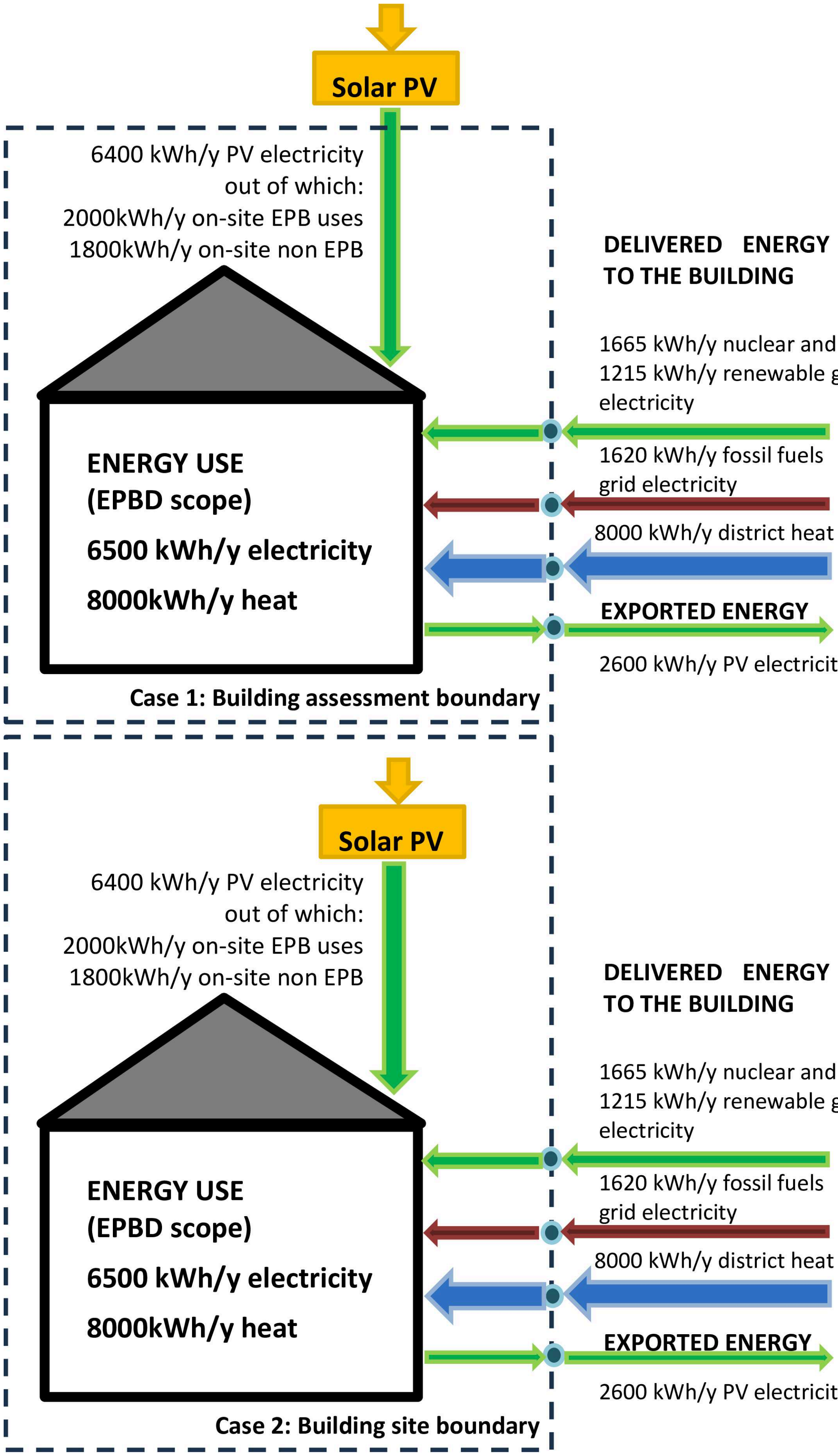

Figure 1: Building assessment boundary (Case 1, top picture) and building site boundary (Case 2, bottom picture) for primary energy calculation.

Table 1

Total primary energy use of the building and compensation of the non-compliant energy from the grid by the renewable energy produced on-site and either exported to the grid or used on-site for non-EPB uses

	Case 1: Building assessment boundary				Case 2: Building site boundary		
	Delivered and exported energy	PEF ([1])	$M_{primary}$ ([2])	Total primary energy	Delivered and exported energy	PEF	Total primary energy
	[kWh/y]	[-]	[-]	[kWh/y]	[kWh/y]	[-]	[kWh/y]
rooftop PV	6 400	1	0	0			
PV electricity used on-site for non-EPB uses	1 800	1	1	1 800	1 800	1	1 800
exported PV electricity to grid	2 600	0,9	1	2 340	2 600	0,9	2 340
electricity from the grid:	4 500	2,28	1	10 260	4 500	2,28	10 260
out of which:							
renewable	1 215	1	1	1 215	1 215	1	1 215
nuclear	1 665	3	1	4 995	1 665	3	4 995
fossil	1 620	2,5	1	4 050	1 620	2,5	4 050
heat from an efficient district heating	8 000	1,2	1	9 600	8 000	1,2	9 600
Total primary energy (for energy demand threshold)				**15 720**			**15 720**

Covering total primary energy by a)-d) options from Article 11(7)	**17 280**			**17 280**
out of which:				
covering by rooftop PV	6 400			6 400
covering by renewable electricity	1 215			1 215
covering by nuclear	1 665			1 665
covering by efficient district heating	8 000			8 000

([1]) PEF means primary energy factor.

([2]) $M_{primary}$ is the multiplier factor from delivered energy to primary energy. In case 1 from the above picture where using the building assessment boundary, the multiplier is necessary to specify which energy flow through the assessment boundary is considered. The multiplier is not necessary when using a building site boundary as in case 2 from the above picture where the on-site rooftop PV system is within the assessment boundary. More details in REHVA paper 'Primary energy and operational CO indicators calculation in revised EPBD' that is available here: EPBD_Guidance_2024.pdf

Another example (see below figures and tables), now with the energy balance calculated as per m2, is an efficient building with a heat pump that uses within the recast EPBD scope 20 kWh/(m^2.y) of electricity and 21.6 kWh/(m^2.y) representing the ambient heat from outdoor air captured by the heat pump. The building has an on-site photovoltaic system (e.g. on the rooftop, on the building's façade or on balconies) that produces 22.8 kWh/(m^2.y) out of which 5.6 kWh/(m^2.y) are delivered to the on-site EPB uses, 6.6 kWh/(m^2.y) to the on-site non-EPB uses and 10.6 kWh/(m^2.y) are exported to the electricity grid. The additional electricity need of the building is covered by 14.4 kWh/(m^2.y) electricity from the grid having a mix of 27 % renewables, 37 % nuclear and 36 % fossil fuels with an average PEF of 2.3, i.e. PEF=1 for renewables, PEF=3 for nuclear and PEF=2.5 for fossil fuels -based electricity (n.b. PEF_{el} = 0.27*1 + 0.37*3 + 0.36*2.5 = 2.3).

Therefore, when expressed in total primary energy, the building uses 12.96 kWh/(m^2.y) electricity of fossil fuels origin from the grid that is not compliant to the requirements of options (a) – (d) of the Article 11 (7) of the Directive (see below table). At the same time, from the on-site PV electricity production, 6.6 kWh/(m^2.y) are used by other on-site non-EPB uses and 9.54 kWh/(m^2.y) are exported to the electricity grid.

This means that when calculating the total primary energy use of the building on annual basis, the renewable energy produced on-site and used on-site for non-EPB uses or exported to the electricity grid amount at 16.14 kWh/(m^2.y) and over-compensate the 12.96 kWh/(m^2.y) electricity of fossil fuels origin from the grid.

In below tables, the calculation of the total energy consumption of the building in primary energy use and the coverage of the total primary energy use of the building by options (a) – (d) from Article 11(7) of the Directive are performed in two boundary conditions: building assessment boundary and building site boundary. The results should be the same in both cases.

To note that in this case there is a relatively low amount of total primary energy use of the building that is not covered by options (a) – (d) from Article 11(7) and may be compensated additional renewable energy produced on-site and exported to the grid.

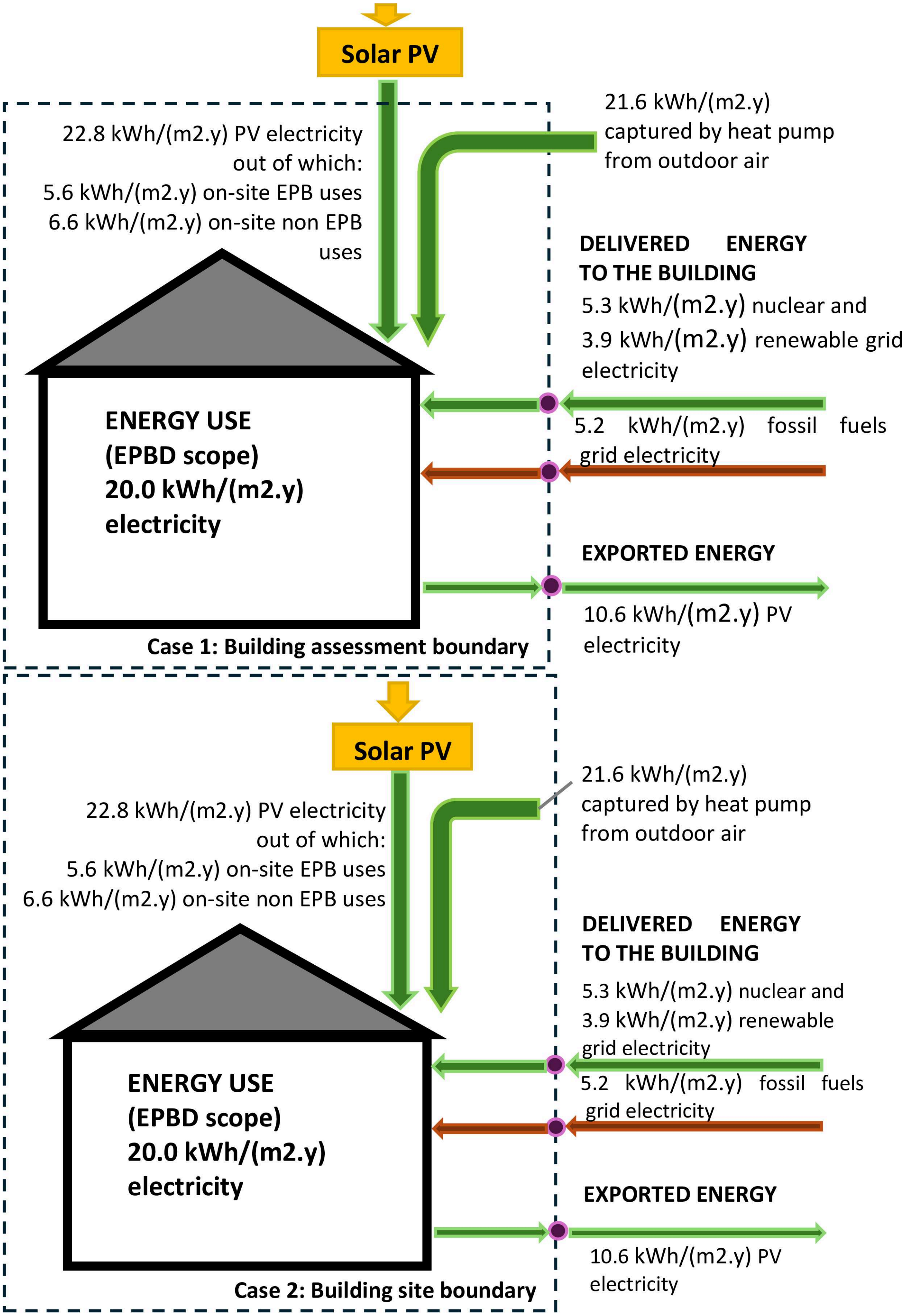

Figure 2: Building assessment boundary (Case 1, top picture) and building site boundary (Case 2, bottom picture) for primary energy calculation.

Table 2

Total primary energy use of the building and compensation of the non-compliant energy from the grid by the renewable energy produced on-site and either exported to the grid or used on-site for non-EPB uses

	Case 1: Building assessment boundary				Case 2: Building site boundary		
	Delivered and exported energy	PEF [1]	$M_{primary}$ [2]	Total primary energy	Delivered and exported energy	PEF	Total primary energy
	[kWh/(m2·y)]	[-]	[-]	[kWh/(m2.y)]	[kWh/(m2.y)]	[-]	[kWh/(m2.y)]
rooftop PV	22,8	1	0	0			
ambient heat for heat pump	21,6	1	0	0			
PV electricity used on-site for non-EPB uses	6,6	1	1	6,6	6,6	1	6,6
exported PV electricity to grid	10,6	0,9	1	9,54	10,6	0,9	9,54
electricity from the grid:	14,40	2,28	1,0	32,83	14,40	2,28	32,83
out of which:							
renewable	3,89	1,0	1	3,89	3,89	1	3,89
nuclear	5,33	3,0	1	15,98	5,33	3	15,98
fossil	5,18	2,5	1	12,96	5,18	2,5	12,96
Total primary energy (for energy demand threshold)				**16,7**			**16,7**

Covering total primary energy by a)-d) options from Article 11(7)	**53,6**		**53,6**
out of which:			
covering by rooftop PV	22,8		22,8
Covering by ambient heat for heat pump	21,6		21,6
covering by renewable electricity	3,9		3,9
covering by nuclear	5,3		5,3

(1) PEF means primary energy factor.

(2) $M_{primary}$ is the multiplier factor from delivered energy to primary energy. In case 1 from the above picture where using the building assessment boundary, the multiplier is necessary to specify which energy flow through the assessment boundary is considered. The multiplier is not necessary when using a building site boundary as in case 2 from the above picture where the on-site rooftop PV system is within the assessment boundary. More details in REHVA paper on Primary energy and operational CO indicators calculation in revised EPBD 2 that is available here: EPBD_Guidance_2024.pdf

Another possibility to comply with the provisions of Article 11(7) of the Directive is provided by the last sentence of the paragraph stating that where it is not technically or economically feasible to cover the total annual primary energy use of a ZEB by options (a) to (d), it is possible to use other energy from the grid complying with criteria established at national level.

As a first step, Member States must detail in which specific cases meeting the requirements of Article 11(7) is not feasible from a technical or economic perspective ([15]). These cases should be clearly identified categories of buildings and/or specific situations with concrete limitations due to, for example, local weather conditions and context. They should be transparently set out, made publicly available and be applied in a non-discriminatory way. As is the case for all exemptions, the exemption related to technical and economic feasibility should be narrowly interpreted.

Technical feasibility should be assessed with a view to contextual limitations and local conditions.

As an example, it might not be technically feasible to ensure 100 % of supply using the options (a) to (d) due to local limitations. For example, in the case of multi-family buildings in high-density environments where the rooftop is not large enough for the use of solar thermal and an inefficient district heating system is in place, 100 % compensation by on-site renewables is not technically feasible due to the lack of space (e.g. insufficient surface area for solar panels) and other solutions are not feasible (e.g. it is not possible to install heat pumps in each apartment due to space limitations, nor to install a heat pump supplying the whole multi-family building).

Another example may be remote buildings in a low-density community in a mountain area with a heat pump supplied by electricity that is not decarbonised, where the compensation by solar power is not feasible (e.g. due to the shading induced by surrounding mountains or trees or other climatic conditions which do not allow for efficient solar installations).

As regards economic feasibility, Member States could establish that it is economically feasible to cover the total primary energy use of a building using options (a) to (d) where the expected benefits outweigh the costs of the required intervention, taking into account the expected lifetime of the system; for example, the compensation by solar electricity would be considered economically feasible where, over the expected lifetime of the solar panels, the expected economic benefits of producing solar electricity outweigh the costs of installing the solar panels.

It is important to underline that the exemption for non-feasibility only relates to covering the annual energy use by options (a) to (d). The other ZEB requirements (very high energy performance and no carbon emissions from fossil fuels) must always be respected. Also, buildings that cannot fulfil the requirements using options (a) to (d) should still contribute to decarbonising the building stock as much as possible.

As a second step, Member States must establish national criteria for those buildings where full compliance with Article 11(7) is not feasible. In their national criteria, Member States should still aim to maximise the use of renewable energy sources and other sources listed in options (a) to (d).

Member States are also encouraged to take additional and parallel measures, so that buildings that fail to meet the requirements of Article 11(7) can still contribute effectively to a decarbonised building stock. Measures could include:

— Additional minimum energy performance requirements for elements of the building envelope. For example: the national criteria may comprise specific stricter requirements for the thermal transmittance (U-value) of building envelope elements (e.g. walls, windows) from a dense urban area.

— Minimum levels of coverage by renewable energy. For example: a minimum 60% coverage.

— Minimum levels of on-site renewable energy production. For example: 80 % of roof must be used for solar energy generation or 60 % of roof and at least 10 % of façade must be used for integrated solar photovoltaic systems, in accordance with the optimised solar energy generation potential under Article 10(1).

([15]) For more details, see the section on technical, economic and functional feasibility from the guidance on technical building systems, indoor environmental quality and inspections in Annex 10 to the Commission Notice providing legal and practical guidance on new or substantially modified provisions of the recast Energy performance of Buildings Directive (EU) 2024/1275.

— Minimum levels of connectivity and demand response. For example: buildings must achieve a minimum SRI (smart readiness indicator) score for the capacity to adapt to signals from the grid and demand response criteria.

4. ARTICLE 11(2) AND (3) - MAXIMUM THRESHOLD FOR ENERGY DEMAND

According to Article 11(2) and (3), a ZEB must comply with a maximum threshold for its energy demand. The maximum energy demand threshold must comply with several conditions:

— It must be set 'with a view to achieving at least the cost-optimal levels established in the most recent national cost-optimal report pursuant to Article 6';

— It must be revised 'every time that the cost-optimal levels are revised';

— It must be 'at least 10 % lower than the threshold for total primary energy use established at Member State level for nearly zero-energy buildings on 28 May 2024'.

The energy demand threshold for ZEBs is to be interpreted in the context of all requirements under Article 11 of the Directive. Article 11(3) links the maximum energy demand threshold of a ZEB to the threshold for total primary energy use for nearly-zero energy buildings. Consequently, the maximum energy demand threshold must also be set for total primary energy use (both renewable and non-renewable), reflecting the energy performance of the building, which is expressed in kWh/(m^2.y) and calculated in accordance with Annex I to the Directive ([16]).

Acknowledging the different energy consumption patterns due to the type of activities, occupancy and climatic context, the maximum energy demand thresholds for ZEBs can be established for different building types, taking into consideration the outdoor climate conditions (e.g. climatic zones) and local context, as shown in the energy performance calculation methodology set out in Annex I.

Furthermore, Article 11(2) states that the maximum energy demand threshold must be set 'with a view to achieving at least the cost-optimal levels established in the most recent national cost-optimal report pursuant to Article 6' and that it must be reviewed 'every time that the cost-optimal levels are revised'.

This indicates that the maximum energy demand threshold should be at least at cost-optimal levels and may be established as part of the cost-optimal calculation. The cost-optimal calculation must be carried out in accordance with Article 6(2) of the Directive and following the Commission Delegated Regulation (EU) 2025/2273 as regards the establishment of a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements ([17]). In accordance with Article 6(2), Member States must report their cost-optimal calculations to the Commission at regular intervals not longer than 5 years. The first report based on the revised Commission Delegated Regulation is due by 30 June 2028. Under Article 11(2), Member States must revise the maximum energy demand threshold for ZEBs every time that the cost-optimal levels are revised; however, if the updated cost-optimal reports do not entail any changes to the cost-optimal levels, there will be no need to change the maximum energy demand threshold for ZEBs.

Nonetheless, in accordance with Article 7(1) of the Directive, the first maximum energy demand thresholds for ZEBs must be established in time for the application of ZEB requirements for new buildings, namely:

— from 1 January 2028 for new buildings owned by public bodies; and

— from 1 January 2030 for all new buildings.

([16]) For more details, see guidance on Common general framework for the calculation of the energy performance of buildings in Annex 12 to the Commission Notice providing legal and practical guidance on new or substantially modified provisions of the recast Energy performance of Buildings Directive (EU) 2024/1275.

([17]) Commission Delegated Regulation (EU) 2025/2273 of 30 June 2025 supplementing Directive (EU) 2024/1275 of the European Parliament and of the Council as regards the establishment of a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements - OJ L, 2025/2273, 6.11.2025, ELI: http://data.europa.eu/eli/reg_del/2025/2273/oj.

The 2028 update of cost-optimal reports under the revised Commission Delegated Regulation (EU) 2025/2273 will come too late to be relevant for the introduction of ZEB requirements for new buildings owned by public bodies and it may also be challenging to use them to set the maximum energy demand thresholds for all new buildings from the beginning of 2030. This means that, in order to apply the ZEB requirements in 2028 (new buildings owned by public bodies) and 2030 (all buildings), the maximum energy demand thresholds may first need to be based on the 2023 cost-optimal reports and then be revised following the 2028 cost-optimal reports.

The maximum energy demand thresholds for ZEBs must be reported to the Commission by the transposition deadline for this Directive; Member States must also report them through the national building renovation plans.

According to Article 11(3), the maximum energy demand threshold of a ZEB must be 'at least 10 % lower' than the threshold for 'total primary energy use' as established at Member State level for nearly zero-energy buildings on 28 May 2024 ([18]). This 'NZEB -10 %' cap will remain in place over time, which means that the maximum energy demand threshold for ZEBs cannot be revised upwards beyond this cap, irrespective of the results of future cost-optimal calculations.

Meanwhile, the methodological framework for the calculation of the energy performance of buildings changed slightly with the amendments to Annex I to the Directive. Furthermore, Commission Delegated Regulation (EU) 2025/2273 introduces additional changes compared with Delegated Regulation (EU) No 244/2012, in line with Article 6 and Annex VII. Additionally, the current thresholds for nearly-zero energy buildings are not always defined in terms of total primary energy use, unlike the maximum energy demand threshold for ZEBs, which have to be expressed in terms of total primary energy use.

Therefore, the thresholds in place on 28 May 2024 for nearly-energy buildings must be 'translated' to current requirements of the recast Directive to be meaningful as a reference for the maximum energy demand thresholds for ZEBs. This adaptation may be done by revisiting the calculation for the thresholds for nearly-zero energy buildings, which are assumed to have been established with a view to the 2018 cost-optimal reports.

This diagram below shows an example on how to set the maximum energy demand threshold over time and in relation to the results of the cost-optimal calculation.

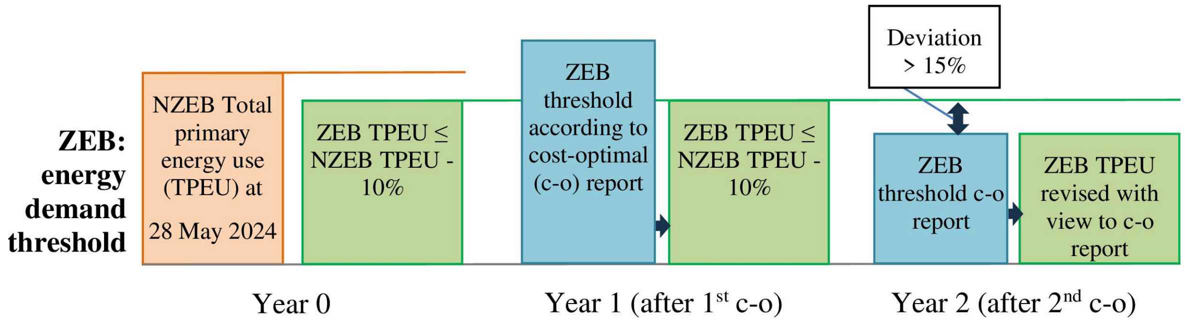

Figure 3: Example on how to review and revise, if necessary, the energy demand threshold for zero emission buildings

5. ARTICLE 11(4) – MAXIMUM ENERGY DEMAND THRESHOLD FOR ZEB AFTER RENOVATION

Article 11(4) of the Directive provides for the possibility of adjusting the maximum energy demand threshold of a ZEB for renovated buildings. The maximum energy demand threshold for renovated buildings must also be set with a view to achieving cost-optimal levels.

The 'NZEB -10 %' cap also applies, but only if Member States have established specific thresholds for renovated nearly-zero energy buildings.

As in the case of new ZEBs, the 'NZEB -10 %' cap (where it applies) will remain in place over time and the maximum energy demand threshold for ZEBs cannot be revised upwards, irrespective of the results of future cost-optimal calculations.

([18]) The date of entry into force of Directive (EU) 2024/1275.

The maximum energy demand threshold for renovated ZEBs is particularly relevant in relation to Article 2(20), which introduces a new deep renovation standard: deep renovation is defined as a renovation in line with the 'energy efficiency first' principle, transforming a building or a building unit into a nearly-zero energy building before 1 January 2030, and into a zero-emission building from 1 January 2030.

The ZEB threshold for renovated buildings is also relevant for the designation of energy performance class A for renovated buildings and for Article 6(1) of Directive (EU) 2023/1791 on the 'exemplary role of public bodies' buildings', which requires that 'at least 3 % of the total floor area of heated and/or cooled buildings that are owned by public bodies is renovated each year to be transformed into at least nearly zero-energy buildings or zero-emission buildings'.

The energy demand thresholds for renovated ZEBs must be reported to the Commission by the transposition deadline for this Directive and through the national building renovation plans.

6. ARTICLE 11(5) - MAXIMUM THRESHOLD FOR OPERATIONAL GHG EMISSIONS

Article 11(5) provides that Member States have to establish a maximum threshold for the operational greenhouse gas emissions of ZEBs. The maximum operational greenhouse gas emissions thresholds may be set at different levels for new and renovated buildings, and it is recommended that they be calculated based on the provisions of Annex I, in line with the building standards. It is also recommended that, where necessary, the building categories and climatic and local conditions be taken into consideration when calculating the maximum energy demand thresholds.

The maximum threshold for operational greenhouse gas emissions must be expressed in $kgCO_2eq/(m^2.y)$ in accordance with Annex I(3).

When setting the thresholds for the operational greenhouse gas emissions of ZEBs, both the operational greenhouse gas emissions released on-site (direct GHG emissions) and those caused by the off-site generation of energy used by the building (indirect GHG emissions) should be considered.

According to Article 11(1), a ZEB must not have direct operational greenhouse gas emissions from the on-site use of fossil fuels. However, the on-site use of bioenergy is allowed under Article 11(1) and the resulting operational greenhouse gas emissions should be taken into account. The consideration should follow the approach from the annual European Union greenhouse gas emissions inventory and as indicated in the IPCC guidelines for national greenhouse gas inventories ([19]).

The indirect operational greenhouse gas emissions from the off-site generation of energy used by the building include the following:

— greenhouse gas emissions from the use of efficient district heating and cooling systems (i.e. option c) of Article 11(7))

— greenhouse gas emissions from the use of electricity generated off-site or heat from district heating and cooling systems or other secondary energy products with carbon content that may be consumed on an annual basis (being either compensated by the renewable energy produced on-site and exported to the grid or used on-site for non-EPB uses, or allowed under the exemption related to technical and economic feasibility).

The operational greenhouse gas emissions from the building's energy use cannot be physically eliminated by the export to the grid or by the on-site use for non-EPB uses of the carbon-free energy produced on-site. However, it is possible to consider that the carbon-free energy produced on-site and exported to the grid or used on-site for non-EPB uses will displace an equivalent amount of energy with carbon content elsewhere (for example, by supplying another building or by being used in another final sector).

([19]) 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary combustion, Chapter 2.3.3.4.: Treatment of biomass and 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary combustion, Chapter 2.3.3.4: Treatment of biomass. Although the CO2 emissions from the combustion of biomass or biomass-based products are already included in the Agriculture, Forestry and Other Land-Use (AFOLU) sector, methane (CH4) and nitrous oxide (N2O) emissions are included in the sectoral total emissions.

Therefore, the operational greenhouse gas emissions displaced in the energy system by the renewable energy produced on-site and either exported to the grid or used on-site for non-EPB uses may be deducted from the sum of the direct and indirect operational greenhouse gas emissions presented above, if such option for compensation is part of national methodology and regulations. In all other cases it is recommended to provide as additional information the amount of exported energy as well as on potentially avoided GHG emissions elsewhere. The selection of the type of approach should be described and notified to the Commission together with the maximum operational GHG emissions threshold as indicated in Article 11(6).

It should be noted that this approach may lead to buildings with negative operational greenhouse gas emissions and this may introduce the risk of double counting. In these cases, Member States should address this by stopping the possible compensation of greenhouse gas emissions at net zero. The remaining GHG emissions displaced by the renewable energy produced on-site that is either used on-site by non-EPB uses or exported to the grid can be taken into account separately as another indication showing the building contribution to the decarbonisation of the whole building stock or economy ([20]).

The threshold for the operational greenhouse gas emissions of a ZEB may be set out together with the cost-optimal calculation or based on its results.

For instance, the considerations on reference buildings, technology packages and variants, done in the framework of the cost-optimal calculations, may help Member States to lay down the greenhouse gas emissions thresholds for ZEB.

The operational greenhouse gas emissions thresholds of new ZEBs and renovated ZEBs must be reported to the Commission by the transposition deadline for this Directive and through the national building renovation plans.

Some examples of how to approach the calculation of the operational GHG emissions are presented below.

Example 1: A ZEB with useful floor area of 110 m^2 has an annual energy use of 6 000 kWh/y out of which 2 000 kWh/y is carbon-free electricity from a nearby photovoltaic generator (zero GHG emissions), while 4 000 kWh/y is heat from an efficient district heating system with an emission intensity of 140 g CO2eq/kWh. Therefore, the total operational greenhouse gas emissions of the ZEB in a year will be:

140 g CO_2eq/kWh * 4 000 kWh/y = 560 000 g CO_2eq = 560 kg CO_2eq/y.

Therefore, the annual operational greenhouse gas emissions of this ZEB represented per unit of floor area will be:

560 kg CO2eq / 110 m^2 = 5.1 kg CO2eq/(m^2.y)

Example 2: A ZEB with useful floor area of 110 m^2 has an annual energy use over one year of 6 000 kWh/y (n.b. calculated as shown in the Guidance document for Annex I to the Directive). Of this, 1 200 kWh are from an on-site photovoltaic generator (zero GHG emissions), 800 kWh/y are from the electricity grid that has 80 % carbon-free electricity and 20 % electricity from fossil fuels with emission intensity of 200 g CO_2eq/kWh, and 4 000 kWh/y are from an inefficient district heating system with 30 % renewables and 70 % fossil fuels with an emission intensity of 240 g CO_2eq/kWh. On annual basis, the delivered energy with carbon content is:

20 % * 800 kWh/y + 70 % * 4 000 kWh/y = 160 kWh/y + 2 800 kWh/y = 2 960 kWh/y

The annual emissions to the energy use with carbon content is:

(800 kWh/y * 20 %) * 200 g CO2eq/kWh + (4 000 kWh/y * 70 %) * 240 g CO_2eq/kWh = 32 000 g CO_2eq/y + 672 000 g CO_2eq/y = 704 kg CO_2eq/y

([20]) For more details about how to consider the operational GHG emissions due to the renewable energy produced on-site and either exported to the grid or used by other on-site non-EPB uses, see the standard EN 15 978 and the Commission Delegated Regulation on Union Framework for life-cycle GWP calculation pursuant to Article 7(3) of the Directive, due to be adopted by end of 2025.

This energy with carbon content used by the building is partially compensated by an on-site photovoltaic generator that produced 4 200 kWh/y, out of which 1 200 kWh/y are used on-site for the EPB uses 1 400kWh/y are used on-site for non-EPB uses (with a recommended PEF=1) and 1 600 kWh/y are exported to the electricity grid (with a possible PEF=0.9). Therefore, the operational greenhouse gas emissions displaced by the renewable electricity produced on-site by the photovoltaic generator and exported to the grid in a year are:

— 1 400 kWh/y * 1 * (20 % * 200 g CO_2eq/kWh) – 1 600 kWh/y * 0.9 * (20 % * 200 g CO_2eq/kWh) = - 113,6 kg CO_2eq/y

Therefore, the annual greenhouse gas emissions of this ZEB represented per unit of useful floor area will be:

704 kg CO_2eq/y – 113.6 kg CO_2eq/y = 590.4 kg CO_2eq/y

590 kg CO_2eq / 110 m^2 = 5.4 kgCO_2eq/(m^2.y)

Example 3: For the second example from Chapter 3.4 of this Guidance document, i.e. a building with a heat pump and a rooftop PV system using electricity from the grid, the calculation of the operational GHG emissions is presented in Table 3 below.

If compensation is not considered, then the operational GHG emissions of the building will be the sum of the operational GHG emissions due to the energy use of the building. Therefore, the building will have 2.07 kg CO_2 eq./(m^2.y).

If compensation is considered, then the operational GHG emissions displaced by the PV electricity produced on-site and either used on-site for other non-EPB uses or exported to the grid will be deducted from the operational GHG emissions due to the energy use of the building. Therefore, the result will be - 0,25 kg CO_2 eq./(m^2.y). As indicated above, in cases where compensation leads to negative operational GHG emissions building, the building should be attributed with zero emissions or 0 g CO_2eq./(m^2.y), while the difference can be taken into account separately.

Table 3

Example for the calculation of the operational GHG emissions

	Delivered and exported energy	CO_2 emission coefficient	Offset factor	Operational GHG emissions
	[kWh/(m2 y)]	[g CO2eq/kWh]	[-]	[kg CO2eq/(m2 y)]
electricity from the grid:				
renewable	3,89	0		0,00
nuclear	5,33	0		0,00
fossil	5,18	400		2,07
rooftop PV:				
exported PV electricity to grid	10,6	144	0,9	1,37
PV electricity to other non-EPBD uses	6,6	144	1	0,95
Total operational greenhouse gas emissions (without compensation)				**2,07**
Total operational greenhouse gas emissions (with compensation)				**- 0,25**

To note that, according to local context, it is possible to further consider a lower greenhouse gas emissions intensity of the one of the electricity grid, e.g. because the amount of PV electricity produced on-site and exported to the grid may be higher during the summer season when the grid electricity mix has a lower share of fossil fuels. Consequently, in this case the displaced greenhouse gas emissions will be lower than when considering greenhouse gas emissions intensity of the annual electricity mix.

7. ARTICLE 11(1).2 - REACT TO EXTERNAL SIGNALS AND ADAPT

According to the second sentence of Article 11(1), a ZEB must, where economically and technically feasible, have the capacity to react to external signals and adapt its energy use, generation or storage.

This requirement should be understood in relation to Recital 23 that states that a ZEB 'can contribute to demand-side flexibility for instance through demand management, electrical storage, thermal storage and distributed renewable generation to support a more reliable, sustainable and efficient energy system'.

This means, in particular, that a ZEB must have technical building systems with the capacity to communicate with the grid and, whenever they receive the appropriate signal from the grid, to contribute to system flexibility by reducing their energy demand to the extent possible, by storing more energy when there is more and/or cheaper energy available, or by exporting more or less renewable energy generated on-site. A ZEB should interact dynamically with the energy system, while nevertheless prioritising the indoor comfort, liveability, reliability and proper functionality of the building and its technical systems.

A ZEB's capacity to react to external signals mainly concerns the technical building systems within the recast EPBD's scope but may also include other equipment in the building such as appliances and ICTs.

If a smart readiness indicator scheme exists, this can be used by defining minimum thresholds for the scores for adapting to signals from the grid for a ZEB.

More recommendations about how to implement this requirement can be found in the Guidance document for Article 13 of the Directive on technical buildings systems.

It should be noted that the capacity of a building to react to external signals and adjust the energy consumption must be shown on the energy performance certificates as indicated in Annex V.

A few examples of how ZEBs can react to external signals:

— The ZEB has (digital) demand response and demand management capabilities, at building level or at the level of the main equipment, meaning that, at electricity grid peak hours, the supply of a technical building system of the ZEB can be temporarily turned off or postponed, potentially based on a pre-defined protocol (e.g. turn off the heat pump if temperature is within a certain acceptable range).

— The ZEB has demand management capabilities that make it possible to maximise the use of cheaper electricity from the grid and to store it in on-site batteries or by heating water from the boiler that will then be used at a time of day when electricity from the grid is more expensive and/or when the building needs are higher.

— The ZEB has a bi-directional electric vehicle charger that allows the vehicle's battery to temporarily support the electricity grid to cope with demand.

8. TIMELINE AND REPORTING

Article 7(1) states the dates from which new buildings must comply with ZEB requirements, namely:

— from 1 January 2028, for new buildings owned by public bodies ([21]); and

— from 1 January 2030, for all new buildings.

According to Article 7(4), Member States may decide not to apply the ZEB requirements from paragraph 1 'to buildings for which building permit applications or equivalent applications, including for change of use, have already been submitted by the dates pursuant to paragraphs 1'.

([21]) In Article 2(5) of Directive (EU) 2024/1275, the meaning of 'public bodies' is cross-referenced to the definition in Directive (EU) 2023/1791. According to Article 2(12) of Directive (EU) 2023/1791, 'public bodies' means national, regional or local authorities and entities directly financed and administered by those authorities but not having an industrial or commercial character.

Article 11(6) states that the maximum energy demand and operational greenhouse gas emissions thresholds for a ZEB, including a description of the calculation methodology per building type and relevant outdoor climate designation, must be notified to the Commission, which must review the thresholds and recommend adjustments where appropriate. According to Annex II(e), both thresholds must be reported through the national building renovation plans.

It is recommended that the initial proposals for the maximum energy demand thresholds and the greenhouse gas emissions thresholds be reported with the draft building renovation plans that are to be submitted to the Commission by the end of 2025, as set out in Article 3 of the Directive.

The maximum energy demand and operational greenhouse gas emissions thresholds must be laid down and reported by the end of the general transposition period for the recast EPBD, i.e. 29 May 2026, together with the transposition measures for the other requirements of Article 11.

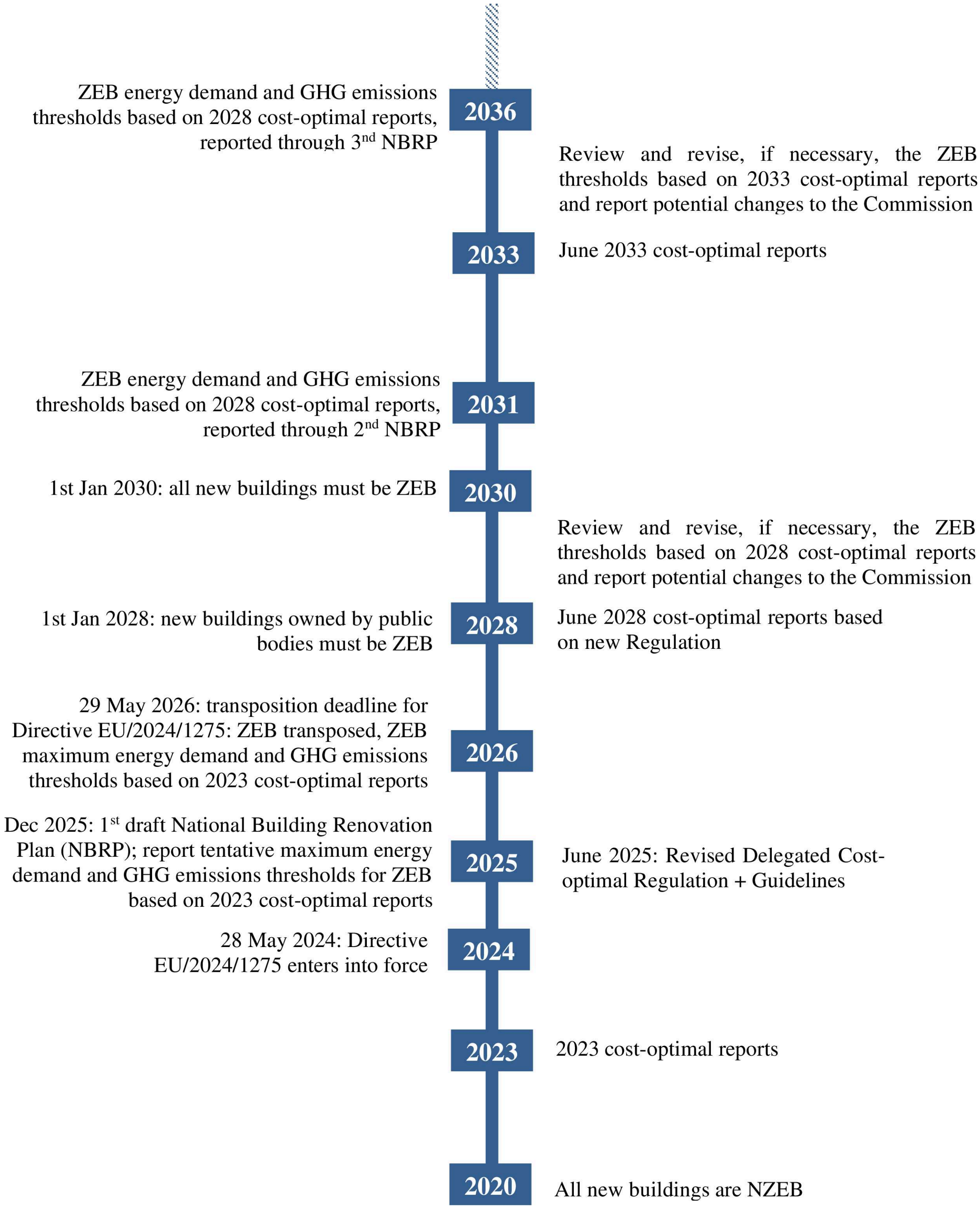

Figure 4: Timeline for zero-emission buildings

ANNEX 8

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Solar energy in buildings (Article 10)

TABLE OF CONTENTS

1. POLICY AND LEGAL CONTEXT

In line with the REPowerEU plan (1), the Commission put forward the legislative proposal for a solar mandate in the recast Energy Performance of Buildings Directive ('the recast EPBD') (2) on the basis of the EU solar energy strategy (3).

The solar mandate in the recast EPBD is closely linked to the revised Renewable Energy Directive (RED) (4), which aims to facilitate the transition to a decarbonised economy by increasing the share of renewable energy to at least 42.5 % of final energy consumption in the EU by 2030, with a goal of 45 % by 2040. It is also linked to RED Article 16d facilitating permitting for solar energy equipment (PV and solar thermal) and RED Article 15a on mainstreaming renewable energy in buildings.

The following guidance for the RED is relevant for Article 10 of the recast EPBD:

— Guidance on heating and cooling aspects in Articles 15a, 22a, 23 and 24 of Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources as amended by Directive (EU) 2023/2413, C(2024)5043 final

The following Recommendation and guidance on permitting procedures for renewable energy are also relevant for EPBD Article 10:

— Commission Recommendation (EU) 2024/1343 of 13 May 2024 on speeding up permit-granting procedures for renewable energy and related infrastructure projects (5)

— Accompanying guidance to the Member States on good practices to speed up permit-granting procedures for Renewable Energy Projects (6).

There are also close links between Article 10 of the recast EPBD and Article 15a on the right to energy sharing of Directive (EU) 2024/1711 (7) on the electricity market design.

2. RELEVANT DEFINITIONS

The following definitions in Article 2 of the recast EPBD are relevant for the implementation of Article 10:

(1) 'building' means a roofed construction having walls, for which energy is used to condition the indoor environment;

(6) 'technical building system' means technical equipment of a building or building unit for space heating, space cooling, ventilation, domestic hot water, built-in lighting, building automation and control, on-site renewable energy generation and energy storage, or a combination thereof, including those systems using energy from renewable sources;

(14) 'energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, osmotic energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas;

(18) 'residential building or building unit' means a room or suite of rooms in a permanent building or a structurally separated part of a building which is designed for all-year habitation by one private household;

(22) 'major renovation' means the renovation of a building where: (a) the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25 % of the value of the building, excluding the value of the land upon which the building is situated; or (b) more than 25 % of the surface of the building envelope undergoes renovation. Member States may choose to apply point (a) or (b);

(35) 'roofed car park' means a roofed construction, with at least three car parking spaces, that does not use energy to condition the indoor environment;

(1) Commission communication of 18 May 2022 entitled 'REPowerEU Plan', COM/2022/230_final.
(2) Directive (EU) 2024/1275.
(3) Commission communication of 18 May 2022 entitled 'EU Solar energy strategy', COM/2022/221 final.
(4) Directive - EU - 2023/2413 - EN - Renewable Energy Directive - EUR-Lex.
(5) https://eur-lex.europa.eu/eli/reco/2024/1343/oj.
(6) SWD/2022/149.
(7) Directive (EU) 2024/1711 of the European Parliament and of the Council of 13 June 2024 amending Directives (EU) 2018/2001 and (EU) 2019/944 as regards improving the Union's electricity market design.

(51) ‘useful floor area’ means the area of the floor of a building needed as parameter to quantify specific conditions of use that are expressed per unit of floor area and for the application of the simplifications and the zoning and allocation or re-allocation rules;

(56) ‘services related to the energy performance of buildings’ or ‘EPB services’ means the services, such as heating, cooling, ventilation, domestic hot water and lighting and others for which the energy use is taken into account in the calculation of the energy performance of buildings;

(60) ‘other on-site uses’ means on-site uses other than EPB services, including appliances, miscellaneous and ancillary loads, or electro-mobility recharging points;

(65) ‘car park physically adjacent to a building’ means a car park which is intended for the use of residents, visitors or workers of a building and which is located within the property area of the building or is in the direct vicinity of the building.

The following definition under the RED is also relevant:

(9b) “solar energy equipment” means equipment that converts energy from the sun into thermal or electrical energy, in particular solar thermal and solar photovoltaic equipment;’

3. IMPLEMENTATION OF OBLIGATIONS UNDER ARTICLE 10

3.1. Design of new buildings

According to Article 10(1), ‘Member States shall ensure that all new buildings are designed to optimise their solar energy generation potential on the basis of the solar irradiance of the site, enabling the subsequent cost-effective installation of solar technologies’.

This means that, when designing a building, architects and other construction professionals must consider its potential for generating solar energy alongside other design parameters.

For the purposes of Article 10, solar technologies include both photovoltaic (PV) and solar-thermal systems. Therefore, the design of new buildings should consider both PV and solar thermal technologies and combinations of the two.

Designing a building optimised for solar-energy generation requires a comprehensive approach. Key factors for such an approach include: (i) adequate **load-bearing capacity** for solar installations; (ii) proper **building orientation**; and (iii) **roof and façade design**. The objective is to ensure suitable solar installations can be added in the future without costly structural changes.

Tools to make it easier to identify suitable sites such as the Photovoltaic Geographical Information System (PVGIS) ([8]) can be used to assess the solar potential of a location. Many European cities and regions also offer local mapping tools (e.g. Aarhus ([9]), Flanders ([10]), North Rhine-Westphalia ([11]), Brussels) ([12]).

On building orientation, in addition to south-facing orientations, both east-facing orientations and west-facing orientations can be considered for new constructions. The south-facing orientation, which is typically used for rooftop installations, benefits from sunshine hours. Electricity tends to be injected into the grid at peak times, which can exacerbate problems of grid congestion, curtailment and negative prices. A west-east orientation provides a different generation pattern, and electricity is not injected at peak times. This helps to alleviate grid congestion problems and makes investment more attractive as the price of this electricity could be higher.

The design of new buildings should consider the use of solar technologies throughout the entire structure, not just on the roof, but also on the façade, balconies and terraces and on roofed car parks and similar structures. Also here, solar installations with west and east orientations can be beneficial for the grid. Balconies and terraces can be designed for solar generation. Building-integrated technologies such as building-integrated photovoltaics (BIPV) and building-integrated solar thermal (BIST) should be considered during the design phase.

([8]) https://re.jrc.ec.europa.eu/pvg_tools/en/.
([9]) https://app.powerbi.com/view?r=eyJrIjoiOGFhMjUyZWQtYmI4MC00NzE1LTlmMTMtNzkzMzQ1ZWJhN2E0IiwidCI6Ijg5ZjA4NzM5LTkxYzAtNDdhZS1hNzMyLTI5MWI1ZGY3YTk0ZSIsImMiOjh9.
([10]) https://apps.energiesparen.be/zonnekaart.
([11]) https://www.energieatlas.nrw.de/site/karte_solarkataster.
([12]) https://geodata.environnement.brussels/client/solar/.

On roof design, a flat roof provides flexibility in placing solar panels at an optimum angle, while a pitched roof can be designed to face the sun in the best direction. The roof's angle should optimise the performance of the solar installation on the basis of the latitude of the building's location. The design should also take into account compatibility with other uses of the roof.

The choice of materials during the design phase should take account of solar installations, for instance in terms of fire safety.

The design of new buildings could also take into account the space required for storage systems such as batteries or hot water storage.

Consideration could also be given at the design stage to combining green roofs with solar installations, as this integration may offer benefits. Green roofs can help to reduce cooling loads and keep solar panels at a temperature closer to their optimal operating range.

3.2. **Permit-granting procedure**

Article 10(2) of the recast EPBD provides that 'the permit-granting procedure for the installation of solar energy equipment set out in Article 16d of Directive (EU) 2018/2001 [RED], and simple-notification procedure for grid connections set out in Article 17 of that Directive shall apply to the installation of solar energy equipment on buildings'.

According to the RED, the permit-granting procedure must not exceed one month for a solar installation with a capacity of up to 100 kW. For solar installations in existing or future artificial structures, including building-integrated solar installations, it must not exceed three months.

Before solar installations up to 10.8 kW may be connected to the grid, the distribution system operator must be notified. If the distribution system operator gives a positive decision or fails to respond within one month, the connection can proceed. Member States may increase this threshold to up to 50 kW.

3.3. **Timeline for deployment of solar installations**

Article 10(3) provides that 'Member States shall ensure the deployment of suitable solar energy installations, if technically suitable and economically and functionally feasible' on different categories of buildings according to the timelines in the table below.

Table 1

Timeline for deployment of solar installations

Building type	Article 10 requirement	Building size useful floor area	Deadline date
New	New public and non-residential buildings	> 250m²	31/12/2026
New	New residential buildings	All	31/12/2029
New	New roofed car parks physically adjacent to buildings	All	31/12/2029
Existing	Existing public buildings	>2 000m²	31/12/2027
Existing	Existing public buildings	>750m²	31/12/2028
Existing	Existing public buildings	>250m²	31/12/2030
Existing	Existing non-residential buildings where the building undergoes a major renovation or an action that requires an administrative permit for building renovations, works on the roof or the installation of a technical building system	>500m²	31/12/2027

For the deployment of solar energy installations on new buildings, Member States may choose to apply the requirements only to buildings for which building permit applications or equivalent applications are submitted after the deadline.

3.4. Interpretation of public buildings

For the purposes of Article 10, public buildings are a subset of non-residential buildings, namely those non-residential buildings that are owned by public bodies. In the case of multiple owners, this refers to buildings where at least 50 % of the non-residential building is owned by public bodies.

Public bodies are defined in the Energy Efficiency Directive Article 2(12) as 'national, regional or local authorities and entities directly financed and administered by those authorities but not having an industrial or commercial character'.

For example, social housing, even if owned by public bodies, does not fall under the obligations laid down for public buildings in Article 10. Instead, it is subject to the requirements applicable to residential buildings.

For mixed-use buildings that include both residential and non-residential units, Member States may choose to treat them as either residential or non-residential buildings and to apply the corresponding obligations. This is clarified in recital 34.

3.5. Interpretation of useful floor area

Useful floor area is used as a criterion for identifying buildings subject to the obligations in Article 10(3). As defined in Article 2(51), useful floor area means the total size of the building, including all floors, rather than the surface area of just one floor.

For public buildings, the requirement to install suitable solar energy systems is being applied gradually, on the basis of the useful floor area, starting with the largest buildings.

According to Article 10(4), Member States 'may use the measurement of buildings' ground floor area instead of buildings' useful floor area, provided that the Member State shows that this results in an equivalent amount of installed capacity of suitable solar energy installations on buildings'. If a Member State chooses to make use of this option, it must prove to the Commission that the impact is equivalent when notifying implementation.

One way to demonstrate equivalence is by showing that the same number of buildings are covered when the ground floor area is used as a criterion as when the useful floor area is used. The ratio of ground floor area to useful floor area for different categories of buildings can be used for this purpose.

For example, in an analysis conducted on 49 non-residential buildings in Germany, the thresholds specified in Article 10 were applied consistently to both the ground floor area and the useful floor area. Using the ground floor area resulted in a decrease of between 6 % and 24 % in the number of buildings subject to the EPBD obligations. In this example, the ratio between ground floor area and useful floor area was around 0.55. Therefore, instead of using a useful floor area threshold of 500 m^2, a ground floor area threshold set at 500 m^2*0.55=275 m^2 could be applied. This is a methodology that can be used by Member States to prove the equivalence between ground floor and useful floor area.

3.6. Solar installations on existing non-residential buildings

As highlighted in the EU solar energy strategy and the European solar rooftops initiative, there is a large untapped potential for solar installations on existing structures such as the roofs of existing buildings ([13]). In particular, certain categories of non-residential buildings such as warehouses, data centres and shopping malls typically have large roofs that could be suitable for solar installations. These buildings also have large electricity needs that could be met through self-consumption of locally produced renewable energy. Also, other existing non-residential buildings such as offices and shops are often suitable for solar installations.

Against this background, Article 10(3)(c) of the recast EPBD requires Member States to ensure the deployment of suitable solar installations 'on existing non-residential buildings with useful floor area larger than 500 m^2, where the building undergoes a **major renovation** or an action that requires **an administrative permit for building renovations, works on the roof or the installation of a technical building system**'.

([13]) For further background: https://publications.jrc.ec.europa.eu/repository/handle/JRC135456.

Major renovation is defined in Article 2(22). In addition to the criterion of major renovation, a second criterion for the deployment of suitable solar installations is 'an action that requires an administrative permit for building renovations, works on the roof or the installation of a technical building system'.

This second criterion refers to interventions that are not considered major renovations but still involve some interaction with a public authority to obtain a permit for the work.

An example would be a renovation that is smaller than a major renovation but for which local regulations require a permit. Other examples include work on the roof or the installation of technical building systems for which permits are required.

Linking the solar obligation to cases where a permit is required makes it easier to identify buildings subject to the requirement and facilitates follow-up, as there is already some interaction with a local authority for other purposes. This is not in any way linked to whether the solar installation as such requires a permit or not; it is simply a way to identify buildings that are subject to the solar installation requirement.

However, there may be cases where a permit is required for a purpose which is not considered relevant at all in relation to solar installations, such as changing the colour of a façade. In such cases, Member States may choose not to consider this a relevant criterion.

As there are differences between Member States as to which actions require an administrative permit, the application of this requirement will vary across Member States.

3.7. **Roofed car parks**

According to Article 10(3)(e), Member States must ensure the deployment of suitable solar installations on all new roofed car parks physically adjacent to buildings by 31 December 2029.

A roofed car park, as defined in Article 2(35), is a 'a roofed construction, with at least three car parking spaces, that does not use energy to condition the indoor environment'.

If a roofed car park has walls and uses energy for heating or cooling, it should be considered a building (in line with the definition of 'building' in Article 2(1)), and the obligations for non-residential buildings apply.

The threshold of three parking spaces is intended to exclude roofed car parks on driveways of single-family houses.

The obligation applies to roofed car parks that are adjacent to buildings (similar to the obligations on recharging infrastructure in Article 14, which applies to car parks that are adjacent to buildings). Article 2(65) of the recast EPBD defines a 'car park physically adjacent to a building' as 'a car park which is intended for the use of residents, visitors or workers of a building and which is located within the property area of the building or is in the direct vicinity of the building'.

3.8. **What is a suitable solar installation?**

According to Article 10(3), 'Member States shall ensure the deployment of suitable solar energy installations, if technically suitable and economically and functionally feasible', in accordance with the timetable set out in Section 3.3 above.

3.8.1. *Interpretation of suitable solar installations*

While there is no definition of what constitutes 'suitable' solar installations, Article 10(4) requires Member States to establish, and make publicly available, criteria at national level for the practical implementation of the obligations under Article 10. These national criteria should be used to define, at national or regional level, what constitutes suitable solar energy installations for different categories of buildings.

The bulleted paragraphs below provide guidance on interpreting what qualifies as suitable solar energy installations:

— The guidance does not specify a number of square metres, share of roof area or installed power of solar installations per building. However, Member States have the possibility of determining such parameters at Member State level in the national criteria. Some Member States that have existing solar standards have chosen to express the solar mandate in terms of a percentage of building area covered by solar installations or minimum installed power per building surface area.

— According to Article 10(4), and as also explained in recital 32, the national criteria must be in accordance with the assessed technical and economic potential of the solar energy installations and the characteristics of the buildings covered by the obligation. A suitable solar installation would therefore be one that is efficient, i.e. it makes efficient use of the available space on the roof, façade, balconies, etc., and thus efficiently exploits the potential for solar energy production. Depending on local building conditions, the exact number of square metres or installed power of solar panels may vary. In most cases, the installation of a single panel on a large roof will not be sufficient to be considered 'suitable'.

— Article 10(4) provides that the criteria 'shall also take into account structural integrity, green roofs, and attic and roof insulation, where appropriate'. For existing buildings, this means that Member States should take into account the need for roof renovations and, if necessary, allow more time for the solar installation to avoid lock-in effects.

— The potential for self-consumption and energy sharing should be taken into account when determining what constitutes a suitable solar installation. In particular, the energy needs of the building should be considered. For the purposes of Article 10, this includes not only the energy required for EPB services (heating, cooling, ventilation, domestic hot water etc.) but also the energy needs for other on-site uses such as IT services, electric vehicle charging, and appliances.

— The energy needs that should be taken into account when determining the size of suitable solar installations under Article 10 are therefore typically larger than those used to calculate cost-optimal levels of energy performance, as these are limited to the EPB services.

— Combining solar electricity production and electric vehicle charging can offer benefits both to the user and to the energy system/grid. The availability of storage (batteries or hot water storage) should also be taken into account.

— Buildings have different energy requirements. Some buildings require more electricity, while others more thermal energy. The energy needs for hot water should be taken into account when determining whether a solar installation is suitable and when deciding between PV and solar thermal energy or combinations of the two. As solar thermal energy differs from PV in terms of space requirements, the available roof area should also be factored in.

— If a solar installation produces more energy than the building needs at a given point in time, the excess electricity can be fed into the grid, also for the purpose of energy sharing ([14]).

— Member States should also take into account that solar installations under Article 10 will contribute to the goal of achieving at least 49 % renewable energy consumption in buildings in the EU by 2030, as laid down in Article 15a of the RED. This goal includes renewable energy produced on-site or nearby, as well as renewable energy sourced from the grid, and therefore has a broader focus than Article 10. However, the table in Annex C to the RED guidance (C(2024) 5043), which shows shares per Member State and for the EU in 2020 based on proxy data reported to Eurostat, might support the calculation for the implementation of Article 10.

— Also, the policies and measures for deploying suitable solar energy installations on all buildings, along with the numerical targets for the deployment of solar energy in buildings, must be included in the national building renovation plans, as required by Article 3.

([14]) Energy sharing as covered in Directive 2024/1711 on electricity market design.

3.8.2. *Technical suitability, economic feasibility and financial feasibility*

The following table shows how each type of suitability and feasibility can be interpreted and gives examples.

Table 2

Interpretation of technical suitability, economic feasibility and functional feasibility

Type	Meaning	Examples
Technical suitability	Technical suitability refers to the compatibility between the technical characteristics of the solar installation and those of the roof or façade of the building ensuring that installation is possible. There is no technical suitability if it is technically impossible to install a solar system.	Technical suitability is a problem if a building does not support a solar installation (either on the roof or on the façade or balconies) required to fulfil the requirements to be considered suitable under the legislation, e.g. if: — the orientation of the roof on an existing building is not suitable. As roofs facing east and west can also be productive, these should not generally be exempted; — the angle of the roof on an existing building is not suitable; — the structural integrity of the existing building (e.g. construction of the roof) does not support solar installations; — there is a lack of space on the roof, and the façade is not suitable for solar installations; — shading from adjacent buildings cannot be mitigated; — the roof material (thatch, straw, wood) is unsuitable for solar installation. For all points above, also consider installing elsewhere than the roof, i.e. facade, balcony
Economic feasibility	Economic feasibility refers to the cost of the solar system and whether the expected benefits outweigh the costs, taking into account the expected lifetime of the solar installation.	Economic feasibility can be calculated, for example, on the basis of: — a maximum payback period, taking into account monetary benefits of the solar system in relation to the expected lifetime of the solar installation; — a maximum ratio between the cost of the solar installation and the cost of the planned intervention (installation of the system) plus any follow-up costs, e.g. costs related to fire safety and structural safety.
Functional feasibility	It is functionally not feasible to deploy solar installations if these would result in changes that affect the building's intended use, taking into account any specific constraints (e.g. regulations) that may apply to the building.	The application of solar installation requirements may not be functionally feasible if, for example — applicable regulations (e.g. on fire safety, the strength and stability of the structure) conflict with the installation requirements.

3.9. National criteria for practical implementation and possible exemptions

Article 10(4) provides that 'Member States shall establish, and make publicly available, criteria at national level for the practical implementation of the obligations set out in this Article, and for possible exemptions from those obligations for specific types of building'.

Member States are required to communicate the national criteria to the Commission when notifying their transposition and implementation of Article 10. Any changes to these criteria after they have been notified must be communicated to the Commission and made publicly available in the Member State.

The conditions, under which suitability and feasibility should be assessed (e.g. climate conditions) should be determined at Member State level or, where regional conditions affect only part of a Member State's territory, at regional level. In the latter case, the regional conditions should be outlined in the national transposition measures.

In Member States with regional jurisdictions, these requirements must be transposed at regional level. In all cases, these conditions should be documented (e.g. as part of technical guidelines) and should be applied uniformly across the national or, where applicable, regional territory. In addition, any exemptions from these requirements should be assessed using clear procedures set and supervised by public authorities. These procedures may vary between different types of buildings, in particular to take account of specific types for which technical suitability, economic feasibility or functional feasibility is an issue.

3.9.1. *Technology neutrality within the context of Article 10*

Article 10(4) requires Member States to take account of the principle of **technological neutrality with regard to technologies not producing any on-site emissions** when laying down the national criteria for the practical implementation of the requirements set out in Article 10 and any possible exemptions.

Article 10 operates on the basis that the decarbonisation of electricity, heating and cooling is equally important. Therefore, one aspect of technology neutrality is that Article 10 applies to all solar technologies: PV, solar thermal and combinations of these.

Furthermore, Article 10 is not limited to solar installations on roofs, but also covers: (i) installations on façades, balconies, terraces, roofed car parks, similar structures; and (ii) building-integrated technologies such as BIPV and BIST.

In summary, Article 10 covers solar installations 'on' buildings but does not extend to ground-mounted solar installations on open land. However, solar installations with a clear link to the building, such as those on patios, terraces, pergolas, winter gardens, canopies, pavilions are included. Technological neutrality in the context of Article 10 also refers to technologies that do not generate on-site emissions. In certain instances, although not mentioned in Article 10, renewable energy systems other than solar, such as wind turbines, may also be considered. There are various wind turbine innovations that are suitable for rooftops, particularly for large and high-rise buildings.

Installations that use renewable energies (e.g. biomass boilers) and the purchase of solar energy through contractual arrangements (e.g. green electricity contracts or energy communities) do not qualify under Article 10.

If a building owner wishes to allow a third party to deploy a solar installation on the building under a contractual agreement, this would be considered in line with Article 10 and could be part of the criteria set by the Member States.

3.9.2. *Guidance on principles for possible exemptions*

Generally, the solar obligation applies to all buildings. However, exemptions may be granted, for example, for the following four cases.

— The first case is when there is ongoing construction: if a building is under construction at the time of the deadline in the article, an exemption may be granted.

— The second case is when a solar installation would be challenging for reasons of technical suitability, economic feasibility and functional feasibility (see Section 3.8 above): this includes safety reasons and concerns relating to the structural integrity of the building.

— The third case is when the roof is being renovated: if a roof renovation has been planned, the building may be temporarily exempted.

— The fourth case is when a solar installation could be replaced with another technology according to the principle of technology neutrality: an exemption may be granted, for example, if an equivalent amount of energy can be produced by another renewable source, such as small rooftop wind turbines. However, the use of a biomass boiler or a (possible) connection to a renewable-energy district-heating system would not qualify, as this is not considered renewable energy production on the building.

Exemptions should not be automatically granted in the following two cases.

— The first case it when there are any grid-related concerns. In this case, alternative solutions should be considered first, e.g. self-consumption, a higher share of solar thermal installations, energy storage, and energy sharing. If these are still not feasible due to grid concerns, a deferral could be considered.

— The second case is when a new construction or a building undergoing major renovation already has a green roof. While green roofs must be taken into account in the national criteria under Article 10(4), green roofs and solar installations are not mutually exclusive. In fact, solar green roofs can offer a synergistic benefit for the urban climate, contributing to the sustainable use and structural preservation of flat roofs, and to decentralised energy production for buildings ([15]). In addition, installing the solar equipment on the facade, balcony, etc could also be a possibility.

3.9.3. *Protected buildings*

In general, Article 10 applies to all buildings, including historical and other protected buildings. Unlike other articles of the recast EPBD, Article 10 does not explicitly mention the possibility of exempting protected buildings from solar obligations. Nevertheless, Member States have sufficient flexibility to lay down specific rules for protected buildings in their national criteria.

As historical and other protected buildings need to be preserved and renovated, it makes sense to use innovative approaches to achieve carbon neutrality in this building stock too. Many solutions are available to integrate solar energy ‘invisibly’ into historical buildings that come close to the original materials in terms of shape, colour and surface texture (e.g. coloured modules (BIPV/BIST) or solar tiles). In addition, traditional, more ‘visible’ solar energy can also be integrated into historical buildings in innovative ways, bringing not only energy but also aesthetic benefits to the building ([16]). For instance, in Amsterdam, visible solar installations will be allowed on monuments and heritage buildings in some cases from 2025 ([17]).

There are many examples of successful integration of solar energy in historical buildings. including:

— the 16th century Renaissance palace in the historic centre of Valladolid in Spain ([18]); and

— the decision tool for the energy retrofitting of historic buildings, including solar energy installations, developed as part of the HiBERtool project ([19]).

([15]) Literature and examples:
— Xiang et al. 2023: Green roofs and facades with integrated photovoltaic system for zero energy eco-friendly building – A review. Sustainable Energy Technologies and Assessments 60(2023)103426
— Fleck et al. 2022: Bio-solar green roofs increase solar energy output: The sunny side of integrating sustainable technologies. Building and Environment. Volume 226, December 2022, 109703
— University of Technology Sydney 2021: Green Roof & Solar Array – Comparative Research Project. Final Report July 2021. 2020/037855/EPI R3 2021920005, https://opus.lib.uts.edu.au/bitstream/10453/150142/2/City%20of%20Sydney%20Final%20Report%20EPI%20R3%20201920005.pdf
Examples of use:
— https://www.sempergreen.com/en/references#page=2
— https://livingroofs.org/green-roofs-solar-power/
— https://zinco-greenroof.com/systems/solar-energy
— https://urbanstrong.com/blog/integrated-solar-green-roofs-are-for-the-greedy.
([16]) See, for example, the Valetta Design Cluster in Malta: https://onyxsolar.com/valletta-design-cluster.
([17]) https://www.pv-magazine.com/2024/06/18/amsterdam-to-allow-solar-panels-on-monuments/.
([18]) https://positive-energy-buildings.eu/demo-cases/spain.
([19]) https://www.tool.hiberatlas.com/en/welcome-1.html.

Buildings officially protected as part of a designated environment or because of their special architectural or historical merit, or other heritage buildings, can be granted exemptions for specific reasons, including in the following case (in line with Article 5(2)):

— The installation of solar energy systems would unacceptably alter their character or appearance. Such an exemption should be based on well-founded case-by-case decision in close coordination with the local government.

Another case is when a protected building is part of a building complex and other buildings within the complex are more suitable for solar energy installations.

3.10. **Administrative, technical and financial support measures**

According to Article 10(5), 'Member States shall put in place a framework providing the necessary administrative, technical and financial measures to support the deployment of solar energy in buildings, including in combination with technical building systems or efficient district heating systems'.

On financial measures, the provisions on solar energy in buildings do not qualify as a 'Union standard' within the meaning of State aid rules. This is clarified in recital 32. Therefore, the existence of Article 10 does not mean that Member States can no longer grant State aid for solar installations.

Below is a selection of existing practices in three different categories of support that are relevant for the implementation of Article 10(5). These three categories are one-stop-shops, support for vulnerable households, and financial incentives. However, the obligation in Article 10(5) is not limited to these three categories of administrative, technical and financial support.

3.10.1. *One-stop-shops*

One-stop-shops are important tools to support the deployment of solar energy in buildings. Some examples are given below. More general guidance on one-stop-shops is also available in connection with Article 22 ([20]) ([21]) of the Energy Efficiency Directive (EED) and Article 18 of the recast EPBD ([22]) as well as in relation to the Renewable Energy Directive.

The Climate Protection Agency Hanover in Germany offers free e.coBizz checks for small and medium-sized companies in various sectors in the Hanover region. Companies with suitable roof surfaces can receive a free solar audit. Building-specific, technical and financial aspects are taken into account during this free solar audit. Depending on the building's specific energy requirements, the consultants from the Climate Protection Agency will assess whether solar thermal or photovoltaic systems are suitable. After a two-hour consultation, companies receive a brief report showing whether and how solar energy is worthwhile.

The Sustainable Energy Authority of Ireland (SEAI) coordinates and subsidises a group of one-stop-shops that provide advice and installation for individual consumers, communities, and businesses. The House2Home one-stop-shop, for example, covers the whole process of installing a solar system, including free solar PV consultations, assistance with applying for grants to purchase solar panels and batteries, and support with the installation of the system.

3.10.2. *Financial incentives*

In 2021 **Sweden** introduced a tax reduction for green technology, covering the installation of solar systems, batteries and charging boxes. The amount is deducted directly from the invoice of the installing company. The tax reduction is available only to private individuals. In 2023, over 200 000 Swedish homeowners received a tax reduction for installing green technologies.

([20]) Article 22 of the EED requires Member States to ensure one-stop shops or similar mechanisms are set up to provide technical, administrative and financial advice on – and assistance with – energy-efficiency improvements to final customers and final users, with a specific focus on households and small non-household users, including SMEs and microenterprises.

([21]) Commission recommendation (EU) 2024/2481 of 13 September 2024 setting out guidelines for the interpretation of Articles 21, 22 and 24 of Directive (EU) 2023/1791 of the European Parliament and of the Council as regards the consumer related provisions.

([22]) Guidance on financial incentives, skills and market barriers, and one-stop shops in Annex 2.

The Mój Prąd scheme in **Poland** is a large solar rebate scheme open to residential rooftop PV projects ranging in size from 2 kW to 10 kW. 'Prosumers' (people who both produce and consume electricity) can submit applications under an agreement that regulates the feed-in of electricity generated by micro-installations into the Polish grid. Since the programme was launched in 2019, it has allocated about EUR 400 million to 411 494 PV projects.

In **Germany**, financial incentives are mostly provided at regional and local level. Several federal states, including North Rhine-Westphalia, Bavaria and Baden-Württemberg, currently have subsidy programmes for PV systems and battery storage systems. These are often municipal subsidy programmes, i.e. they provide grants from cities and municipalities. At state level, only the federal state of Berlin subsidises electricity storage systems and special PV systems.

The **reduction or abolition of VAT** in Austria (0 % VAT for PV up to 35 KW), Germany and the UK (0 % VAT), Belgium (6 % VAT), the Netherlands (7 % VAT) and Poland (8 % VAT) is an efficient, transparent and simple way to subsidise solar systems.

3.10.3. *Vulnerable households*

Member States are encouraged to ensure that vulnerable households can also benefit from the installation of solar systems. Some examples of existing practices are given below.

In Germany, favourable conditions for balcony power plants make it possible for many people, including tenants and lower-income groups, to participate in the energy transition. Plug-in balcony power plants are available for just a few hundred euro and are subsidised by many federal states, cities and energy supply companies, with subsidies of up to EUR 500. The offer is open to everyone, but vulnerable households usually receive higher subsidies. More than 400 000 plug-in solar power systems are now in operation.

The main objective of the Horizon 2020 project Sun4All is to improve access to renewable energy for vulnerable households. To this end, Sun4All is adapting New York's Solar for All scheme to the European context. Sun4All is thus a concerted effort to help vulnerable households to switch to renewable energy and thereby reduce their energy bills. As part of the project, a financing system based on a collective self-consumption model is being tested, which would finance the purchase and installation of solar panels for vulnerable households. It is expected to make a significant contribution to combating energy poverty. The scheme is being tested in the cities of Almada (Portugal), Barcelona (Spain), and Rome (Italy) and in the community of municipalities Cœur de Savoie (France).

ANNEX 9

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Infrastructure for sustainable mobility (Article 14)

TABLE OF CONTENTS

1. POLICY AND LEGAL CONTEXT

A shortage of recharging points in private buildings can be a barrier to the take-up of electric vehicles in the EU. The overall aim of Article 14 of the the recast Energy Performance of Buildings Directive ('the recast EPBD') ([1]) on infrastructure for sustainable mobility is to accelerate the deployment of recharging infrastructure in or adjacent to buildings. The EPBD complements Regulation (EU) 2023/1804 on the deployment of alternative fuels infrastructure (also known by its short form 'alternative fuels infrastructure Regulation', AFIR) ([2]).

Electric vehicles are expected to play a crucial role in the decarbonisation of transport and can contribute to the decarbonisation and efficiency of the electricity system, namely through the provision of flexibility, balancing and storage services, especially through aggregation. This potential of electric vehicles to integrate with the electricity system and contribute to system efficiency and further absorption of renewable electricity should be fully exploited. Recharging in relation to buildings such as offices and multi-family buildings is particularly important, since this is where electric vehicles park regularly and for long periods of time. In line with the Renewable Energy Directive ([3]), the recast EPBD includes requirements on smart and, where appropriate, bi-directional recharging.

Promoting zero-emission vehicles and sustainable travel is a key part of the European Green Deal, and buildings will play an important role in providing the necessary recharging points for both electric vehicles and electric bicycles.

Article 14 also provides for better parking infrastructure for bicycles, in line with the European Green Deal and the new EU urban mobility framework, as a shift towards active modes of transport such as cycling can significantly reduce greenhouse gas emissions from transport.

1.1. Legal context

1.1.1. *Alternative Fuels Infrastructure Regulation*

The Alternative Fuels Infrastructure Regulation ([4]), which applies since 13 April 2024, sets interoperability standards for recharging points, deployment targets, and requirements for publicly accessible recharging infrastructure.

Questions and answers on this Regulation are available on the European Commission's Mobility and Transport website ([5]).

1.1.2. *Renewable Energy Directive*

The revised Renewable Energy Directive entered into force on 20 November 2023 with a main transposition deadline of 21 May 2025. Its goal is to facilitate the transition to a decarbonised economy by increasing the share of renewable energy to at least 42.5 % by 2030 - with a goal of 45 % by 2040.

A document providing guidance on Article 20a on energy system integration ([6]) is relevant for the implementation of Article 14 of the recast EPBD.

2. SUMMARY OF OBLIGATIONS

Article 14 builds upon the provisions on electromobility in Article 8, which were added by Directive (EU) 2018/844. The provisions related to bicycle parking spaces were, however, not part of the previous EPBD. They are new to the recast EPBD.

([1]) Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast).

([2]) Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU.

([3]) Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652.

([4]) Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU.

([5]) https://transport.ec.europa.eu/transport-themes/clean-transport/alternative-fuels-sustainable-mobility-europe/alternative-fuels-infrastructure_en.

([6]) Guidance on Article 20a on sector integration of renewable electricity of Directive (EU) 2018/2001 on the promotion of energy from renewable sources, as amended by Directive (EU) 2023/2413. C(2024) 5041 final.

An overview of the obligations in Article 14 is presented in the table below.

Table 1

Summary of obligations under Article 14

Scope		MS obligation
New buildings and buildings undergoing major renovation, where the car park is either inside the building or physically adjacent to it and the major renovations include the car park.	Non-residential > 5 parking spaces Art. 14(1)	— At least one recharging point for every five parking spaces. — Office buildings: at least one recharging point for every two parking spaces. — Pre-cabling for at least 50 % of parking spaces, ducting for the remaining parking spaces. — Load management system where feasible. — Bicycle parking spaces representing at least 15 % of average or 10 % of total user capacity.
	Residential > 3 parking spaces Art. 14(4)	— Pre-cabling of at least 50 % of parking spaces, ducting for the remaining parking spaces. — At least two bicycle parking spaces for every residential building unit.
New buildings	Residential > 3 parking spaces Art. 14(4)	— The requirements above, plus at least one recharging point.
Existing buildings	Non-residential > 20 parking spaces Art. 14(2)	By 1 January 2027: — At least one recharging point for every 10 car parking spaces or ducting for at least 50 % of all car parking spaces. — Bicycle parking spaces must account for at least 15 % of average or 10% of total user capacity. By 1 January 2033: — Buildings owned or occupied by public bodies: pre-cabling for at least 50 % of car parking spaces.
All new and existing buildings	All buildings Art. 14(8)	— Simplifying, streamlining and accelerating the procedure for installing recharging points in new and existing residential and non-residential buildings.

For new buildings there is a link to Article 11(1), which requires zero-emission buildings to offer the capacity to react to external signals and adapt its energy use, generation or storage where economically and technically feasible. Charging of electric vehicles can benefit from this capacity.

Furthermore, under Article 3 and Annex II, policies and measures adopted by the Member States to deploy infrastructure for electric vehicle charging in buildings must be included in their National Building Renovation Plans.

3. RELEVANT DEFINITIONS

The following definitions in Article 2 are relevant for Article 14:

Article 2(5): ‘public bodies’ means public bodies as defined in Article 2, point (12), of Directive (EU) 2023/1791.

Article 2(18): ‘residential building or building unit’ means a room or suite of rooms in a permanent building or a structurally separated part of a building which is designed for all-year habitation by one private household.

Article 2(22): '**major renovation'** means the renovation of a building where: (a) the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25 % of the value of the building, excluding the value of the land upon which the building is situated; or (b) more than 25 % of the surface of the building envelope undergoes renovation. Member States may choose to apply point (a) or (b).

Article 2(33): '**recharging point**' means a recharging point as defined in Article 2, point (48), of Regulation (EU) 2023/1804 of the European Parliament and of the Council (i.e. the Alternative Fuels Infrastructure Regulation, where it is defined as 'a fixed or mobile, on-grid or off-grid interface for the transfer of electricity to an electric vehicle which, although it may have one or more connectors to accommodate different connector types, is capable of recharging only one electric vehicle at a time, and which excludes devices with a power output less than or equal to 3.7 kW the primary purpose of which is not the recharging of electric vehicles').

Article 2(34): '**pre-cabling**' means all measures that are necessary to enable the installation of recharging points, including data transmission, cables, cable routes and, where necessary, electricity meters.

Article 2(37): '**smart recharging**' means smart recharging as defined in Article 2, second paragraph, point (14 m), of Directive (EU) 2018/2001 of the European Parliament and of the Council (i.e. the revised Renewable Energy Directive, where it is defined as a recharging operation in which the intensity of electricity delivered to the battery is adjusted dynamically, on the basis of information received through electronic communication).

Article 2(38): '**bi-directional recharging**' means bi-directional recharging as defined in Article 2, point (11), of Regulation (EU) 2023/1804 (i.e. the Alternative Fuels Infrastructure Regulation, where it is defined as a smart recharging operation where the direction of the electricity flow can be reversed, allowing that electricity flows from the battery to the recharging point it is connected to).

Article 2(64): '**bicycle parking space**' means a designated space for parking at least one bicycle.

Article 2(65): '**car park physically adjacent to a building**' means a car park which is intended for the use of residents, visitors or workers of a building and which is located within the property area of the building or is in the direct vicinity of the building.

The following definitions laid down in the Alternative Fuels Infrastructure Regulation are also relevant for Article 14:

High-power recharging point is defined in Article 2(31) as a recharging point with a power output of more than 22 kW for the transfer of electricity to an electric vehicle.

Normal-power recharging point is defined in Article 2(37) as a recharging point with a power output less than or equal to 22 kW for the transfer of electricity to an electric vehicle.

Several other terms that are not legally defined are also relevant:

Car park: No definition is provided, but for the purposes of the recast EPBD, 'car park' would exclude on-street parking on public roads, for example.

Ducting infrastructure means 'conduits for electric cables'. This should be broadly interpreted to include cable ducting fixed to walls and cable pass-through walls.

Electrical infrastructure (of a building or a car park): No definition is provided in the recast EPBD. However, it should be understood to mean the electrical installation (either the whole installation or any part of it) of a building or car park, including electrical wiring, apparatus and associated equipment such as switchboards, transformers, etc.

Non-residential buildings are buildings that are used for a purpose other than residential (i.e. office buildings, healthcare buildings, wholesale and retail shops, schools, hotels and restaurants, etc.).

Office buildings: No definition is provided, but this category refers to buildings whose primary function is to provide space for administrative, financial, professional or customer services. The office area must cover most of the building's total area, but the building may also have other rooms such as meeting rooms, classrooms, staff facilities or technical rooms.

4. IMPLEMENTATION OF OBLIGATIONS

Member States must bring into force the laws, regulations and administrative provisions necessary to comply with Article 14 by the transposition deadline of 29 May 2026.

The obligations to install recharging points, pre-cabling, ducting (i.e. conduits for electric cables) and bicycle parking spaces differ for new buildings, buildings undergoing major renovation and existing buildings.

The recast EPBD does not specify how the sustainable mobility requirements are to be applied to buildings that have both a residential and a non-residential function (e.g. a residential building with commercial spaces on the ground floor). It is therefore up to the Member States to identify the most appropriate approach for such cases. This is clearly stated in Recital (34): *With regard to mixed-used buildings that include both residential and non-residential building units, Member States may continue to choose whether to treat them as residential or non-residential buildings.*

In transposing the provisions of Article 14, the Member States have the discretion to determine (or not to determine) whether the recharging points to be deployed should be normal or high-power recharging points.

4.1. Recharging infrastructure in new and renovated non-residential buildings

Article 14(1) requires the Member States to ensure that recharging points, pre-cabling and ducting are installed in new non-residential buildings, and non-residential buildings undergoing major renovation, that have more than five car parking spaces.

The requirements of Article 14(1) of the recast EPBD are broadly similar to those of Article 8(2) of the previous EPBD, the main differences being that the threshold has been lowered to from 10 to 5 parking spaces and that at least **one recharging point is required for every five car parking spaces** as compared to one for the entire car park previously.

Also, a new requirement has been introduced specifically for office buildings, where there must be **one recharging point for every two parking spaces**. To identify the buildings that fall under the requirement for office buildings, Member States can use the classification of buildings for the purpose of calculating energy performance, as set out in point 6 of Annex I to the recast EPBD.

Where there is a major renovation, the requirement only applies if the renovation work includes the car park or the electrical installation of the building or car park.

According to Article 14(1), at least one recharging point must be installed for every five car parking spaces, and pre-cabling must be installed for at least 50 % of car parking spaces and ducting for the remainder.

To determine the number of car parking spaces that must have recharging points, pre-cabling or ducting installed, see the following example:

For a car park with 20 car parking spaces, 10 parking spaces, i.e. 50 %, would have to be pre-cabled, while the remaining 10 parking spaces would need ducting.

In addition, there must be at least one recharging point per five parking spaces, i.e. at least four recharging points in this example. These four recharging points would need to be installed on four out of the 10 pre-cabled parking spaces.

In the case of an office building, where the requirement is at least one recharging point for every two parking spaces, in the above example with 20 car parking spaces, 10 pre-cabled parking spaces and 10 parking spaces with ducting would be required. All the pre-cabled parking spaces would need to have a recharging point installed, as the requirement would be 10 recharging points in total.

For buildings that have parking spaces for both customers and staff, for instance supermarkets, the national rules can allow building owners to take account of the difference in expected parking time when distributing the recharging points.

For instance, in a supermarket with 100 parking spaces, of which 10 are reserved for staff, 20 recharging points would be required in total. These could then be distributed between, for instance, five normal recharging points at parking spaces for staff and 15 recharging points for customers. Any number of the recharging points for customers could be high-power recharging points. Article 14 does not specify the installed power of recharging points.

The time that a vehicle is parked can vary significantly between building categories. In large non-residential building (with more than 20 car parking spaces) such as wholesale and retail trade services buildings where visitors typically park for short times, i.e. less than one to two hours, the installation of high-power recharging points might meet the needs of visitors better than normal-powerrecharging points. Member States may therefore consider providing some flexibility when designing their requirements on recharging points for this category of buildings as long as they ensure the availability of the required number of recharging points taking into account the needs of the users of the car park.

The notion of **physically adjacent,** as defined in Article 2(65), is relevant where a car park is not located inside a building but is clearly linked to it in other ways. In particular, there may be situations where the car park is not strictly speaking physically adjacent to the building (e.g. located on the other side of the street or separated from it by a green area), but is nevertheless clearly linked to it due to habitual use by residents, visitors or workers. This would make it relevant and appropriate to apply the obligations. Parking spaces used by the occupants of a multi-family building would be one such example.

When implementing the definition of 'car park physically adjacent to building' Member States can choose to include car parks within the property area of the building or in the direct vicinity of the building. Member States can also choose to include both car parks within the property area and in the vicinity.

4.2. **Recharging infrastructure in existing non-residential buildings**

Article 14(2) requires the Member States to ensure that recharging points or ducting are installed in existing non-residential buildings with more than 20 car parking spaces by 1 January 2027.

This requirement applies to all non-residential buildings which, as of 1 January 2027, have an existing car park of more than 20 parking spaces.

The new requirements must be transposed by 29 May 2026.

The transposition could be based on the existing rules implementing Article 8(3) of the previous EPBD, which required a minimum number of recharging points to be installed in all non-residential buildings with more than 20 car parking spaces by 1 January 2025.

The requirements of Article 14(2) may be postponed until 2029 for buildings renovated in the two years prior to 28 May 2024, to comply with national requirements laid down under Article 8(3) of the previous EPBD.

For buildings owned or occupied by public bodies, at least 50 % of car parking spaces must have pre-cabling installed by 1 January 2033. Public bodies are defined in Article 2(5).

4.2.1. *Interpretation of ducting*

'Ducting infrastructure' means conduits for electric cables. If ducting already exists in the car park, i.e. for lighting or other purposes, in many cases the existing ducting can be used to fulfil the requirement.

For outdoor car parks, where the charging stations may be directly connected to an outdoor electric box or cupboard, all spaces that can be directly and safely connected (according to national legislation) to the box or cupboard would be considered as ducted. For example, if national legislation indicates that the maximum distance between charging point (or equivalent electric installation) and the electric cupboard is 10 meters, then all spaces that are located within 10 meters of a location suitable for an electric cupboard would be considered as ducted.

In the case of indoor car parks where the cables are fixed to the walls, ducting would mainly be needed when the cables need to pass through a wall.

Member States can specify further technical details as regards ducting if needed.

4.2.2. *Combination of recharging points and ducting*

Article 14(2) requires all non-residential buildings with more than 20 car parking spaces to have at least one recharging point installed for every 10 car parking spaces, or ducting for at least 50 % of car parking spaces, by 1 January 2027.

This means that Member States can choose the installation of either recharging points or ducting.

A combination of charging points and ducting is also possible as long as the minimum requirements are fulfilled. As an example, if an existing non-residential building meets the ducting requirements, for instance through existing ducting, the recommended solution could be to install different kinds of recharging points to fulfil the needs of customers, visitors, and employees.

When they draw up such recommendations, the Member States could consider how many registered electric vehicles they expect to have by the end of 2026 (just before the requirements of Article 14(2) of the EPBD come into effect).

In line with the recommendations set out in the previous EPBD ([7]), they could also take account of the following to ensure that the deployment of recharging points is proportionate and appropriate:

(a) relevant national, regional and local conditions; and

(b) possible diversified needs and circumstances based on area, building typology, public transport coverage and other relevant criteria.

In addition, Member States can take into account the differences in estimated parking times for different categories of non-residential buildings when choosing between recharging points or ducting, or a combination.

As clarified in Section 4.1, Member States may consider providing some flexibility when designing their requirements under Article 14(1) and 14(2).

Table 2

Examples of considerations for recharging infrastructure in different types of building

Parking duration	Type of building	Recharging infrastructure
Short (<1h)	Supermarket, gym, library, etc.	High-power recharging points for customers, normal-power recharging points for staff. (Customer parking times too short for normal-power recharging or smart/bi-directional charging.) Alternatively in case the parking is open outside the opening hours of the supermarket or similar: sufficient number of normal-power recharging points for people living nearby to charge in the evening and at night, also allowing users to benefit from smart charging. Example: https://www.redactie24.be/shopping/drastische-verandering-op-parkings-van-colruyt-en-ook-buiten-de-openingsuren-174462
Medium (1-3h)	Large retail centres, furniture stores, etc.	A combination of high-power recharging points and normal-power recharging points for parking of longer duration. More normal-power recharging points with smart charging than high-power recharging points can be an advantage for the grid. If a facility is in the city centre, the building owner could offer people living nearby evening/night charging.

([7]) Commission Recommendation (EU) 2019/1019 of 7 June 2019 on building modernisation.

Parking duration	Type of building	Recharging infrastructure
Long (>3h)	Parking towers, etc.	A large number of normal-power recharging points to allow load balancing, smart charging and grid support (plus a few high-power recharging points to provide backup).

Member States can also take into account the difference between customer and staff parking spaces. Parking spaces for staff are more suitable for smart charging because cars are parked for much longer, allowing the time of charging to be adapted to take advantage of off-peak electricity prices, the share of renewable electricity in the grid, etc.

Grid concerns can be taken into account for the transposition in Member States when determining whether the installation of recharging points or of ducting is most appropriate.

4.3. **Recharging infrastructure in new and renovated residential buildings**

Article 14(4) requires the Member States to ensure that pre-cabling and ducting are installed in new residential buildings, and residential buildings undergoing major renovation, that have more than three car parking spaces. In new residential buildings with more than three car parking spaces, at least one recharging point must be installed in addition to the pre-cabling and ducting.

There are many similarities with the requirements for non-residential buildings in Article 14(1) and the requirements laid down in Article 8(5) of the previous EPBD. The main difference compared to the previous EPBD is that the threshold has been lowered from 10 to 3 parking spaces. Moreover, 50 % of the parking spaces must be pre-cabled, and new residential buildings must have at least one recharging point.

The intention is to cover multi-family buildings, not single-family homes as they typically do not have more than 3 car parking spaces, and barriers to the installation of recharging points are likely to be few.

4.4. **Pre-cabling and ducting**

Article 2(34) defines pre-cabling as all measures that are necessary to enable the installation of recharging points, specifying that it includes cables, cable routes, data transmission, etc.

However, the technical details of the installation can vary from case to case, also depending on the expected power output of the recharging points. This is something the Member States could take into consideration when transposing the rules into national law.

Ducting is not defined, but it is clear from Article 14(1)(b), (2)(a) and (4)(a) that it is to be understood as conduits for electric cables. Conduits for electric cables could, for instance, be buried under the ground in outdoor car parks, or laid in the floor or fixed to the walls in indoor car parks. Conduits are typically used for several purposes, and there is no need to make new ducting if the necessary cables can be fitted into conduits that are already in place and cover the planned parking spaces.

Also, in indoor car parks where the cables are to be fixed to a wall, the roof or a cable tray, ducting would only be needed where the cables need to pass through a wall (for instance a fire compartmentation wall).

Pre-cabling must be 'dimensioned so as to enable the simultaneous and efficient use of the required number of recharging points'. Here, 'required number of recharging points' should be understood as the expected number of parking spaces for which recharging points will have to be installed to respond to future demand. Also, the transformer substation plans and the electrical single line diagrams (SLD) for wiring and circuit protection should be drafted and at least the circuit breakers installed at the transformer substation and/or the primary distribution/fuse box (if any). This will make upgrading and installation of recharging points later on straightforward and cost effective.

Where there are severe grid constraints, or it is difficult to estimate the cabling needs at the time of construction or major renovation, Member States could consider allowing the replacement of pre-cabling with ducting with a pulling cord, cable trays in indoor car parks and/or straight unpaved areas and charger point supports in outdoor car parks, in order to avoid installing cables that will eventually not be used.

To make it easier for local authorities to check that pre-cabling and ducting requirements have been meet, building owners could present a floorplan showing the exact location of switches and power outlets and a schematic plan of the wiring diagram.

This documentation could serve as proof that they have thought out the details of a future recharging installation as well as making it easier to verify compliance with the EPBD pre-cabling requirements. It is therefore recommended that the Member States make such documentation a requirement.

4.5. **Features of recharging points**

4.5.1. *Smart and bi-directional recharging*

Article 14(6) requires the Member States to ensure that the recharging points referred to in paragraphs 1, 2, and 4 are capable of smart recharging and, where appropriate, bi-directional recharging.

Smart recharging allows users of electric vehicles to plan the time of charging according to the cost of electricity, the share of renewable energy and their own needs. It also benefits the grid as it helps shift load times and therefore reduce peak loads.

Bi-directional recharging allows electric vehicle batteries to behave like stationary batteries connected to the grid. It also contributes to the uptake of variable renewable energy by allowing excess energy to be stored when energy prices are low, and to be fed back to the grid when prices are high and less renewable energy is being generated.

However, there is still some way to go to before we are able to exploit the full potential of bi-directional charging. Article 14 does not set specific requirements for bi-directional recharging precisely because the technology is developing at a rapid pace.

Article 14(6) is in line with Article 20a(4) of the Renewable Energy Directive, which requires Member States or their designated competent authorities to ensure that, as of the transposition date, new and replaced non-publicly accessible normal-power recharging points installed in their territory support smart recharging functionalities and, where appropriate, the interface with smart metering systems.

Also, under that Article, in conjunction with Article 15(3) and (4) of the Alternative Fuels Infrastructure Regulation, new and replaced non–publicly accessible normal-power recharging points should be able to support bi-directional recharging functionalities where appropriate.

The guidance for Article 20a of the Renewable Energy Directive provides clarifications for Member States which are also relevant for the implementation of Article 14 EPBD ([8]).

Article 20a(5) of the Renewable Energy Directive states that in addition to the requirements of Regulation (EU) 2019/943 ([9]) and Directive (EU) 2019/944 ([10]) laying down common rules for the internal market for electricity, the Member States must ensure that the national regulatory framework allows electric vehicles to participate in the electricity markets, including congestion management and the provision of flexibility and balancing services, including through aggregation.

([8]) Paragraphs 3.4.2 and 3.4.4 of the Guidance on Article 20a on sector integration of renewable electricity of Directive (EU) 2018/2001 on the promotion of energy from renewable sources.
([9]) Regulation (EU) 2019/943.
([10]) Directive (EU) 2019/944.

To that end, the Member States should lay down technical requirements for participation in the electricity markets on the basis of the technical characteristics of those systems, in close cooperation with all market participants and regulatory authorities.

In addition, Article 5(8) of the Alternative Infrastructure Regulation requires publicly accessible recharging points to have smart recharging capabilities. This obligation applies to operators of publicly accessible recharging points; there is no reference to smart recharging at recharging points to which the public does not have access.

Smart recharging and bi-directional recharging are defined in the Renewable Energy Directive and the Alternative Fuels Infrastructure Regulation (see the section on relevant definitions). In 2022 a standard was adopted that, among others, enables bidirectional recharging and also facilitates smart recharging (ISO 15118.20). It can be implemented on a voluntary basis.

Several recharging station manufacturers offer products that comply with ISO 15118.20 either by default or as an option. This means that the necessary hardware is either built in or can be retrofitted to support bi-directional charging.

It is recommended that recharging points installed under Article 14 comply with or have plug-in modules and/or firmware that can be updated to comply with ISO 15118.20. An upcoming delegated act under AFIR will mandate the standard on new recharging points as of 2027.

4.5.2. *Clarification of where bi-directional charging is considered appropriate*

According to the guidance on Article 20a of the Renewable Energy Directive, cases where bi-directional recharging might be the most relevant are:

— **When expected private benefits exceed costs.** The expected benefits of bi-directional recharging which would benefit the households/businesses owning the recharging points exceed the additional costs of installing the recharging infrastructure that allows for bi-directional recharging.

— **When the size of the recharging infrastructure is large,** for example in office spaces and large residential buildings.

— **When there is a significant potential of renewables generation** - Bi-directional charging can store excess renewable energy and release it back to the grid when needed.

— **When flexibility is especially needed due to power grid congestion in a specific area** - Bi-directional recharging in congested areas can help to increase the production of renewables while reducing grid expansion needs.

— **When there is a specific need to enhance grid stability and reliability** - Bi-directional recharging can support the grid by providing other services, such as voltage control and emergency services.

In addition, it can be relevant where energy sharing is foreseen.

Also, parking duration is a factor that influences the suitability of bi-directional charging and the potential grid benefits that can be obtained. Member States can take this into account when considering where bi-directional recharging is appropriate.

4.5.3. *Power output of recharging points*

There are no requirements as regards the power output of the recharging point in the recast EPBD. For their implementation, Member States are therefore free to require normal power recharging points or high-power recharging points, or a combination of the two, according to what is most appropriate in their specific situation.

For the benefits for the energy system and for the grid, in many cases smart recharging at normal recharging points can be beneficial. Also, cars, in particular private cars, typically remain parked for the best part of the day (up to 23 hours), which makes them well suited for o smart recharging at normal-power recharging points.

Because technology is evolving and the EPBD requirements need to be future-proof, Article 14 does not specify the output power of recharging points. It is therefore up to the Member States to determine the combination of fast and normal recharging points that works best for them. Member States should take into account that private cars often stay parked most of the time, either at home or at the workplace, making access to normal recharging points in homes and at workplaces important. Normal-power recharging has many advantages because it can also be combined with smart recharging.

4.5.4. *Operation of recharging points*

Under Article 14(6), recharging points must be operated on the basis of non-proprietary and non-discriminatory communication protocols and standards, in an interoperable manner. They must also comply with any European standards adopted under Article 21(2) or delegated acts adopted under Article 21(3) of the Alternative Fuels Infrastructure Regulation.

Under Article 21(2), in conjunction with Article 10 of Regulation (EU) No 1025/2012 [11], the Commission may ask European standardisation organisations to draft European standards that set technical specifications for areas referred to in Annex II to the Alternative Infrastructure Regulation for which no common technical specifications have been adopted by the Commission.

Article 21(3) requires the Commission to adopt delegated acts. Relevant in this context are in particular technical specifications for communication exchange for electric vehicle recharging (see Annex II to the Regulation).

4.6. **Load management systems**

Load or recharging management systems allow demand from electric vehicles to be managed so that several vehicles can charge at the same time and at the same location.

Under Article 14(1), Member States should support the installation of a **load or recharging management system** in new and renovated non-residential buildings with more than five parking spaces, where appropriate and to the extent this is technically and economically feasible and justifiable.

Load management of charging points can help minimise their impact on the electrical infrastructure while distributing the available energy between all connected loads. In general, there are three main levels of load management:

— Static load management limits the power drawn by the EV charging loads to a fixed power level;

— Dynamic load management optimises energy use and allocates available power to EV charging loads in a building;

— Smart load management optimises energy use and costs based on EV planning, energy tariffs, local power generation and energy consumption forecasts.

Smart load management can have several functions which can be measured based on the following indicators:

— Renewable energy curtailment;

— Peak demand reduction;

— CO_2 emissions reduction;

— Average electricity cost.

(11) Regulation (EU) No 1025/2012.

Reducing the peak power demand is the main load management function to be considered when designing electric vehicle recharging in a car park, because it can help reduce the total rated power of the electrical installation (cabling, transformer, grid connection) and therefore bring down the investment or upfront costs.

Best practice:

In the Netherlands, the installation of load management and/or smart charging is explicitly referred to as a measure designed to counter grid congestion. Flexible charging of electric cars will become a permanent part of the contracts that the government makes with municipalities to address grid concerns ([12]).

4.7. Possible exemptions

4.7.1. *Micro-isolated systems and outermost regions*

Under Article 14(5)(a), the Member States may decide not to apply the requirements of Article 14(1), (2) and (4) to specific categories of building if the necessary recharging installation would rely on micro-isolated systems, or if the buildings are situated in the outermost regions within the meaning of Article 349 of the Treaty on the Functioning of the European Union (TFEU) and this would lead to substantial problems for the operation of the local energy system and endanger the stability of the local grid.

This is not a new provision in the recast EPBD; the same rule applied under the EPBD of 2010, as amended in 2018.

Article 2(36) defines micro-isolated system as 'any system with consumption less than 500 GWh in the year 2022, where there is no connection with other systems'.

As regards the outermost regions, Article 349 TFEU recognises the specific constraints faced by certain regions, including Guadeloupe, French Guiana, Martinique, Réunion, the Azores, Madeira, and the Canary Islands. These regions, due to their remoteness, island nature, small size, difficult topography, climate, and economic dependence on a few products, are eligible for specific measures and provisions in EU legislation to address their challenges.

This exemption is only intended to be used where there is a risk that recharging facilities cause network instability and issues with power system operability in isolated microgrids. Remote regions should be included in the green transition as far as possible and be allowed to benefit from the development of recharging infrastructure.

4.7.2. *Cost exemption*

Under Article 14(5)(b), Member States may decide not to apply the requirements of Article 14(1), (2) and (4) to specific categories of building where the cost of the recharging and ducting installations exceeds at least 10 % of the total cost of a major renovation of the building.

This provision was introduced by the 2018 EPBD; the only change in the recast EPBD is that the **threshold has been raised from 7 % to 10 %**.

In this context, it is important to recall the definition of major renovation, which is included in the section on relevant definitions.

Existing practice

The following example of existing practice relates to Article 8(6). The only difference from Article 14(5)(b) is that the threshold has been raised to 10 %:

In **Greece**, the owner of an existing residential or non-residential building undergoing major renovation may be exempted from the obligations provided that the engineer responsible for the issuance of the building permit declares on honour to the municipality's urban planning office that the cost of a recharging and ducting installation would exceed 7 % ([13]) of the total cost of renovating the building.

([12]) https://www.rijksoverheid.nl/onderwerpen/duurzame-energie/kabinet-neemt-maatregelen-tegen-vol-elektriciteitsnet-netcongestie.
([13]) The threshold is 10 % in the recast EPBD.

4.8. **Bicycle parking spaces**

A shortage of bicycle parking spaces, both in residential and non-residential buildings, is a major barrier to the uptake of cycling, a very energy-efficient, pollution-free and climate-friendly mode of transport. Article 14 of the recast EPBD sets requirements for a minimum number of bicycle parking spaces in different categories of buildings.

Table 3

Summary of obligations for bicycle parking spaces

Scope		MS obligation
New buildings and buildings undergoing major renovation where the car park is either inside the building or physically adjacent to it and the major renovations include the car park	Non-residential > 5 parking spaces	— Parking spaces for bikes corresponding to at least 15 % of average or 10 % of total user capacity. — Enough space for bikes that are larger than the standard size. — Pre-cabling and ducting to enable the installation at a later stage of recharging points for electrically powered bikes. — The required number of parking spaces may be adjusted for certain types of non-residential building not typically accessed by bikes.
	Residential > 3 parking spaces	— At least two parking spaces for every residential unit. — Member States may, subject to an assessment by local authorities and taking into account local characteristics, including demographical, geographical and climate conditions, adjust requirements for the number of bicycle parking spaces. — Where, in the case of major renovation, ensuring two bicycle parking spaces for every residential building unit is not feasible, Member States must ensure as many bicycle parking spaces as appropriate.
Existing buildings	Non-residential > 20 parking spaces	By 1 January 2027: — Parking spaces for bikes corresponding to at least 15 % of average or 10 % of total user capacity. — Enough space for bikes that are larger size than the standard size. — Pre-cabling and ducting to enable the installation at a later stage of recharging points for electrically powered bikes. — The required number of parking spaces may be adjusted for certain types of non-residential building not typically accessed by bikes.

4.8.1. *Determination of the number of bicycle parking spaces in non-residential buildings*

Article 14(1) and (2) require non-residential buildings to have parking spaces for bikes corresponding to at least 15 % of average or 10 % of total user capacity.

Average user capacity and **total user capacity** are not defined in the EPBD; the way these terms are generally used in building practices or building permits can be used as a guide.

For example, total user capacity is to be understood as the **maximum number of people who can safely and comfortably occupy or use a building**. This number is an upper limit of occupants according to building codes and fire and safety regulations.

Average user capacity is to be understood as the **usual or expected number of occupants or users of a building under normal operating conditions**, rather than maximum occupancy. This can vary depending on the type of building and how it is used ([14]).

([14]) In an office, average user capacity might be based on the typical number of people working in the building on a regular day. For retail stores or shopping malls, average user capacity might be based on observational studies of the number of customers.For libraries, museums or schools, average user capacity could refer to the number of visitors, students or staff present on an average day, bearing in mind that peak times may vary.

The following are a few examples of how average user capacity can be determined.

— Based on building type and usage: the specific use of the building (offices, retail shops, school) plays a major role in determining average capacity;

— Based on historical data: in many cases, average capacity is based on historical data such as average daily foot traffic or occupancy trends;

— Based on space allocation: both maximum capacity and average capacity can be calculated on the basis of floor space per user, but average capacity is based on a more realistic estimate of usage, not just the maximum.

For the purpose of Article 14, **Member States are free to choose either total or average user capacity** as the metric on which to base the requirement for bicycle parking spaces. They can for example choose the metric that is the most readily available and places the smallest possible administrative burden on building owners.

One advantage of 'total user capacity' could be that this information is often readily available for buildings, for instance in relation to fire safety. In cases where 'average user capacity' is considered more suitable, data on typical use would need to be gathered.

The intention is that, independently of the metric used, a similar number of parking spaces for bikes should be obtained, at least for buildings such as offices and schools that have relatively stable occupation. This is the reason the required share of parking spaces for bikes is 10 % if the metric is 'total user capacity' and 15 % if the metric is 'average user capacity' (total user capacity being larger than average user capacity).

Example: Office building

An office building with a total user capacity of 100 would require parking spaces for bikes corresponding to 10 % of total user capacity, i.e. at least 10 parking spaces.

Assuming that the office building has an average user capacity of 2/3 the total user capacity (67 people), the building would require parking spaces for bikes corresponding to 15 % of the average user capacity, i.e. at least 10 parking spaces.

It is also possible for Member States to implement the obligation in the Article through metrics based on typical number of users per square meters for different categories of buildings. For example, the Brussels Region ([15]) has laid down requirements based on floor area which vary per building type. For example, one parking space for bikes is required per 200 m^2 floor area in office buildings, as compared to 1.5 parking spaces per 100 m^2 floor area in shops.

As regards space for bikes that are a **larger than the standard size**, the intention is that the building owner should also provide parking spaces that are large enough for e.g. cargo bikes, long bikes, bikes with trailers, tricycles or bikes for people with disabilities. There is no requirement as to the exact share of bicycle parking spaces to be reserved for larger bicycles.

Article 14 does not mention security specifically, but Member States are recommended to take protection against theft into consideration by ensuring that there is a possibility for bicycles to be locked conveniently ([16]) to a secure point at the parking space.

4.8.2. *Possible exemption for bicycle parking spaces in non-residential buildings*

According to Article 14(3) Member States may adjust requirements for the number of bicycle parking spaces in accordance with paragraphs 1 and 2 for specific types of non-residential building not typically accessed by bikes.

([15]) https://environnement.brussels/pro/reglementation/obligations-et-autorisations/stationnement-et-livraison-les-obligations-concernant-velos-motos-et-autos.

([16]) I.e. using good to access and difficult to cut (rectangular profiles are safer than round profiles) 'inverted U-arcs'. Too low bike parking frames (for holding only wheels) should be avoided as inconvenient and constituting a risk to the wheels when the bike is pushed laterally).

This includes non-residential buildings that are very difficult to access by bike, for example a store, a supermarket or an office located on a highway without bicycle access.

Another example of buildings that are not typically accessed by bicycle are buildings where the share of visitors that are accessing it by bike is very low compared to the total number of visitors, for example a store selling large objects that are difficult to transport by bike. The Member States should bear in mind, however, that providing parking spaces for bikes in areas with little bike traffic could be an incentive for increased use.

4.8.3. *Possible exemptions for bicycle parking spaces in residential buildings*

The requirements on bicycle parking spaces apply to residential buildings with more than three car parking spaces, with the intention of covering multi-family buildings and not single-family homes (which rarely have more than three parking spaces for cars).

According to Article 14(4), Member States have the possibility to adjust the number of bicycle parking spaces in new residential buildings and residential buildings undergoing major renovation subject to an assessment by local authorities and taking into account local characteristics, including demographical, geographical and climate conditions.

Also, Article 14(4) requires ‘as many parking spaces as appropriate’ to be provided in residential buildings undergoing major renovation if ensuring two bicycle parking spaces for every residential building unit is not feasible.

4.8.4. *Ducting and pre-cabling for electrically powered bikes*

Article 14 of the recast EPBD does not require specific recharging points to be installed for electric bicycles. However, to ensure that new and renovated residential and non-residential buildings can accommodate electric bikes, their pre-cabling and ducting installation should also take into account the needs to supply electricity to bicycle parking spaces for the future installation of sockets for recharging electric bikes.

There are no specific requirements as regards the specific number of pre-cabled bicycle parking spaces. This would be up to the Member States to decide in relation to the uptake of electric bicycles.

There is a difference between the recharging of electric vehicles and electrical bicycles in the sense that no specific recharging point is needed to recharge an electric bike; a standard household socket is sufficient.

4.8.5. *Existing practices relating to parking spaces for bikes*

Belgium requires any new car park to have parking spaces for bikes in ‘sufficient numbers’ in relation to the activity of the site. Renewal of the environmental permit of an existing car park is conditional on a quantitative and qualitative analysis of whether there are sufficient parking spaces available for bikes.

Bulgaria sets a minimum number of parking spaces for bikes for different types of building, specifying the share of parking spaces to be reserved for bikes parking for more than two hours and bikes parking for less than two hours.

Lithuania has legislation with specific requirements for parking spaces for bikes, including their size and their distance from the entrance of the building.

The province of Vorarlberg in **Austria** has specific rules for e-bikes, including the obligation to install parking spaces with appropriate ducting in new buildings or residential buildings with three or more apartments undergoing major renovation, if the parking spaces are located inside or in the direct vicinity of the building and are roofed or enclosed by walls or other constructions.

In addition to these best practices, Member States are recommended to seek guidance on quality bike parking from cyclists’ organisations, including on accessibility of the bike parking spaces.

4.9. Simplifying, streamlining and accelerating the installation of recharging points

Article 14(8) requires the Member States to take measures to **simplify, streamline** and **accelerate** procedures, especially those of **co-owners' associations,** for installing recharging points in new and existing residential and non-residential buildings, and to **remove regulatory barriers**, including the permitting and approval procedures of public authorities, without prejudice to the property and tenancy law of the Member States.

This requirement is similar to that of Article 8(7) of the previous EPBD, which required the Member States to take measures to simplify the deployment of recharging points in new and existing residential and non-residential buildings and to address possible regulatory barriers, including permitting and approval procedures, without prejudice to the property and tenancy law of the Member States.

The Member States could therefore build on what has already been implemented, taking further steps to promote the installation of recharging infrastructure in all buildings.

They should look into the policies in place relating to the installation of recharging points to see if they might lead to undesired costs and/or delays or to an excessive administrative burden.

The following are examples of regulatory, technical/practical and financial barriers to the deployment of recharging infrastructure in buildings ([17]):

Regulatory barriers

— Complex and/or lengthy authorisation and permitting procedures;

— Separate building permits;

— Lack of uniform requirements across regions or municipalities;

— Multiple responsible authorities;

— Lengthy administrative processes for obtaining power increases;

— Lack of information on legal requirements;

— Financial aspects of recharging (e.g. the need to clarify the business model for sharing recharging points);

— Excessive fire safety requirements in underground car parks;

— Prohibition on installing type-2 recharging points in buildings with public access.

Technical/practical barriers

— Shortage of qualified providers;

— Municipal technical services overwhelmed;

— Shortage of available technicians;

— Lack of data on parking spaces.

Member States could consider the examples above when analysing any barriers that need to be addressed.

Member States could also take inspiration from the following good practice, based on an analysis of existing policies ([18]):

([17]) Promotion of e-mobility through buildings policy - Report from the Commission to the European Parliament and Council, COM(2023) 76 final.

([18]) Promotion of e-mobility through buildings policy - Report from the Commission to the European Parliament and the Council, COM(2023) 76 final.

Good practice:

— introducing policies which ensure that a recharging point installation:

— is at the expense of the person making the request;

— requires notification rather than approval;

— facilitating co-owner decisions on shared recharging points, mainly by allowing decisions to be made by simple majority instead of absolute majority;

— simplifying planning and permitting procedures, mainly by exempting recharging infrastructure from planning permission;

— providing guidance, information and model agreements to the relevant parties;

— providing training for real estate professionals;

— pre-financing collective infrastructure.

See the table below for existing national initiatives to promote recharging infrastructure.

Table 4

National initiatives to promote recharging infrastructure.

MS	National initiatives to promote recharging infrastructure
NL	The nation-wide initiative ‘National Agenda for Charging Infrastructure’ (NAL) ([19]) is based on cooperation between several parties ([20]) organised into working groups which aims to promote laws and regulations to speed up the roll-out of charging infrastructure. Based on input from NAL, a guide has been drawn up for owner associations ([21]) outlining all the necessary steps for installing recharging infrastructure in multi-ownership buildings. To facilitate for the Association of Owners to make decisions, detailed information is included in the guide. A few examples: — Different approaches with regard to individual and common ownership of parking spaces; — Suggestions on required grid capacity extension: 2.9 kW per vehicle; — Cost estimates for maintenance and management; — Diagram indicating the possible benefits of load balancing and solar energy integration; — Explanation of financing models. In addition, a legal toolkit is provided as an Annex.
DE	On behalf of the German Federal Ministry for Digital and Transport ([22]), the National Centre for Charging Infrastructure coordinates and manages activities aimed at expanding the charging infrastructure in Germany. The centre provides support in connection with planning, implementing and funding charging infrastructure and collects relevant data to gain a better understanding of the need for charging stations They do this by networking with all the key stakeholders, share knowledge and present to the users ([23]).

([19]) https://www.agendalaadinfrastructuur.nl/english/.
([20]) Ministry of Infrastructure and Water Management, Ministry of Economic Affairs and Climate, the ‘Rijksdienst voor Ondernemend Nederland’ (RVO), the Formule E-Team, the Association of Dutch Municipalities, het Interprovinciaal Overleg, the grid operators (ElaadNL) and the National Knowledge Platform Recharging Infrastructure (NKL).
([21]) https://vveladen.nl/wp-content/uploads/2022/04/NAL-BROCHURE_TOEGANKELIJK.pdf.
([22]) BMDV – Bundesministerium für Digitales und Verkehr.
([23]) https://nationale-leitstelle.de/en/.

MS	National initiatives to promote recharging infrastructure
IE	Electric Vehicle Charging Infrastructure Strategy 2022-2025 [24]. The focus of the strategy is to provide publicly funded charging infrastructure for electric cars and light-duty vehicles, the demand for which will grow as EV uptake increases. To support individual needs, the strategy lays out four main categories of charging infrastructure to be developed: — home/apartment charging; — residential neighbourhood charging; — destination charging; — motorway/en-route charging.

4.9.1. *Technical inspections*

Some Member States require a technical inspection ('verification') before an installed recharging point can be used, which adds costs and leads to delays, whereas other Member States have no such technical inspection requirement [25].

Those Member States that have inspections in place are recommended to reassess the need for them or consider whether they can be simplified, while keeping in mind aspects related to fire safety.

4.9.2. *Consent from the landlord or co-owners*

Under Article 14(8), Member States are required to remove barriers to the installation of recharging points in residential buildings with parking spaces, **in particular the need to obtain consent from the landlord or co-owners** for a private recharging point for own use.

A request by tenants or co-owners to be allowed to install recharging points in a parking space may be refused only if there are serious and legitimate grounds for doing so.

An example of an existing practice is presented below.

In **France**, the owner of a building with secure-access parking spaces for private use or, in the case of co-owned buildings, the condominium association, represented by the managing agent, may not refuse a request from a tenant or occupant acting in good faith and at their own expense to fit parking spaces with an electric recharging point for electric or hybrid rechargeable vehicles that allow individualised metering of consumption, unless they have serious and legitimate grounds for doing so.

Examples of serious and legitimate grounds are when recharging points are already in place, when it is impossible to carry out the works, or when the owner or syndicate of co-owners cannot make a decision to allow the installation within a reasonable period.

Also, the owner or the managing agent of a co-owned building must allow the service provider chosen by the tenant or occupant acting in good faith to access the technical premises of the building. The owner of the collective housing building and the provider of the installation must sign an agreement before works begin, stipulating the conditions of access to and operation of the common areas and specifications for fitting, managing and maintaining the installation.

These rules are further specified in Articles R113-7 to R113-9 of the Code of Construction and Housing, setting out the notification obligation and procedure, the procedure for owners to oppose the installation, and the procedure for concluding the agreement between the owner and the provider of the installation.

In addition, amendments were introduced to the legislation governing decisions of the assembly of co-owners to enable decisions on the installation of recharging points to be taken by simple majority rather than by absolute majority.

[24] gov.ie - EV Infrastructure Strategy 2022-2025.
[25] https://feedsnet.org/wp-content/uploads/2024/01/FEEDS-mapping-Electrical-inspections-regimes-in-the-EU_2024.pdf.

4.10. Technical assistance and support schemes

Under the third and fourth subparagraphs of Article 14(8), the Member States must ensure the availability of technical assistance for building owners and tenants wishing to install recharging points and bicycle parking spaces.

With regard to residential buildings, they should consider introducing support schemes for the installation of recharging points, pre-cabling or ducting of parking spaces in line with the number of battery electric light-duty vehicles registered in their territory.

See the table below for examples of existing support schemes.

Table 5

Examples of support schemes

MS	Subsidy and support schemes
NL	https://elaad.nl/ [Technical Support Scheme] eLaadNL conducts tests and research on the sustainable charging of electric vehicles.

	https://www.rvo.nl/subsidies-financiering/svve/oplaadpuntenadvies-basislaadinfrastructuur-2024
	Subsidy for providing advice on recharging points
	'Recharging station advice' is provided by certified advisors registered with the Dutch Chamber of Commerce (KVK). The advisors perform on-site inspections and describe how recharging stations can be installed in a future-proof way.
	If required, a non-technical explanation can be given to members of owners' associations.
	Several conditions apply:
	— At least one owner/inhabitant in the building;
	— Date requirement;
	— The charging needs for the next 10 years should be covered;
	— Fire safety;
	— Rules on cost division between users;
	— Electrical requirements:
	    — Best current distribution and charging times;
	    — Load management advice;
	    — Physical security and cybersecurity;
	— List of legal requirements concerning fire safety and installation practices.
	Amount of subsidies: 15 % of advice costs, up to EUR 1 500.
	Subsidy for base recharging infrastructure
	Conditions:
	— At least one owner/inhabitant in the building;
	— An offer must be submitted with a technical description, including of the following technical details:
	    — Ducts and/or cabling;
	    — Additional breaker boards;
	    — Smart charging equipment;
	    — Central safety switch to disable all recharging points in case of fire;
	    — Data network for internet access;
	    — Number of parking spaces covered;
	    — Details on how inhabitants can use the charging points.
	Amount: Subsidy of EUR 100 per parking space with recharging points.

MS	Subsidy and support schemes
FR	https://advenir.mobi/ French national funding scheme for recharging installations for private individuals, professionals and owners' associations.
	https://logivolt.fr/ Residential recharging funding scheme.
	https://www.zeplug.com/ Private companies providing support to owners' associations in connection with the installation of recharging points.
FI	The construction of recharging points in housing associations has been supported since 2018. From the beginning of 2022, subsidies began to be granted not only to housing associations, but also for electric car charging devices installed at workplaces. A total of EUR 32.5 million was allocated to charging subsidies for housing associations and workplaces for 2022–2023. https://commission.europa.eu/publications/finland-final-updated-necp-2021-2030-submitted-2024_en
ES	https://www.idae.es/ayudas-y-financiacion/para-movilidad-y-vehiculos/programa-moves-iii Action 2: Deployment of electric vehicle recharging stations.
CY	Recharging station sponsorship scheme 'Electromobility with 1000'
IT	Charging station bonus for businesses and professionals | Ministry of the Environment and Energy Security
PT	Support for Chargers in Condominiums - Mobi.e

4.11. **Accessibility of recharging points**

Recital 51 states that the Member States should ensure access to recharging points for people with disabilities. This is also addressed in Article 14(2) of the Alternative Fuels Infrastructure Regulation, which requires Member states to report, in the context of their National Policy Frameworks, on measures they have taken to ensure that publicly accessible recharging and refuelling points for alternative fuels are accessible to older persons, persons with reduced mobility and persons with disabilities in accordance with the accessibility requirements of Directive (EU) 2019/882.

Guidelines on the accessibility of electric recharging infrastructure are currently being developed by the Sustainable Transport Forum.

5. **FIRE SAFETY IN CAR PARKS**

The following guidelines on fire safety have been adopted as required by Article 14(10). More information can be found in the guidance issued by the Sustainable Transport Forum on fire safety for electric vehicles and charging infrastructure in covered parking spaces [26].

[26] European Commission: Directorate-General for Mobility and Transport, *Guidance of fire safety for electric vehicles parked and charging infrastructure in covered parking spaces*, Publications Office of the European Union, 2025, https://data.europa.eu/doi/10.2832/6681178.

5.1. Challenges and risks

Recharging infrastructure for battery electric vehicles (BEVs) poses a number of risks in the following scenarios:

— installation is not performed in compliance with the applicable safety regulations;

— the installer lacks the proper qualifications to install BEV charging infrastructure;

— the electrical equipment used is unsuitable or unsafe;

— maintenance or inspections are not conducted properly;

— the charging infrastructure is vandalised.

5.1.1. *Challenges and risks for parking operators and building owners*

As BEVs become increasingly common on European roads, car park operators and building owners must prioritise fire safety when providing services such as parking facilities and recharging infrastructure for BEVs. A key concern for stakeholders is ensuring that both BEVs and internal combustion engine vehicles (ICEVs) can park safely, particularly in enclosed spaces beneath or adjacent to buildings. This is vital to ensuring public safety. Accommodating BEVs presents new challenges for parking operators and building owners, especially given the diversity in building construction and design. Establishing consistent fire safety standards for both new and existing structures is difficult, as some preventive measures are not feasible in existing buildings. The increasing size of both ICEVs and BEVs further exacerbates the issue, reducing available space and increasing the risk of fire spread and structural damage. Moreover, the use of proper recharging infrastructure is critical. In the absence of designated recharging stations, BEV drivers may resort to non-compliant equipment, which can significantly elevate fire risks ([27]). Addressing these challenges, along with implementing necessary fire prevention measures, places a financial burden on operators and building owners as they adapt to the evolving automotive landscape.

5.2. Maintaining high fire safety standards for BEVs in covered car parks

Maintaining fire safety in covered car parks is not simply a matter of selecting specific measures and equipment. Rather, it requires a combination of strategies to ensure an adequate level of safety. This section explores guidance for both preventing fires and managing them if they occur. It is important to emphasise that the measures required will differ between buildings designed for residential or public use and those intended solely for parking vehicles.

This section is structured around five key pillars, which represent the fundamental aspects to consider in relation to BEV safety when developing a fire safety strategy for covered car parks:

— prevention of fires;

— detection of fires;

— evacuation;

— propagation control;

— fire extinguishing.

In addition to these pillars, it is crucial for any building accommodating BEVs to conduct its own risk assessment. That assessment should take account of the specific types of vehicles, the recharging infrastructure in place, and the materials used within the parking area. Particular attention must be given to existing parking facilities, as it is existing facilities, rather than newly constructed ones, that account for the majority of current infrastructure. Local and regional authorities are therefore strongly encouraged to implement comprehensive fire risk assessments for existing covered parking facilities as these assessments play a vital role in ensuring user safety and minimising fire risks. By providing a detailed and objective analysis of current infrastructure, these assessments offer actionable recommendations for improving safety. They can also be used to help develop phased action plans tailored to the constraints of individual operators, enabling a systematic and effective approach to enhancing fire safety standards.

([27]) Hynynen et al., 2023.

5.2.1. *Fire prevention*

Fire prevention measures are critical to reduce the risk of ignition. When addressing fire prevention, three key aspects should be considered: access conditions to covered car parks, the design of recharging infrastructure and the materials used in car park construction.

5.2.1.1. *BEV access to covered car parks*

According to research findings ([28]), BEV fires do not occur more frequently than fires involving ICEVs. Therefore, restricting BEV access to covered parking facilities because of fire risk is neither logical nor beneficial. Such restrictions could hinder the uptake of BEVs. For these reasons, it is advisable to allow BEVs to park in covered parking areas. However, it is important to recognise that, like other vehicles, damaged BEVs pose a fire risk. To minimise potential hazards, it is advisable to prohibit severely damaged vehicles from parking in covered car parks.

In the event of flooding, especially when salt water is involved, BEVs should be evacuated from covered parking areas and stored outdoors for a few days. Owners and emergency responders should remain vigilant for signs of battery fires, such as vapour clouds resembling smoke (either dark or light) and unusual sounds such as hissing or hooting.

In the EU, harmonised product standards cover all safety requirements, including requirements for protection against fire risk, such as the use of non-flame propagating products for cable management systems.

In general, all recharging infrastructure must be safeguarded against mechanical damage caused by vehicles. This could be done by positioning it above ground level on a raised platform or protecting it with curbs, bollards or metal barriers, while ensuring the accessibility of recharging points. Additionally, the use of extension cables for BEV recharging in public areas should not be allowed.

5.2.1.2. *Fire-safe materials*

Fire-resistant construction materials should be used in covered car parks to enhance fire safety while garages should be kept free of all combustible materials and all general construction materials and must be sufficiently stable and mechanically strong. The French Building Code requires walls to be compartmentalised, with a fire-stop rating of one hour ([29]). Communications between the car park and other activities must be via a firewall with E30 doors ([30]).

5.2.2. *Fire detection*

Robust fire detection measures in car parks, including detectors, thermal cameras and video surveillance systems, significantly enhance fire safety. They enable early detection and identification of fires, thereby facilitating swift evacuation, limiting fire spread and helping firefighters to locate and extinguish fires effectively. Fire detectors, strategically placed throughout the car park, promptly detect smoke, heat or flames, initiating evacuation protocols and intervention measures. Thermal cameras detect temperature changes, identifying potential fire hotspots, while video surveillance systems provide visual confirmation of fire incidents, helping to verify the presence and location of fires quickly. Upon detection, automated alarm systems alert occupants, facilitating safe and efficient evacuation. Early detection and response help contain and suppress fire spread, mitigating damage and reducing the risk of secondary fires. Real-time monitoring and surveillance capabilities provided by video cameras enable firefighters to assess the situation remotely and plan their response accordingly. Thermal imaging technology assists in pinpointing the fire source and identifying potential hazards, helping to develop effective firefighting strategies.

In short, fire detection measures in car parks are indispensable for enhancing safety. By enabling early detection and response, these measures facilitate evacuation, limit fire spread and provide crucial support to firefighters, safeguarding lives and property.

([28]) Fire safety – electric vehicles and charging infrastructure, Sustainable Transport Forum.
([29]) French Building code: order of 25 June, 1980 completed by order of May 9, 2006.
([30]) French Building code: order of 25 June, 1980.

5.2.3. *Evacuation*

In covered car parks, the presence of various ventilation systems is paramount for evacuating smoke in the event of a vehicle fire. These systems are a critical element in providing individuals present in the car park with essential time to evacuate safely and enabling firefighters to intervene effectively at the scene of the fire. Different types of ventilation systems are utilised in covered car parks, each with its own unique capabilities and functionalities that are effective against BEV fires:

(a) Natural ventilation. Natural ventilation systems rely on passive airflow through openings such as vents, windows, or shafts to remove smoke and heat from the parking area. These systems leverage natural forces such as wind and thermal buoyancy to facilitate the movement of air, helping to dissipate smoke and maintain breathable conditions. These ventilation systems are common worldwide. They are typically designed to have an opening area of a specified size, for example 35% in Poland, and 1/20 of the floor area in the United Kingdom. For small fires (approximately 1,4 MW), open ventilation worked well in 86,31 % of cases. For larger fires (4 MW or 6 MW), this percentage fell to 38,79 % and 33,31 % respectively. In case of a fire representing the 95th percentile of vehicle fires (8,80 MW), the open ventilation produced a satisfactory outcome in 14,24 % of cases ([31]).

(b) Mechanical ventilation. Mechanical ventilation systems utilise fans or blowers to actively circulate air within the car park, facilitating the removal of smoke and pollutants. These systems can be configured with ductwork and exhaust fans strategically positioned throughout the parking area to ensure effective ventilation and smoke extraction.

(c) Smoke control systems. Smoke control systems are specifically designed to manage smoke in the event of a fire, typically incorporating both natural and mechanical ventilation components. These systems may include smoke detectors, smoke exhaust fans, and smoke barriers to contain and disperse smoke, preventing its accumulation in critical areas and aiding the safe evacuation of occupants.

In the event of a BEV fire, prompt activation of ventilation systems is crucial. These systems play a pivotal role in evacuating smoke from the covered car park, creating clear pathways for occupants to exit safely and providing visibility for emergency responders. By evacuating smoke and heat, ventilation systems buy precious time for evacuation procedures to unfold smoothly. They also enable firefighters to locate and address the fire swiftly, reducing the risk of further escalation and facilitating more effective fire suppression efforts.

In addition to the evacuation of smoke and heat, it is essential that safety lighting and signs are put in place in covered car parks to guide individuals to evacuation routes and to enable firefighters to combat the fire effectively. Instructions providing occupants and users with information adapted to their needs must be posted in sufficient numbers and in places where they are easy to read. These notices should include guidance for responding to fire emergencies. The instructions should also enable individuals to recognise the alarm signal and understand practical evacuation protocols and routes.

5.2.4. *Propagation control*

In enclosed car parks, maintaining fire safety for BEVs necessitates specific considerations. According to reports from the Research Institutes of Sweden (RISE) ([32]), key good practices to enhance fire safety include:

— increasing the distance between parked vehicles by having wider parking spaces;

— increasing the ceiling height of parking garages.

([31]) Research project OPUS19 No 2020/37/B/ST8/03839 'Wind effects on building fires in a multiparametric risk assessment with numerical modelling' funded by the Poland National Science Centre.

([32]) Hynynen et al., 2023.

In multi-level open car parks, there is the potential for fire to spread to another floor through the drainage system, particularly in liquid pool fires. These fires can arise from ruptures in petrol or diesel tanks due to external heating, and their extent depends on factors such as the amount of fuel, the incline of the flooring, and adjacent drains. The probability of fire spread in enclosed spaces is influenced by three primary factors [33]:

— the distance between parked vehicles;

— the materials used in vehicle manufacturing;

— the ceiling height of the enclosed space - lower ceilings heighten the risk of fire spread by increasing radiation from the ceiling towards vehicles and decrease the time available for evacuation, as that depends on smoke layering remaining above occupant head level for a certain period of time.

5.2.4.1. *Structural fire protection measures to limit propagation*

Using fire-resistant walls, doors and gates to separate fire compartments or fire dampers and bulkheads to separate BEVs from each other is essential to limit fire propagation, as it helps to protect ICEVs from the fire [34]. Separation means that the entire envelope of the vehicle or group of vehicles is located at a distance of at least 3 meters (outdoors) or 4.5 meters (indoors) from other vehicles or combustible materials, or is separated from them by E60 primary barriers extending from the floor to the ceiling, or a combination of both [35]. Moreover, covered car parks should ensure access for removal of BEVs in case of fire. To reduce the chance of the battery reigniting, the BEV that caught fire may need to be moved outside the covered car park for monitoring and further extinguishing [36]. Removing the vehicle is not the duty of the local fire and rescue service, so it might be necessary to arrange a contract with a car removal company. If this approach is chosen, the clear headroom of the car park must be considered, as it could restrict the types of recovery vehicles that can access the area [37].

5.2.4.2. *Technical fire protection measures to limit propagation*

Automatic fire protection systems play a crucial role in limiting the propagation of BEV fires in covered car parks. Sprinkler or mist systems are the main technologies considered by the existing EU regulation and recommendations to mitigate the potential impact of such fires.

Sprinkler

Sprinkler systems in covered car parks utilise heat-activated sprinkler heads connected to pressurised water pipes. Upon detecting elevated temperatures, the system releases water onto the heat source to suppress or extinguish the fire. Such systems are widely used for fire protection in enclosed car parks and can often be supplied directly from the water main. Sprinkler systems are also accepted by insurers as a mean to enable risk transfer.

Water mist

Another technical fire protection measure to limit propagation is water mist. Although it uses less water than a sprinkler system, it is usually more expensive for this purpose than sprinklers because it always needs a dedicated pump and tank. Water mist systems provide advanced fire suppression by dispersing fine water droplets at high pressure around a detected heat source. These droplets rapidly cool the fire, displace the oxygen and efficiently suppress the flames. The system can be triggered either by heat-sensitive nozzles or by other electronic detection apparatus such as smoke or temperature detectors. It is a suitable alternative to sprinkler systems, especially in existing garages where there may not be enough space for a sprinkler tank, as it involves less water and smaller pipe diameters.

[33] Hynynen et al.
[34] Technical guide 'Electric vehicle recharging installations' of the firemen of Barcelona.
[35] Technical guide 'Electric vehicle recharging installations' of the firemen of Barcelona.
[36] Technical guide 'Electric vehicle recharging installations' of the firemen of Barcelona.
[37] Technical guide 'Electric vehicle recharging installations' of the firemen of Barcelona.

Impact of automatic systems on fire protection

— Rapid fire suppression. Sprinkler and mist systems are designed to detect and respond to fires swiftly and are triggered by heat-sensitive nozzles or other electronic detection apparatus, such as smoke or temperature detectors. These systems will act to provide early warning to occupants and alert emergency responders to the incident. When activated, the system releases water directly onto the fire source, helping to suppress the flames and prevent the fire from spreading further. These systems cannot extinguish battery fires but could reduce or mitigate fire propagation.

— Cooling effect. BEV fires often involve high temperatures generated by the vehicle battery packs. Sprinklers and mist systems can provide a cooling effect by dispersing water onto the heat source, thereby reducing its surface temperature. At the same time, the dispersion of water droplets in the atmosphere surrounding the heat source contains the thermal radiation around the car on fire. Hence, automatic extinguishing systems can prevent fire spread from the first vehicle to other vehicles and reduce the overall heat increase in the garage. A single car on fire, burning in a controlled manner and without damage to the car park structure, is much more manageable for the fire service.

— Protection of surrounding areas. Sprinkler or water mist systems are typically installed throughout a building or facility, including in areas adjacent to car parks or garages. By suppressing fires in their early stages, these systems help prevent fires in other areas from spreading to vehicles, structures, or other combustible materials in the car park.

— Reducing toxic fumes. BEV fires can release toxic fumes and gases, posing risks to occupants and emergency responders. By quickly extinguishing the fire, automatic systems help mitigate the release of harmful substances, while the water droplets dispersed in the area around the fire source are able to capture water-soluble gases. These systems therefore improve safety for individuals in the vicinity and for emergency personnel.

Automatic extinguishing systems are highly effective fire protection measures that can significantly reduce the impact of all types of vehicle fires by swiftly suppressing flames, cooling heat sources, and limiting the spread of fire and smoke. Their ability to operate automatically and provide continuous protection makes them invaluable assets in safeguarding property and preserving life in the event of an emergency.

5.2.5. *Fire extinguishing*

It is important for emergency responders to develop a firefighting strategy, whether offensive or defensive, immediately upon arrival. According to the ‘Guidelines for fire and rescue services’ published by the Norwegian Directorate for Civil Protection in 2021, there are four levels of risk for fires in lithium-ion batteries. BEV fires in covered parking areas correspond to level 3 ‘medium to high risk’. Extinguishing, containing and suppressing such a fire will require appropriate expertise in the form of training in battery fires.

Another important aspect when it comes to determining how to combat a BEV fire is the risk of a hydrogen gas cloud explosion. The total amount of vent gas formed during battery thermal runaway can be estimated at from 0,6 to around 3,5 l/Ah. The gaseous hydrogen concentration in the gas mixture could be around 25 % of the total gas released. If the hydrogen content explodes in a confined space, the peak blast wave overpressure would end up being between 14 and 20 kPa at 20-50 m distance and is a function of the distance from the cloud centre for various quantities of hydrogen mixed with air. Liquid fuels such as petrol and diesel are more likely than alternative fuels to initiate a fire or contribute to it at an early stage, for example liquid pool fires.

As regards possible reignition of a battery, if a high-voltage battery is damaged, energy may remain inside any undamaged battery modules and cells, with no path to discharge it. That stranded energy can cause a high-voltage battery to reignite multiple times after firefighters extinguish an electric vehicle fire. Emergency responders have no way of measuring how much energy remains in a damaged battery, and no way of draining that energy, other than time-consuming methods such as allowing a battery fire to burn itself out. Engineers or other specialists can use the battery management system to check for remaining voltage if the system is operational, and some batteries have built-in discharge ports, which can also be used by specialists. However, the high-voltage battery system may be damaged, preventing access to the battery management system or to the discharge ports ([38]).

A (non-exhaustive) list of the methods currently used by firefighters is provided below.

(1) Different kinds of blankets are used to cover a fire source in order to stop the fire spreading to surrounding vehicles or infrastructure.

(2) Water or other standard agents are used for electric vehicle fires. Water does not pose an electrical hazard to firefighters in a BEV fire, but recharging equipment does.

(3) Sprinkler systems are used to help limit the spread of the fire, reduce its temperature, reduce the amount of smoke and slow the development of the fire until the fire department can intervene. Moreover, if the fire started somewhere other than the battery, the sprinkler system might even extinguish it.

When handling BEV fires, firefighters must always use full safety clothing with respirators. For firefighters, skin absorption will therefore be the only way that they can be exposed to hydrogen fluoride (HF). If the gas mixture from a BEV fire is below the lower explosive limit, there will not be a sufficient concentration of HF to pose a significant risk to firefighters. If firefighters have the gas mixture under control below the lower explosive limit, then the HF gases are also likely to be under control. Normal firefighting clothing will in most cases offer good protection against HF. In the event of an extended exposure in spaces with poor ventilation, a splash suit can be used as an extra barrier ([39]).

5.3. Recommendations for industry and business stakeholders

— **Emergency planning**. Businesses should implement comprehensive fire emergency plans for all covered parking facilities.

— **Signage**. Recharging station areas in car parks must have visible and appropriate signage.

— **Staff training and emergency response**. Security personnel and other staff should be informed of the location of recharging areas, power isolation procedures, and alarm activation steps. Staff must be trained to safely operate vehicle chargers and must report damaged equipment promptly. Defective chargers should be isolated, marked with warning notices and updated as ‘offline’ in the relevant apps.

— **Fire risk management**. Car parks should not store combustible materials or flammable products or allow refuelling of vehicles, smoking or open flames.

— **Measures to consider when installing recharging infrastructure.**

  — **Location.** Install recharging stations near the entrance or exit of underground garages to facilitate quick access for emergency responders.

  — **Qualified installation.** To comply with legal and technical standards, only specialised, registered electricians should install charging devices and associated power supplies. Non-compliant installation may void insurance coverage.

([38]) Hynynen et al., 2023.
([39]) *Guidelines for Fire and Rescue Services: Risk Assessment and Handling of Fire in Lithium-Ion Batteries*, 2021.

- **Protection and safety.**
  - Protect charging stations from collisions or mechanical damage.
  - Ensure compliance with the following minimum standards:
    - power supply via a central distribution unit, with overcurrent protection and residual current circuit breakers for each charging point;
    - emergency shutdown buttons installed in secure, accessible locations;
    - surge protection;
    - chargers mounted on non-combustible surfaces;
    - clearly labelled kill switches and circuit breakers.

— **Measures to consider for damage prevention**

- **Fire alarms and sprinklers**. Install automatic fire alarms and sprinkler or water mist systems to enhance safety, particularly given the flammability of modern vehicle materials.
- **Emergency shutdowns**. Equip parking facilities with automatic and manual emergency shutdown systems for all chargers, operable from a central location such as a fire alarm centre.
- **Minimise combustible materials**. Limit flammable materials or critical infrastructure near charging stations. Walls should have adequate fire resistance (minimum two hours), and passive barriers should be installed to contain fire.
- **Risk modelling**. Recharging infrastructure manufacturers should enhance risk modelling and battery performance monitoring to mitigate potential hazards.

— **Measures concerning standardisation and certification**

- **Infrastructure standardisation**. Increased standardisation can improve accessibility and reliability of EV recharging infrastructure.
- **Equipment certification**. Certification of recharging equipment can enhance reliability and safety for public use.

5.4. Recommendations for BEV users

- Users of BEVs have a responsibility as well, and they can play their part by treating the devices and cables with care and preventing damage by not crushing, shearing, or driving over cables.
- Users should consult the user manual for instructions on battery charging (voltage, current, maximum charging times, etc.).
- Users should also frequently check the charging cables and charging devices for damage, for instance by carrying out a visual inspection each time before charging. Defective connectors and cables should be replaced immediately.
- Only charging cables approved by the manufacturers and specifically intended for charging electric vehicles may be used. Standard household extension cables, multiple socket strips, or charging adapters cannot be used for recharging BEVs.
- Electric vehicles which have been damaged, exposed to fire or submerged or which are under recall or may have a damaged battery could pose a particular fire hazard and should therefore never be parked in any parking structure.
- Having a system in place that alerts in case of overload of the power cable connected to the wall-charger could help prevent fires.

5.5. **Recommendations for firefighters**

— When fighting a vehicle fire, firefighters may use different kinds of blankets to cover the fire source to mitigate fire propagation.

— Firefighters may use towing equipment to move a vehicle into the open air to monitor it in case of thermal runaway. However, potential re-ignition of high voltage batteries cannot be excluded.

— Maintaining a safe distance, using 1 000-volt gloves near batteries and high-voltage circuits, is crucial because physical damage and fires can lead to the potential exposure of live components.

— Water or other standard agents may be used for BEV fires. Using a high volume of water is one of the solutions for cooling down high-voltage batteries. Water does not pose an electrical hazard to firefighters in an electric vehicle fire. In a safe scenario and after a risk assessment, a vehicle may be moved outside a parking area and possibly submerged in a big (portable) container of water (cooling is the best way to control a fire) if other extinguishing methods were not effective.

5.6. **Recommendations for public authorities**

— It is recommended that local and regional authorities strongly encourage fire risk assessments for existing infrastructure to ensure a high level of safety for users and minimise the risk of fire.

— These assessments provide an in-depth, objective analysis of existing facilities and make recommendations for improving safety. They make it possible to draw up progressive action plans tailored to operators' constraints, in order to raise safety levels in a structured and effective way.

— Public authorities can help ensure that there are enough fully qualified individuals capable of correctly installing charging points. They can invest in training unemployed workers to be able to meet the booming demand or they can invest in and promote the traditional education system and seek to attract more students.

— Public authorities should better regulate and enforce the fire safety requirements for enclosures, plugs, and sockets used in BEV recharging infrastructure by raising the minimum fire safety/flammability standards. They should also introduce fire safety requirements and tests to address new fire safety challenges for electric powertrains and Li-ion batteries.

ANNEX 10

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU)2024/1275

Technical building systems, indoor environmental quality and inspections (Articles 13, 23 and 24)

TABLE OF CONTENTS

1. INTRODUCTION

The recast Energy Performance of Buildings Directive (the 'recast EPBD') ([1]) includes new provisions on the requirements for technical building systems, some of which are addressed in this document.

This document provides guidance on how to interpret and transpose the recast EPBD, particularly those provisions that concern technical building systems, indoor environmental quality and inspections. The recast EPBD extends the scope and requirements regarding the regular inspection of technical building systems and groups the provisions together under one individual article. In addition, a new inspection scheme – or alternative measures – is introduced in Article 23(8). That scheme is aimed at certifying that the construction and renovation works delivered meet the designed energy performance and are compliant with the minimum energy performance requirements laid down in the building codes or equivalent regulations. This document will set out certain minimum elements of interpretation.

A definition of 'indoor environmental quality' (IEQ) is introduced in Article 2(66), and multiple references are made throughout the text to reflect that new concept, including within the scope of the legal text. This document provides practical information and technical background as well as elements of interpretation of various provisions regarding IEQ to support Member States in transposing the definition, addressing IEQ issues in new and existing buildings, and establishing requirements to install measuring and control devices to monitor and regulate indoor air quality in line with Article 13(5).

2. TECHNICAL BUILDING SYSTEMS

2.1. Extension of the definition of 'technical building system'

The obligations arising from Article 13 apply to technical building systems as defined in Article 2(6). According to this definition, the term 'technical building system' means technical equipment of a building or building unit for space heating, space cooling, ventilation, domestic hot water, built-in lighting, building automation and control, on-site renewable energy generation and energy storage, or a combination thereof, including those systems using energy from renewable sources. The recast EPBD updates the definition of 'technical building system' by altering the wording for the system for 'on-site electricity generation' in order to extend its scope (now 'on-site renewable energy generation') and by extending it to include 'energy storage' ([2]).

2.1.1. *On-site renewable energy generation*

'On-site renewable energy generation' generally refers to the production of energy from renewable sources such as ambient air, solar, wind, hydro, biomass, and geothermal directly at the place where the energy is consumed, as opposed to being produced off-site and transported via the electricity grid or by other means. Under the previous EPBD, the term 'on-site electricity generation systems' was used, referring to systems which are designed to produce electricity, are installed in or within the confined boundaries of the premises where the building is located, and which are to some degree integrated into the building and its electrical installation. Those systems include, in particular, photovoltaic (PV) panels (e.g. roof-mounted PV panels), micro combined heat and power (CHP) installations based on renewables (e.g. bioenergy, solar) and small wind turbines ([3]).

The term 'on-site renewable energy generation' used in the recast EPBD is widened to also include thermal generation systems, the main target being solar thermal ([4]).

In this context, combustion boilers based on renewable fuels and biomass heating systems are considered to be heating systems and therefore are considered to be technical building systems. They both fall under the general provisions for technical building systems and the specific provisions for heating systems.

([1]) Directive (EU) 2024/1275.

([2]) Recital 36 of the recast EPBD mentions that the electrification of buildings, such as through the deployment of heat pumps, solar installations, batteries and recharging infrastructure, changes the risks with regard to the fire safety of buildings, which Member States need to address. To this effect, stand-alone guidance on fire safety related to the electrification and renovation of buildings will be provided.

([3]) Commission Recommendations on building modernisation (7 June 2019).

([4]) Note that the capacity and benefits of on-site renewable energy generation will be evaluated separately in EPC (Annex I, Annex V) and Smart Readiness (Annex IV) of the recast EPBD.

Heat pumps, aquifer thermal storage systems (ATES) and geothermal systems are considered to be heating systems (and, where relevant, also cooling systems) and system requirements should be set under these. On-site renewable generation systems, also in combination with other technical building systems (e.g. energy storage, heating and cooling systems), are relevant in terms of a building's capacity to react to external signals and adapt its energy generation (see also section 2.7 of this Guidance).

2.1.2. *Energy storage*

Energy storage, particularly 'behind the meter', can help consumers, from households to industries, maximise self-consumption of self-produced renewable energy and adapt their energy consumption to price signals from the grid, making it possible for those consumers to reduce their energy bills ([5]). Energy storage can also be used to provide flexibility to the grid. Energy storage involves various technologies, and can be sorted in five categories: mechanical, electromechanical, electrical, chemical and thermal ([6]).

With regard to energy storage ([7]) the main targets are electrical storage systems, such as on-site building batteries and bi-directional recharging infrastructure for electrical vehicles ([8]), and thermal storage systems, such as solar thermal energy storage, energy storage tanks for heating and cooling systems and ATES.

System requirements for solar thermal storage systems for everyday use should not be considered alone, but in combination with the system requirements for solar thermal systems. System requirements for energy storage tanks, in combination with heat pumps and ATES, are set under the requirements for the heating or cooling system as a whole.

If relevant to ensure capacity to react to external signals (discussed in section 2.7) and, more generally, to demand-side flexibility and seasonal storage, Member States should update these system requirements for energy storage systems ([9]), ([10]), (see also Table 1).

Domestic hot water tanks may to some extent be considered as energy storage. Buildings thermal mass and thermally activated building structures (TABS) ([11]) are in this context not considered as energy storage but may be considered under section 2.7, for their relevance towards the capacity of a building to react to external signals.

Article 13(6) requires Member States to promote energy storage for renewable energy in buildings, which means that they will need to put in place measures to support it (e.g. through financing measures, provision of training and advice to professionals and inspectors, including through one-stop-shops) ([12]).

2.2. **Setting of system requirements**

For newly introduced technical building systems, which were not covered by the EPBD before the recast, Member States will have to define and lay down system requirements at national level and ensure that those requirements cover all of the aspects referred to in Article 13(1) of the recast EPBD.

([5]) European Commission. Energy Storage – Underpinning a Decarbonised and Secure EU Energy System. Commission Staff Working Document SWD(2023) 57 final, 14 Mar. 2023.
([6]) Directorate-General for Energy. Study on energy storage – Contribution to the security of the electricity supply in Europe (2020). https://energy.ec.europa.eu/publications/study-energy-storage_en.
([7]) Annex I(5) to the recast EPBD specifically states that the positive influence of electrical (e) and thermal (f) storage systems should be considered in the calculation of the energy performance of buildings.
([8]) Mentioned in Recital 49 and 52, 'bi-directional recharging' is defined in Article 2(38) and means bi-directional recharging as defined in Article 2(11) of Regulation (EU) 2023/1804.
([9]) Note that the capacity and benefits of energy storage will be evaluated separately in EPC (Annex I, Annex V) and Smart Readiness (Annex IV) of the recast EPBD.
([10]) Relevant parameters for energy storage could be storage capacity (e.g. kWh), charge/discharge power rating (e.g. kW), depth of discharge, losses during storage, durability (e.g. number of possible charges), system efficiency, response time, or material specific properties. For thermal storage, for example, the temperature range can be a relevant parameter.
([11]) TABS is an embedded water-based surface heating and cooling system, where the pipe is embedded in the central concrete core of a building's construction.
([12]) For examples of ways to increase the uptake of energy storage, see the work cited in footnote 5.

Table 1 indicates the meaning of each of these aspects, giving examples (for illustration purposes only) for the expanded and new types of systems that have been added to the list of technical building systems in the recast EPBD. System requirements are set when technical building systems are installed, replaced or upgraded.

New elements were introduced in Article 13(1) to ensure that, when setting system requirements, Member States give sufficient consideration to energy-saving technologies.

Recital 16 mentions energy-saving technologies with very short payback periods, e.g. thermostatic control valves or heat recovery from exhaust air or wastewater. Energy performance requirements for technical building systems should apply to whole systems, as installed in buildings, and not to the performance of stand-alone components, falling under the scope of product-specific regulations.

Other examples of energy-saving technologies that may be considered can be at technical system level e.g. control systems together with sufficient monitoring devices, appropriate ability to control heating, cooling and ventilation systems, and suitable zoning.

New elements introduced also include hydronic balancing, described in Chapter 2.3.

When setting requirements, Member States must also take account of design conditions and typical or average operating conditions, thereby ensuring that the system can perform efficiently and effectively under all representative conditions. Examples of this would be requirements when designing variable air volume ventilation systems and cooling systems, ensuring that valves in heating and cooling distribution systems are dimensioned for lower flow conditions, and that BACSs are designed and optimised for the full range of operating scenarios, including sufficient monitoring devices and benchmarking.

Reference to energy saving technologies that can optimize the performance of technical building systems under typical or average operating conditions is also made in relation to the inspections, in Article 23(4).

Table 1

Different system requirements areas

Type of requirement	Refers to	Example	
		On-site renewable energy generation	Energy storage
'overall energy performance'	The performance of the system as a whole (not to be confused with the performance at product or component level and the performance of the whole building)	System performance factor of a photovoltaic (PV) system or a solar thermal system (e.g. according to standard EN 15316-4-3)	System performance depending on functionality, i.e. peak shaving (security of supply) and back-up power (ability to operate critical systems)
'appropriate dimensioning'	The appropriateness of the system size or capacity given the needs and characteristics of the building under expected use conditions	Determine the optimal size of the solar system based on energy cost reduction, available mounting area, control and other constraints that could apply. For thermal solar additionally storage capabilities.	Determine optimal size of the electric or thermal energy storage based on capacity, duty cycle, recovery time, service life, and cost optimization.

Type of requirement	Refers to	Example	
		On-site renewable energy generation	Energy storage
'proper installation'	The way the system should be installed in the building in order to operate properly	Installation by a trained and/or certified installer.	Installation by a trained and/or certified installer (e.g. IEC 62933-2-1 for electrical and e.g. EN 12977-1 and 12977-5 for solar water heater storage).
'appropriate adjustment'	Testing and fine-tuning actions on the system, once installed, under real usage conditions	Sequence of tests to be performed after installation to check that the system operates in accordance with its specifications. System is hydronically balanced.	Sequence of tests to be performed after installation to check that the system operates in accordance with its specifications (e.g. IEC 62933-2-1 for electrical storage and EN 12977-3 for solar water heater storage). System is hydronically balanced.
'appropriate control'	Desired or required control capabilities of systems	(Where applicable) control of electrical or thermal feed (e.g. to grid, self-consumption or storage). Capacity to react to external signals and adapt its energy generation.	Optimize for peak-shaving, cost, or both. Capacity to react to external signals and adapt its energy storage.

2.3. **Hydronic balancing**

The recast EPBD refers to hydronic balancing in: Article 13(1), in relation to the requirements for technical building systems installed in new and existing buildings; in Article 13(3), in relation to existing buildings when heat generators or cooling generators are replaced; in Article 13(11)(b), in relation to control functionality requirements in residential buildings that are new or undergoing major renovation; and in Article 23(4), detailing the requirements of inspections.

2.3.1. *Requirements for hydronic balancing for Technical Building Systems*

The requirements for technical building systems cover hydronic systems (i.e. systems making use of water, steam or a water solution – such as glycol with water – as a heat-transfer medium) for space heating, space cooling and domestic hot water. Balancing requirements are equally relevant for airborne ventilation systems, but in this context, it would only be the associated hydronic parts, such as heating and cooling coils, zone heating or cooling surfaces, etc. Recital 12 states that system balancing is one of the factors that play an increasingly significant role in the energy performance of buildings. Hydronic balancing ensures that the flow ([13]) in a building's hydronic heating or cooling network is distributed correctly, so that enough heating or cooling energy is supplied to all emitters and spaces in a building. A non-balanced system may result in inadequate functionality, insufficient comfort and increased energy use.

([13]) Hydronic systems also include steam systems for space heating.

For systems with small pressure differences, such as a single-family house, static balancing is more typically used. Dynamic balancing is typically used in systems with larger pressure differences and varying loads, for example in a large office building of a significant horizontal spread and with more storeys, where the differential pressure between the first and last vertical shaft is significant ([14]).

Article 13(1) provides that Member States must, where appropriate (i.e. in hydronic systems), set system requirements in respect of the hydronic balancing of the relevant technical building system when it is installed in new or existing buildings, in new buildings, in existing buildings when heat generators or cooling generators are replaced, and in new residential buildings and residential buildings undergoing major renovations.

As regards hydronic balancing, system requirements should achieve at least Level 2 or higher in Table 2. Higher-level requirements for larger buildings are recommended, where appropriate. For single-family houses (SFH), the hydronic balancing requirements would be those achieving at least Level 1 or higher in Table 2.

Table 2

Example of requirements for hydronic balancing of technical building systems. Requirements are based on EN ISO 52120, Table 5, M3-6 and M4-6

Level	Type of requirement - Space heating and space cooling
0	No balancing
1	Balanced statically per emitter, without group balance
2	Balanced statically per emitter, and a static group balance (e.g. with balancing valve)
3	Balanced statically per emitter and dynamic group balance (e.g. with differential pressure control)
4	Balanced dynamically per emitter (e.g. differential pressure controllers)

The appropriate design for hydronic balancing will generally require correct calculation of heat loss, correct dimensioning of emitters, adequate sizing of valves, correct system build-up, correct flows, temperatures, pressure losses and distribution, a sufficient possibility for measurement and control of flow and pressure in the system, and that the differential pressure between emitters is not too large. The appropriate verification of hydronic balancing for construction and renovation works delivered will generally require correct design specifications, flow and temperature testing, flushing, venting and complete documentation of the tests.

2.3.2. *Requirements for hydronic balancing in Inspections*

Article 23(4) states that inspections must include an assessment of hydronic balancing systems. As the verification of hydronic balancing systems usually requires the correct design documentation, the appropriate test conditions, multiple tests and readings of pressure, flow and temperature and verification with design conditions, it may be too costly to include this work within an inspection. An assessment of hydronic balancing systems could therefore include verification of whether hydronic balancing has been performed recently and there is sufficient documentation of it, combined with spot checks of temperatures, pressures and flows in the distribution system. In practice, hydronic balancing is often complex to monitor.

([14]) Static balancing usually involves setting the flow rates and adjusting the valves in the system during verification of design conditions. Dynamic balancing is based on automatic pressure independent valves and controls to adjust the flow dynamically in response to changes in system demand and part loads. In practice many systems are a combination of static and dynamic balancing. Care should generally be taken to ensure unintentional hydronic pressure oscillation between dynamic components and pumps.

2.4. **Requirements for low-temperature heating systems**

The recast EPBD refers to low-temperature heating systems and/or more efficient temperature settings in Article 5(1) on setting of minimum energy performance requirements, Article 13(2) on technical building systems, Article 19(8) on energy performance certificates and Article 23(4) on inspections, as shown in Table 3.

Low-temperature heating systems are generally required to ensure sufficient efficiency of heat pumps, low-temperature district heating, renewable energy systems and other systems where a low temperature is required, and to reduce distribution losses. However, in many conventional systems there is also a potential to lower the system temperature.

Low-temperature heat emitters will have surface temperatures that are closer to room temperatures than conventional systems and will therefore often require larger emitter surface areas in order to provide the same heat output, i.e. larger radiators or convectors, or the use of floor-heating.

Table 3

Provisions on low-temperature heating systems

Article reference	Requirements in Articles
Article 5(1) Setting of minimum energy performance requirements	Member States may set the requirements for building elements at a level that would facilitate the effective installation of low temperature heating systems in renovated buildings, when setting minimum energy performance requirements. Generally, when setting requirements, Member States may differentiate between new and existing buildings and between different categories of building.
Article 13(2) Technical building systems	Member States may set specific system requirements for technical building systems in order to facilitate the effective installation and operation of low temperature heating systems in new or renovated buildings.
Article 19(8) Energy performance certificates	The recommendations in the EPCs shall include an assessment of whether the heating systems, ventilation systems, air-conditioning systems and domestic hot-water systems can be adapted to operate at more efficient temperature settings, such as low temperature emitters for water based heating systems, including the required design of thermal power output and temperature and flow requirements.
Article 23(4) Inspections	Where relevant, inspections shall assess the feasibility of the system to operate under different and more efficient temperature settings, such as at low temperature for water-based heating systems, including via the design of thermal power output and temperature and flow requirements, while ensuring the safe operation of the system. Additionally, where no changes have been made to the system or to the requirements of the building following an inspection, Member States may choose not to require the assessment of main component sizing or the assessment of operation under different temperatures to be repeated.

Low-temperature heating systems generally require an adequately insulated building with sufficiently low heat losses, and sufficiently large heat emitters. New residential buildings that apply floor and wall heating type emitters can have a system design temperature of 35 °C, due to low heat loss and large heating surfaces. By insulating a building or upgrading its windows, the heat loss will be lower, and the existing radiators can operate at lower temperatures. However, in many existing buildings there is already a potential to decrease the supply temperature to a certain degree.

In order to characterise the temperature settings of an existing heating system, the following parameters should be applied:

1. System design temperature ([15]),

2. Seasonal average system temperature, supply and return temperature ([16]).

([15]) This value for a heating system in an existing building or building unit upgraded in terms of thermal insulation, can be estimated by assessing the heat load (after the upgrade) versus the installed emitters capacity.
([16]) These parameters can be calculated based on the first parameter, using additional information on the minimum capacity of the generator, the climate zone and the flow in the distribution system.

Table 4

Examples of space heating design temperatures with heat pumps or district heating systems. Requirements will typically be higher for domestic hot water systems, which may require additional heating capacity

System	Main relevant characteristics
Heat pump	Space heating design temperatures preferably below 40 °C (and not above 50 °C), and low temperature differences < 5 °C between supply and return temperature, requiring larger water flow rates.
District heating system	Space heating design temperatures at 60 °C and requirement of low return temperatures of typically not more than 40 °C, requiring high temperatures differences of 20-30 °C. This will often require lower water flow rates ([17]).

Other relevant parameters that Member States may set to facilitate the effective installation and operation of low-temperature heating systems may concern emitter types and sizes, the pipe distribution system of the building, and the characteristics and requirements of the generator. As a system converted to lower temperatures with the same emitter sizes may be slower to reheat, this should be given special consideration. Indoor comfort considerations should also be taken into account: e.g. there may be a higher draught risk from a poorly insulated window when the emitter below operates at lower temperatures, and the risk of higher relative humidity levels in areas that previously operated at higher temperatures should also be considered.

It may generally be considered technically and economically feasible to design for low-temperature regimes (see Table 5) in new buildings. When renovating existing buildings, it is usually technically and economically more feasible to design for medium temperature regimes. For heat emitters with large areas, such as floor heating, it is considered technically and economically feasible to design for low-temperature heating systems. Lower temperature regimes can be achieved depending on the characteristics of the building, the heat generator (e.g. a heat pump) and the heat emitters (e.g. floor heating).

The guidance on energy performance certificates and independent control systems in Annex 3 to this Commission Notice on Energy performance certificates (Articles 19-21, Annexes V) and independent control systems (Annex VI) also addresses low-temperature heating systems at section 4.4. Revha Guidebook No 7 provides further examples of these systems ([18]).

Table 5

Temperature regimes for low-temperature heating systems

Medium-temperature regime	Term to be used for a heating system that achieves a system design temperature of ≤ 55 °C. This should make it possible to achieve a seasonal average system temperature of ≤ 50 °C. This regime allows for the operation of boilers in condensing mode (those that allow it) and for heat pumps to operate at fairly efficient levels.
Low-temperature regime	Term to be used for a heating system that achieves a system design temperature of ≤ 45 °C. This should make it possible to achieve a seasonal average system temperature of ≤ 42 °C. This regime allows for the operation of boilers in condensing mode (those that allow for it) and for heat pumps to operate at far more efficient levels.

([17]) Note that in newer, well-insulated buildings with low heat losses, the heat loss in a given emitter can often be so low that the designated valve may not be able to operate properly, leading to imbalances in the system. This will therefore often require lowering of the supply temperature to obtain sufficiently high flow rates and to obtain a system that can be hydronically balanced.

([18]) Babiak, J. (ed), Olesen, B.W., Petras, D., Low temperature heating and high temperature cooling – Embedded Water based surface heating and cooling systems, Rehva Guidebook No 7.

2.5. **Building automation and control systems for non-residential buildings**

Directive 2010/31/EU as amended by Directive (EU) 2018/844 (the '2018 amended EPBD') ([19]), Articles 14(4) and 15(4) referred to 2025 as the year by which non-residential buildings, with an effective rated output for heating systems, air-conditioning systems, systems for combined space heating and ventilation, or systems for combined air conditioning and ventilation of over 290 kW ([20]), must be equipped with building automation and control systems (BACS) meeting the conditions laid down in those Articles. The requirements ensuring installation were required to be transposed by the 10 March 2020. The provisions should therefore already have been transposed.

In the recast EPBD, these provisions have now been grouped under Article 13(9) and (10), and the limit date for BACS installation is now more clearly indicated as 31 December 2024. The transposition of the existing BACS functionalities, detailed in the recast EPBD in Article 13(10)(a) to (c), will not be revisited. In addition, a lower threshold of 70 kW for the installation of BACS is introduced as of 31 December 2029. Note that the threshold for BACS is calculated in a different way than the threshold for inspections, as it is based on the effective rated output for heating systems, air-conditioning systems, systems for combined space heating and ventilation, or systems for combined air conditioning and ventilation. As in the amended EPBD of 2018, BACS requirements must be complied with if either the heating or cooling generator rated outputs (separately) reach the threshold identified.

Member States must ensure that BACS installed in non-residential buildings in line with Article 13(9) and (10) have the listed capabilities at least for the following technical building systems: heating systems, air-conditioning systems, combined heating and ventilation systems, combined air-conditioning and ventilation systems.

The BACS capabilities required under Article 13(10)(a) to (c) could correspond to B-class BACS under standard EN 52120-1 ([21]). If individual components of the system are replaced, the requirements should be fulfilled for these. Member States are encouraged to provide professionals with the appropriate technical guidelines to help them assess the BACS capabilities, identify potential gaps, and provide recommendations on how to fill those gaps effectively. This assessment may be done according to the EN 52120-1.

The new functionality of indoor environmental quality (IEQ) monitoring, introduced in Article 13(10)(d) of the recast EPBD, will be described in detail in section 3.2 of this document and will become mandatory as of the transposition date (29 May 2026). These new BACS capabilities should at least conform to Class B of EN 52120-1. This means that non-residential buildings that, according to Article 13(9)(a), must be equipped, where technically and economically feasible, with the capabilities in Article 13(10)(a) to (c) by 31 December 2024, will also need to be equipped, where technically and economically feasible, with IEQ monitoring by 29 May 2026. IEQ monitoring means continuous measuring of parameters in spaces designed for human occupancy and, e.g., it can be implemented with integrated sensors in HVAC systems or via centralised BACSs.

A sub-system may be considered sufficient to meet one or more of the requirements of Article 13(10)(a) to (d), if the individual BACS components – also called function blocks or programmable control units – allow for data exchange and interoperability. For example, the capability of monitoring IEQ can be ensured by components of the ventilation system that in turn will need to be interoperable with the main BACS.

When installing a BACS, that system must enable communication between interconnected technical building systems and other appliances within the building and it must be able to be operated together with other types of technical building system, even of different proprietary technologies, devices and manufacturers. This also applies where individual components of the system are being replaced.

([19]) Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings as amended by Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018.

([20]) Systems that serve non-EPB uses (e.g. providing hot water for industrial processes or refrigeration for fridges and storage rooms) should not be considered in the calculation of the effective rated output. For a system that serves both an EPB and a non-EPB use (e.g. a boiler of a hotel providing heating, domestic hot water and hot water for industrial washing machines), the power threshold may be identified based on the assessment of the part of the system that is serving EPB-uses.

([21]) Replacing EN 15232-1. Class B was also mentioned in the Commission Recommendations on building modernisation (7 June 2019). For further information refer to EN ISO 52120-1 chapters 5.4, 5.5 and 5.6 including Tables 5 and 6. Some individual requirements for Class B in Table 6 may not be technically or economically feasible for a specific project, and may therefore be omitted, if documented.

Two distinct ways of addressing the economic feasibility of BACS requirements can be found in the relevant legislation in France ([22]) and in Germany ([23]).

2.6. Monitoring and control functionalities in residential buildings

The installation of electronic monitoring and effective control functionalities in residential buildings can lead to significant energy savings, improve the management of the indoor environment and be beneficial to building owners and users. This is particularly the case in large buildings, where access to system controls and system information is limited for most users.

According to Article 13(11), Member States must establish requirements to ensure that, where technically, economically and functionally feasible, residential buildings are equipped with electronic monitoring and control functionalities. This measure was previously voluntary, so Member States could decide whether or not to establish those requirements for residential buildings.

Article 13(11)(a) concerns the provision of continuous electronic monitoring. Systems that do this measure energy consumption and use it to calculate system performance, which should be made available to the system owner or manager. If system performance falls significantly or if there is a service need, the system notifies the system owner or manager. The system should operate continuously, as opposed to periodically (e.g. every three months). Article 13(11)(b) concerns the provision of effective control functionalities to ensure optimum generation, distribution, storage and use of energy and, where applicable, hydronic balance. These control functionalities should take into consideration the scenario of a multi-apartment building with a single heating system, where individual users are only able to control the system within the boundaries of their building unit.

Member States that have transposed the corresponding provisions in the 2018 amended EPBD (Articles 14(5)(a) and (b), 15(5)(a) and (b)) will need to ensure that, where relevant, hydronic balancing (see section 2.3) is included among the effective control functionalities in their transposition measures and that the functionality c), capacity to react to external signals and adjust the energy consumption, described in further detail in section 2.7, is introduced. Article 13(11) does not include details on thresholds for effective rated output and covers all residential buildings regardless of their size.

It is recommended that Member States take into account the differences in system and building type when setting requirements. In addition, Member States are encouraged to provide professionals with the appropriate technical guidelines.

Standard EN ISO 52120 introduces a list of capabilities for residential buildings ([24]). To transpose the provisions under Article 13(11)(a) and (b), Member States could require buildings to meet Class B for part 7. Technical home and building management requirements. For Single-Family Houses undergoing major renovations, Member States could require to meet Class B or C for different segments of part 7. Technical Home and building management requirements, as shown in Table 6. Not all requirements are relevant in all cases: e.g. the requirements in point 7.4 (local energy production and renewable energies) are only relevant if local generation of renewable energy is present after the major renovation or construction of the building. For Article 13(11)(c), in addition to point 7.7 of Table 6, the requirements are discussed in section 2.7. Rehva Guidebook 29 ([25]) provides additional definitions and advice for technical monitoring.

Article 13(11) also introduces the possibility for Member States to exclude single-family houses undergoing major renovations from these monitoring and control functionalities, where the costs of installation exceed the benefits. This paragraph provides for a specific exclusion for specific sub-categories of single-family houses where the cost-benefit

([22]) In the Décret No 2023-259 du 7 avril 2023 relatif aux systèmes d'automatisation et de contrôle des bâtiments tertiaires, an automation and control system must be installed in all non-residential buildings above 70 kW unless the owner produces a study establishing that its installation is not feasible with a return on investment time of less than ten years (https://www.legifrance.gouv.fr/).

([23]) In the Gebäudeenergiegesetz GEG 2024, §71a, the conditionality of technical and economic feasibility is not included in non-residential buildings above 290 kW (https://www.gesetze-im-internet.de/geg/BJNR172810020.html#BJNR172810020BJNG002001128).

([24]) For further information refer to EN ISO 52120-1 chapters 5.4, 5.5 and 5.6 including Tables 5 and 6. Some single requirements for single-family houses in Table 6 may not be technically or economically feasible for a specific project, and may then be omitted, if documented.

([25]) Plesser, S., Teisen, O., and Ryan, C., Rehva Guidebook 29 (2019). Quality Management for buildings, Improving Building Performance through Technical Monitoring and Commissioning. Available at: https://www.rehva.eu/hvac-guidebook-repository/rehva-guidebook-29.

assessment is negative. Member States that decide to make use of this exclusion should demonstrate to the Commission how they have transposed this provision and determined that the cost of installing those functionalities exceeds the benefits (lower energy consumption, savings due to exemption from costs of inspections, etc.), also considering setting less advanced requirements for single-family houses undergoing major renovation, as shown in Table 6.

Table 6

Example of part 7. Technical Home and building management minimum requirements for monitoring and control functionalities installed in new residential buildings or residential buildings undergoing major renovations

Building type	Single-family houses undergoing major renovations	New residential buildings, new single-family houses and multi-apartment buildings undergoing major renovations
Minimum level	Class B / Class C	Class B
7.1 **Setpoint management** 13(11b)	Class C: Manual setting room by room individually	Adaptation from distributed/ decentralized plant rooms only.
7.2 **Runtime management** 13(11b)	Class C: Manual setting (plant enabling)	Individual setting following a pre-defined time schedule including fixed preconditioning phases.
7.3 **Detecting faults of technical building systems and providing support to the diagnosis of these faults** 13(11a)	Class C: No central indication of detected faults and alarms.	With central indication of detected faults and alarms ([a])
7.4 **Reporting information regarding energy consumption, indoor conditions** 13(11a,b)	Class B: Trending functions and consumption determination	Trending functions and consumption determination
7.5 **Local energy production and renewable energies** 13(11b,c)	Class C: Uncontrolled generation depending on the fluctuating availability of renewable energy sources (RES) and or run time of combined heat and power (CHP); overproduction will be fed into the grid.	Coordination of local RES and CHP with regard to local energy demand profile including energy storage management; optimisation of own consumption.
7.6 **Waste recovery and heat shifting** 13(11b)	Class C: Managed use of waste heat or heat shifting (including charging/ discharging thermal energy storage)	Managed use of waste heat or heat shifting (including charging/ discharging thermal energy storage)
7.7 **Smart Grid Integration** 13(11c)	Class B: Building energy systems are managed and operated depending on grid load; demand side management is used for load shifting.	Building energy systems are managed and operated depending on grid load; demand side management is used for load shifting.

([a]) Different central building units each with the functionality of central indication of detected faults and alarms will be considered to fulfil this requirement.

2.7. **Capacity to react to external signals**

Article 13(11)(c) requires Member States to lay down requirements to ensure that, where technically, economically and functionally feasible, new residential buildings and residential buildings undergoing major renovation are equipped with a 'capacity to react to external signals and adjust the energy consumption', as of 29 May 2026.

Article 11(1) requires a zero-emission building (ZEB) ([26]) to offer, when technically and economically feasible, a capacity to react to external signals and adapt its energy use, generation, or storage ([27]).

The rationale of this provision is explained in Recital 23 stating that ZEBs can contribute to demand-side flexibility, e.g. through demand management, electrical storage, thermal storage and distributed renewable generation to support a more reliable, sustainable and efficient energy system. The capacity to react to external signals concerns, in particular, the technical building systems falling within the scope of the recast EPBD but may further include other equipment in buildings, such as appliances.

Furthermore, Annex V to the recast EPBD detailing the template for energy performance certificates (EPCs) introduces in point d) among the mandatory indicators to be displayed in an EPC 'a yes/no indication whether the building has a capacity to react to external signals and adjust the energy consumption'.

Table 7

Relevant timelines and obligations

		Buildings undergoing major renovation as defined in Article 2(20)	Buildings undergoing deep renovation as defined in Article 2(22)	New buildings
		Article 13(11)(c)	Article 13(11)(c) Article 11(1)	Article 13(11)(c) Article 11(1)
Residential	**As of transposition date**	Equipped with a capacity to react to external signals and adjust the energy consumption ([a])	Equipped with a capacity to react to external signals and adjust the energy consumption ([a])	
	As of 2030 (as of 2028, for new buildings owned by public bodies)		Equipped with a capacity to react to external signals and adapt its energy use, generation, or storage ([b])	
Non-residential	**As of transposition date**	-	-	
	As of 2030 (as of 2028, for new buildings owned by public bodies)		Equipped with a capacity to react to external signals and adapt its energy use, generation, or storage ([b])	

([a]) where technically, economically and functionally feasible;
([b]) where technically and economically feasible

([26]) From 1 January 2028, all new buildings owned by public bodies; from 1 January 2030, all new buildings.
([27]) The terms 'adapt its energy use' in Article 11(1) and 'adjust the energy consumption' in Article 13(11c) should be considered to mean the same.

A building subject to this obligation should generally be equipped with a **smart metering system** ([28]) and have the ability to react to signals from the grid. Systems or equipment controlling the building operation must have the capabilities to exchange valid data in both directions. This would also ensure that owners, tenants and managers have the ability to install, e.g., technical building systems and energy smart appliances ([29]) in individual building units or serving the whole building.

Some examples of how a building can be equipped with the capacity to react to external signals and adjust the energy consumption, bringing it into line with Article 13(11)(c), are as follows:

— The building has **(digital) demand response and demand management capabilities, at building level or for main equipment** that, for example, at electricity grid peak demand hours, are able to minimize, turn off temporarily or postpone the supply to the main equipment of the building, potentially based on a pre-defined use case (e.g. turning off a heat pump or limiting its power if the temperature is within a certain pre-defined range, also considering an acceptable deviation, and if the thermal performance of the building envelope allows for it). This capability could also be used to delay the start, or temporarily stop, if possible, the supply to other energy smart appliances, e.g. the 'white goods'.

— The building has **demand management capabilities** that make it possible to maximise the use of cheaper electricity from the grid and its **storage in on-site batteries or in thermal storage systems**, to be used when electricity from the grid is more expensive ([30]), when building energy needs are higher and/or to reduce energy needs (e.g. through pre-heating the building).

— The building is equipped with recharging points for electric vehicles with the capability of **smart or bi-directional charging** ([31]).

Good thermal performance of the building envelope and building thermal mass could be exploited in conjunction with smart technical building systems.

More specific examples of interpretation are given in Table 8, based on the functionality levels which are part of the smart readiness indicator (SRI) methodology. In line with Article 15, the SRI will initially become mandatory for large non-residential buildings. When an SRI is issued in the future, Member States may link their SRI score in the functionality of adapting to signals from the grid in order to establish requirements in terms of capability to react for ZEBs. Alternatively, before the entry into force of the SRI scheme and for those buildings that will not be covered by it, the examples of smart-ready services ([32]) included in Table 8 can be a part of a checklist that the EPC assessor could use to verify whether or not the building assessed is able to offer the capacity to react to external signals and adapt its energy use, generation, or storage.

([28]) Article 2(23) of Directive (EU) 2019/944 defines 'smart metering system' as an electronic system that is capable of measuring electricity fed into the grid or electricity consumed from the grid, providing more information than a conventional meter, and that is capable of transmitting and receiving data for information, monitoring and control purposes, using a form of electronic communication.

([29]) Energy smart appliances (ESA) are products that provide energy flexibility being capable of automatically (by means of machine-to-machine communication) optimising their consumption patterns (e.g. time or profile) in response to external stimuli, based on user permission. energy smart appliances can include 1) heating, ventilation, and air-conditioning appliances (HVAC), including heat pumps or 2) white goods: washing machines, tumble driers, washer-driers, dishwashers. For these products, certain common demand response services (i.e. 'use cases') are defined in the EU Code of Conduct on the interoperability of Energy Smart Appliances. Cf. Code of Conduct for Energy Smart Appliances | JRC SES (europa.eu).

([30]) This works in the case of energy supply contracts based on dynamic pricing.

([31]) Cf. Annex 9 to this Commission Notice on Infrastructure for sustainable mobility (Article 14). Guidance on Article 20a on sector integration of renewable electricity of Directive (EU) 2018/2001 on the promotion of energy from renewable sources, as amended by Directive (EU) 2023/2413, available at efcd200c-b9ae-4a9c-98ab-73b2fd281fcc_en.

([32]) As defined in Delegated Regulation (EU) 2020/2155 of 14 October 2020 supplementing Directive (EU) 2010/31/EU of the European Parliament and of the Council by establishing an optional common European Union scheme for rating the smart readiness of buildings.

The examples in Table 8 should be seen in connection with sections 2.5 on BACS, 2 on on-site renewable energy generation and 2.2 on energy storage, relevant ecodesign requirements ([33]) and the following Articles and related guidance documents: Article 11(1) on ZEBs, Article 10 on solar energy in buildings, Article 14 on infrastructure for sustainable mobility, Article 20a of the revised Renewable Energy Directive ([34]).

Table 8

Examples with interpretation of requirements for a capacity to react to external signals and adjust energy consumption, generation, and storage, based on SRI Functionality Levels

Domain	Smart-ready Service	Minimum required SRI Functionality Level (FL)
Monitoring and control	Single platform allowing for automated control and coordination between TBS + optimisation of energy flow based on occupancy, weather and grid signals	FL3: Single platform that allows automated control and coordination between TBS + optimisation of energy flow based on occupancy, weather and grid signals
Monitoring and control	Run time management of HVAC systems	FL3: Heating and cooling plant on/off control based on predictive control or grid signals
Heating	Flexibility and grid interaction	FL3: Heating system capable of flexible control via grid signals (e.g. demand-side management, DSM)
Heating	Thermal energy storage (TES) for building heating (excluding TABS)	FL3: Heat storage capable of flexible control through grid signals (e.g. DSM)
Cooling	Flexibility and grid interaction	FL3: Cooling system capable of flexible control through grid signals (e.g. DSM)
Cooling	Control of Thermal Energy Storage (TES) operation	FL3: Cold storage capable of flexible control through grid signals (e.g. DSM)
Domestic hot water (DHW) ([35])	Control of DHW storage charging (with direct electric heating or integrated electric heat pump)	FL3: Control of DHW storage charging (with direct electric heating or integrated electric heat pump)
Domestic hot water	Control of DHW storage charging (using hot water generation)	FL3: DHW production system capable of automatic charging control based on external signals (e.g. from district heating grid)
Electricity	Optimizing self-consumption of locally generated electricity	FL2: Automated management of local electricity consumption based on current renewable energy availability
Electricity	Control of combined heat and power plant (CHP)	FL1: CHP runtime control influenced by the fluctuating availability of RES; overproduction will be fed into the grid
Electricity	Storage of (locally generated) electricity	FL2: On site storage of energy (e.g. electric battery or thermal storage) with controller based on grid signals
Electricity	Support of (micro)grid operation modes	FL1: Automated management of (building-level) electricity consumption based on grid signals
Electricity	EV charging grid balancing	FL2: 2-way controlled charging (e.g. including desired departure time and grid signals for optimization)

([33]) Regulation (EU) 2024/1781 of the European Parliament and of the Council of 13 June 2024 establishing a framework for the setting of ecodesign requirements for sustainable products.
([34]) Directive (EU) 2018/2001, as amended by Directive (EU) 2023/2413.
([35]) Legionella risk should be considered if control of domestic hot water storage charging is applied.

2.8. Automatic lighting controls

Article 13(12) requires Member States to lay down requirements to ensure that, where technically and economically feasible, large non-residential buildings are equipped with automatic lighting controls. The automatic lighting controls must be suitably zoned and capable of occupancy detection.

The non-residential buildings falling under this provision are the same buildings that fall under the provisions on BACS set out in Article 13(9). The limit dates are 31 December 2027 for an effective rated output over 290 kW, and 31 December 2029 for an effective rated output over 70 kW. Requirements are established for 'built-in lighting' systems ([36]). Today, lighting systems are increasingly equipped with energy-efficient light sources. However, lighting still accounts for a significant portion of the electricity consumption in buildings, especially non-residential, due to its normally extended operation time, compared to usage time/working hours. Operation time can be reduced cost-effectively if automatic lighting control is installed, and the lighting system is regulated according to activity and occupancy patterns in the different areas of the building.

The design of the automatic lighting controls must ensure that sensors correctly detect occupancy in the different zones in order to reduce electricity consumption without compromising the area's functionality, safety and productivity. It is important that the type and number of sensors are chosen and placed according to the activity, the physical geometry of the area and the layout of furniture to ensure adequate sensor coverage of the entire area. The lighting control interface should be easily accessible so that delay times for the individual zones can easily be set and adjusted to the zone's functionality and daily occupancy patterns.

The lighting control can be set up as one or more stand-alone systems or as an integrated part of a centralised control system for the building. In small rooms with few light fixtures, it might be feasible to use light fixtures with integrated occupancy sensors to save on installation costs, but the consumption of such sensors (including stand-by consumption) needs to be carefully considered in relation to the actual savings they provide. In a centralised control system, the occupancy sensors, lighting fixtures, switches, etc., are connected via a network (bus or wireless) and can be monitored and programmed centrally. An advantage of a centralised lighting control system is that the occupancy sensors can also be used for the control of the building's indoor conditions. Since the occupancy detection data can be used in the control of the indoor climate as well, integration as part of the building management system will benefit and optimise the overall technical building system.

The consumption and working hours of the lighting system can be continuously monitored, and the data collected can be used for the operation and maintenance of the lighting system. The automatic lighting control must ensure that the required maintained illuminance levels are met. Implementing verification and commissioning procedures to ensure proper installation and operation is recommended.

In line with Article 13(12), the automatic lighting control should generally comply with the requirements shown in Table 9.

Table 9

Example of requirements for automatic lighting control

Type of requirement	Description
Occupancy detection	The occupancy detection should be designed to fulfil the requirements of Table 5, ref. No 5.1, level 2 in EN ISO 52120-1.

([36]) The wording 'built-in lighting' emphasises that it covers only lighting equipment that is installed in order to implement lighting specifications defined at design time, and to fulfil related requirements. From Commission Recommendations on building modernisation (7 June 2019).

Type of requirement	Description
Zoning	Several rooms can be grouped into zones or, alternatively, one large room can be divided into zones according to the occupancy pattern; the automatic lighting control is assigned to each zone. Zones should be defined to ensure that the operation time of the lighting system serving them corresponds as far as possible to their use, so that the operation time is limited as much as possible ([37]). Zoning should generally be aligned with zoning in building automation control systems and other technical building systems, where relevant.
Daylight control (optional)	Further energy savings can be achieved by adding automatic daylight control in areas with sufficient daylight. In these types of areas, a daylight sensor could be installed or integrated in the occupancy sensors to monitor the daylight level and adjust the light accordingly.

Whichever lighting control system is used (on the level of a single fixture, one or more stand-alone systems, central systems, etc.), various of their components (sensors, control boxes, zone and main switchboards, etc.) usually draw additional power to operate. The corresponding annual consumption (during the time that the light sources are on as well as when they are off) must be properly taken into consideration when evaluating the overall system performance and the energetic and economic feasibility.

Establishing and operating the automatic lighting control can therefore be costly and must therefore be compared with the expected energy savings over the lifespan of the system. In calculating the technical and economic feasibility, the expected annual savings on electricity should be compared with the investment in the automatic lighting control system. The calculation should also take the expected annual electricity consumption, including stand-by consumption of the lighting control, into account. Calculations can be made in line with standards EN 15193-1 and EN 15193-2 and the expenditure factors ([38]), defined in those standards, can also be used.

In new non-residential buildings, automatic lighting control can generally be considered technically and economically feasible.

For existing non-residential buildings, if a system has an expenditure factor of 6 or above, it should be considered technically and economically feasible to implement automatic lighting control. If the expenditure factor is above 2, it is recommended that a calculation be made to determine whether it is technically and economically feasible.

When evaluating technical and economic feasibility, daylight control should always be considered as an option, as it typically has a positive cost-benefit ratio.

3. INDOOR ENVIRONMENTAL QUALITY

Article 2(66) introduces a definition of indoor environmental quality (IEQ), which means 'the result of an assessment of the conditions inside a building that influence the health and well-being of its occupants, based upon parameters such as those relating to the: temperature, humidity, ventilation rate and presence of contaminants'. On that basis, in transposing the relevant provisions on IEQ, Member States will have to address the minimum scope for IEQ targeting the domains of **thermal comfort** and **indoor air quality (IAQ)** ([39]). However, Member States could go further and include in their definition also other aspects affecting the health and well-being of occupants, such as lighting and acoustics.

([37]) Typical zones in a non-residential building may include office spaces, meeting rooms, classrooms, corridors and circulation areas, stairs, general areas such as toilet, dressing and shower areas, cloakrooms, resting rooms, canteens and break areas, storerooms, etc.
([38]) Indicator of the energy efficiency of a given lighting system compared to a reference system.
([39]) Cf. Commission staff working document on supporting indoor air quality. SWD(2024) 147 final.

The concept of **optimal indoor environmental quality** is introduced in the recast EPBD. This concept must be taken into account when setting minimum energy performance requirements, in order to avoid possible negative effects, such as inadequate ventilation (Article 5(1)), and it must be addressed in relation to new buildings (Article 7(6)). Member States must address, also in relation to buildings undergoing major renovation, the issues of indoor environmental quality (Article 8(3)). In this case 'optimal' is not mentioned, leaving scope for Member States to set higher ambition in the IEQ requirements for new buildings than for existing ones. These provisions concern IEQ in the design phase, resulting in the obligation to set requirements for IAQ and thermal comfort in national and regional regulations for new buildings and major renovations, if they have not yet been set. Renovation can also be the optimal trigger point to remove possible hazardous materials installed in buildings, including asbestos. This is an issue that has links with building occupants' health but is addressed separately in the recast EPBD (i.e. outside of the IEQ definition). It is also mentioned in Article 8(3) as an issue that must be addressed when a building undergoes major renovation ([40]).

Article 13 supports high indoor environmental standards during operation, for example calling for the setting of national requirements for the **implementation of adequate indoor environmental quality standards** in buildings in order to maintain a healthy indoor climate (Article 13(4)). These requirements may be referred to in the recommendations in EPCs on improving IEQ (Article 19(5)). If inadequate IEQ standards are found during inspections, their improvement should be recommended. If during the preparation of an EPC inadequate standards are observed, recommendations should be issued. In line with Article 8(3), major renovation will have to address IEQ issues and should strive to improve IEQ in order to achieve the relevant design levels.

Inadequate indoor temperatures, humidity and contaminant affect the wellbeing of occupants as well as their productivity (relevant e.g. in office building or in schools) and can cause health problems. High indoor temperatures can cause heat stress, and high humidity in cold rooms can cause condensation, which increases the risk of mould developing. High concentrations of pollutants ([41]) indoors are caused by indoor emission sources or outdoor pollution. High levels of carbon dioxide (CO_2), which can occur e.g. in airtight rooms with little ventilation or due to increased number of occupants, serves as an indicator of poor indoor air quality, impacting the health and well-being of occupants (e.g. due to the potentially increased risk of airborne pathogen transmission).

In addition, Article 13(5) requires that non-residential zero-emission buildings (ZEBs) be equipped with measuring and control devices for monitoring and regulating indoor air quality. These will apply, as of 2028, to new non-residential buildings owned by public bodies and, as of 2030, to all new non-residential buildings and to buildings renovated to ZEB-level. This is also the case for non-residential buildings undergoing major renovations, where technically and economically feasible. Member States may require the installation of such devices in residential buildings. Additionally, for non-residential buildings, Article 13(10)(d) introduces the new functionality of IEQ monitoring.

3.1. References for indoor environmental quality requirements

In order to set relevant IEQ requirements, Member States can refer to the parameters introduced in the EN 16798-1 standard, describing the occupant expectation towards IEQ through Categories I to IV. The European framework for sustainable buildings – Level(s) – can also supplement the standard ([42]). Another example of IEQ indicators for buildings undergoing renovation is TAIL ([43]).

With regard to addressing the issues of (optimal) indoor environmental quality in new buildings and buildings undergoing major renovations, it is up to each Member State to establish the requirements to be addressed in the design phase, based inter alia on their respective cost-optimal calculations.

([40]) Further information on possible target buildings and regions could be obtained, based on the construction year and asbestos ban date. Cf. Maduta, C., Kakoulaki, G., Zangheri, P. and Bavetta, M., Towards energy efficient and asbestos-free dwellings through deep energy renovation, Publications Office of the European Union, Luxembourg, 2022, doi:10.2760/00828; Kakoulaki, G., Maduta, C., Tsionis, G., Zangheri, P. and Bavetta, M., Identification of vulnerable EU regions considering asbestos presence and seismic risk, Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/652785.
([41]) Chemicals and biological pollutants could be in gaseous, vapour, liquid, or solid states (the latter two emitting from products).
([42]) https://environment.ec.europa.eu/topics/circular-economy/levels_en.
([43]) https://aldren.eu/comfort-well-being/.

For new buildings, where ‘optimal’ IEQ is mentioned, it is recommended that Member States use the Category II specified in EN 16798-1 (medium occupant expectation), whose values ensure the comfort and well-being of occupants and limit adverse health effects.

For existing buildings undergoing major renovation, Member States may set less stringent requirements, based on technical, economic and functional feasibility considerations, which would justify less ambition requirements in renovated buildings (also in line with Article 8(3), simply referring to indoor environmental quality). The cost-optimal methodology enables these elements to be taken into account.

The values in Table 11, mostly based on Category II of EN 16798-1, can constitute a useful reference for Member States.

For the implementation of adequate indoor environmental quality standards in buildings to ensure a healthy indoor climate (i.e. for existing buildings in operation), in line with Article 13(4), Member States may refer to Category III, based on moderate occupant expectation. Requirements may be tightened according to special requirements linked to the use of specific buildings (e.g. occupants with special needs such as children, older people, people with disabilities, etc.).

Member States may set different requirements for residential and non-residential buildings and may also differentiate further for specific building types. Requirements may also concern air filtration or cleaning, where relevant (e.g. to address specific concerns).

Documentation requirements may also differ according to the building type, size or effective rated output of heating, ventilation and air-conditioning systems, and any combination thereof.

Examples of parameters for IEQ and extreme conditions are introduced in section 3.4.

It is important to underline that ensuring indoor air quality is a requirement linked with better living conditions and minimising both short-term and long-term health risks in the building. Depending on the situation it might be linked to an increase in energy consumption, but the alternative is an unhealthy indoor climate. Several solutions for ensuring indoor environmental quality are already cost-efficient (e.g., ventilation and heat recovery minimise thermal losses in winter to ensure adequate indoor air quality), even before considering the positive impacts linked to the improved health and well-being of building occupants.

3.2. **Guidelines on measuring and control**

Multiple origins of indoor air pollution ([44]) and distribution in a room makes full IAQ monitoring complicated. Direct measurement of all indoor air pollutants is impossible in practice as it generally requires sampling and subsequent chemical analysis. However, affordable sensors for routine IAQ monitoring are available for indoor temperature ([45]), CO_2, relative humidity (RH), and fine particulate matter ($PM_{2.5}$). These could generally be considered technically and economically feasible for new buildings and for major renovations. CO_2 concentration can be continuously monitored as a proxy for ventilation, which is an important factor for good IAQ. $PM_{2.5}$ monitoring can ensure, where relevant, that outdoor air for ventilation is clean or adequately filtered and that indoor sources, such as cooking (relevant e.g. in commercial kitchens), are properly extracted.

Article 13(5) sets requirements for buildings to be equipped with measuring and control devices for the monitoring and regulation of IAQ ([46]). It is recommended that such devices measure carbon dioxide and, where relevant, particulate matter ($PM_{2.5}$). An example of these can be demand-controlled ventilation systems (in principle mechanical, hybrid or natural) which have both control and monitoring functions ([47]).

([44]) The six pollutants included in World Health Organisation Air Quality Guidelines (WHO AQG), available at https://www.who.int/publications/i/item/9789240034228, are particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulphur dioxide and carbon monoxide.
([45]) It is generally recommended that indoor temperature complements IAQ requirements.
([46]) Note that other IEQ parameters such as temperature are not described.
([47]) Demand-controlled operation of ventilation systems is not currently addressed in standards, but it is considered in ongoing revision of EN 16798-1:2019, and therefore specific attention in national regulation/guidelines is expected.

Member States may also decide to introduce IAQ monitoring and regulating capabilities for residential buildings and have complete flexibility with regard to the type of equipment to install (e.g. only measuring sensors), the parameters to monitor, the buildings to target (e.g. new and existing, based on dimension, age of construction, etc.). If the requirements of Article 13(5) are extended also to cover residential buildings, it could be useful, for example, to monitor CO_2 levels in living spaces, and relative humidity in 'wet rooms', such as toilets and bathrooms.

It is recommended to specify at which unit or zone level or in which space categories it is relevant to require measuring and control of IAQ, as not all spaces in a building require the same levels of IAQ and not all spaces need IAQ measuring and control. For non-residential buildings, appropriate zoning would typically be per room characterised by long-term occupation (but depending on its dimensions or occupancy). Typical zones in a non-residential building may include office spaces, meeting rooms, classrooms, resting rooms, canteen and break areas, reception areas, etc. In circulation areas such as stairs and corridors, it may be required to ensure adequate conditions, so they do not affect occupied zones negatively. Large rooms or multiple areas served by a single system (e.g. cellular offices served by the same system) may require division into smaller zones according to occupancy pattern. For residential buildings, appropriate zoning could, for example, include a ventilation system servicing each building unit. Common areas with higher occupancy would also be considered an appropriate zone.

Article 13(10)(d) introduces a requirement for indoor environmental quality monitoring for existing non-residential buildings by 29 May 2026. It is recommended that IEQ monitoring in non-residential buildings includes indoor temperature, relative humidity, carbon dioxide, and, where relevant, particulate matter ($PM_{2.5}$). It is common in existing buildings to use the air temperature measurement as a proxy for the number of people in the room and associated ventilation rates (even without CO_2 sensor). In such cases, where monitoring equipment is already present and it is able to interact with the ventilation system to ensure the identified ventilation rates, it may not be technically and economically feasible to upgrade with IEQ monitoring existing buildings in operation until a major renovation is performed for the building.

3.3. Relevant IEQ parameters and examples of optimal IEQ conditions

Table 10 (page 23) provides examples of relevant IEQ parameters when setting design requirements (e.g. in line with Articles 7(6) and 8(3)), conducting commissioning, performing monitoring (e.g. in line with Article 13(5)), and conducting inspections (in line with Article 23). Dedicated inspections can address specific issues in operation (e.g. short-term monitoring via sensors installed for certain periods to observe or address specific issues), but Table 10 refers to the inspections referred to in Article 23(1).

Table 11 (page 25) provides examples of optimal IEQ reference values and ranges in design outdoor conditions, that Member States may use for new buildings. The values in this table are mostly based on Category II of EN 16798, based on a medium expectation of occupants. Member States may use these values as reference when setting IEQ requirements for design and monitoring in typical outdoor conditions, i.e. periods without extreme events (such as heat waves) which are introduced at section 3.4.

In relation to thermal comfort, the seasons are defined according to EN 16798. The heating and cooling seasons are defined as the part of the year during which heating or cooling is needed, respectively, to keep the indoor temperature within specified levels. The transition season is defined as periods between the heating and cooling season. As season length differs substantially between Member States, the running mean temperature (Trm) is used to provide a uniform distinction between heating, cooling, and transition periods ([48]). Buildings with mechanical cooling use active means to provide cooling of supply air. These include fan coil units, chilled ceilings and beams cooled surfaces. Opening of windows during night and daytime or mechanical supply of cold outdoor air is not regarded as mechanical cooling.

Table 11 provides thermal comfort recommended ranges with and without mechanical cooling. Recommended ranges in buildings without mechanical cooling can be used only if occupants have easy access to operable windows and do not have strict clothing policies. Otherwise, the recommended ranges 'with mechanical cooling' apply. For non-residential buildings without mechanical cooling, it is recommended that the airing system is automatically controlled and appropriate consideration is taken to draught risk.

([48]) Natural ventilation rates can be calculated in accordance with EN 16798-7 or with dynamic thermal simulation tools.

3.4. Adaptation to climate change and extreme outdoor conditions

With the rise of global temperatures, measures to reduce indoor temperatures by design (e.g. adjusting the orientation of facades to reduce direct sunlight, using external shading, and using natural ventilation) will become increasingly important. These elements have a significant effect on indoor conditions and therefore on indoor environmental quality.

Articles 7(6) and 8(3) state that, in relation to new buildings and buildings undergoing major renovation, Member States must, among other issues, address that of adaptation to climate change and indoor environmental quality ([49]).

Member States may address the issues of adaptation to climate change by requiring use of outdoor climate conditions and their future changes according to best available climate projections (e.g. IPCC models for climate change, heating and cooling degree days – HDD and CDD – projections, etc.) when assessing energy performance of buildings and their ability to maintain indoor comfort requirements. A heat stress assessment performed with respect to extreme conditions may also be required as part of the design process. In situations with extreme outdoor conditions, where comfort requirements may be exceeded, Table 12 (page 27) provides additional indicators to evaluate passive survivability that may be considered in the design phase.

Advice for the selection, implementation, commissioning, and operation of passive and active cooling systems with regards to maintaining comfort and energy efficiency are provided by IEA EBC Annex 80 ([50]) and REHVA ([51]), for example. Numerous passive cooling solutions such as solar shading, ventilative cooling (especially during nighttime) and the thermal mass of the building can be used to reduce and control the building cooling load, while active cooling solutions (e.g. radiant or air-based systems, fans) can be used for cooling when passive systems are insufficient to ensure comfort and health. Electrical fans may be combined with air-conditioning to reduce discomfort, if the upper limit of the operative temperature is exceeded.

In addition, for building locations with outdoor PM2.5, CO, NO_2 concentrations above the recommended WHO levels ([52]), filtration of outdoor air can be used to reduce pollutant transmission.

A definition of a heatwave can help Member States to address overheating risk in buildings in extreme conditions. Individual Member States may have their own definitions of a heatwave, though most do not have one. One possible definition is the meteorological heatwave definition ([53]), which has been adopted, e.g., by Spain. Other Member States, such as Austria, Belgium, France, and Germany, use similar definitions. An advanced definition is the physiological heatwave ([54]), where the heatwave is defined on the basis of heat stress for people under sunshade using heat stress or thermal discomfort metrics. An example for a heatwave definition, combining the meteorological and physiological heatwave definitions and heat index, is a period of three consecutive days with an outdoor running mean temperature above 30 °C, for which the outdoor heat index, combining air temperature and relative humidity, exceeds 32.2 °C.

Table 12 provides indicators for passive survivability against heat waves and extreme outdoor air pollution events. The thermal comfort indicators can be used during design and assessed during inspection, to optimize the building using passive measures (e.g. solar shading, cross-ventilation and filtration). However, if limits are not met during design and inspection, the building or space may not have the passive ability to withstand an extreme event. If a certain level of passive survivability is surpassed, e.g. danger for heatwaves and poor for air pollution, buildings may require active measures (e.g. active cooling, fans and air cleaning) against extreme outdoor conditions. Monitoring can indicate potential reductions in comfort during operation.

([49]) The LEVEL(s) framework addresses, under Macro-objective 5, the issues of adaptability and resilience to climate change. Specifically, occupier health and thermal comfort are addressed in Dodd N., Donatello S. & Cordella M., 2021. Level(s) indicator 5.1 Protection of occupier health and thermal comfort user manual: introductory briefing, instructions and guidance, available at https://susproc.jrc.ec.europa.eu/product-bureau/product-groups/412/documents.

([50]) International Energy Agency. Resilient Cooling of Buildings Technology Profiles Report (Annex 80). Energy in Buildings and Communities Technology Collaboration Programme, May 2024.

([51]) Resilient Cooling Design Guidelines, REHVA.

([52]) World Health Organization, (2021). WHO global air quality guidelines. Particulate matter ($PM_{2.5}$ and PM_{10}), ozone, nitrogen dioxide, sulphur dioxide and carbon monoxide. https://www.who.int/news-room/questions-and-answers/item/who-global-air-quality-guidelines.

([53]) International Energy Agency. Resilient Cooling of Buildings Key Performance Indicators Report (Annex 80). Energy in Buildings and Communities Technology Collaboration Programme, 2024.

([54]) Cf. footnote 3.

Table 10

Examples of relevant parameters for indoor environmental quality

	Indicator	D	C	M ([a])	I ([a])	Description and references
Thermal Comfort	Operative temperature	X		(X)		Possible alternative to air temperature in the monitoring stage. Uniform temperature of an imaginary black enclosure in which an occupant would exchange the same amount of heat by radiation plus convection as in the actual non-uniform environment. Ranges are provided as a function of building type, season, and dependent on the cooling system (with or without) by the predicted mean vote (PMV) and adaptive comfort models. (EN ISO 7730, EN ISO 7726).
	Air temperature	X	X	X	X	Required in the assessment of other indicators. Air temperature can be used in long-term measurements if corrected for large hot or cold surfaces to determine the operative temperature. Indoor temperatures above 18 °C during the heating season will have significant health benefits. (EN ISO 7730, EN ISO 7726).
	Air velocity	X				It influences general thermal comfort and local thermal discomfort due to draught. Comfortable air velocity generally below 0.2 m/s. In buildings with mechanical cooling artificially increased air velocity under personal control (e.g. fans) can be used to compensate for increased air temperature under summer comfort conditions (operative temperature >25 °C). (EN 16798-1, EN ISO 7726). A comfort area for increased air velocity (<0.8 m/s) without personal control for temperatures above 25.5 °C is defined in ASHRAE 55 ([b]).
	Relative humidity	X		X		Composition of the air in terms of water vapour in relation to the maximum amount it can hold at a given temperature. It also influences air quality. Very low RH (<20%) can cause irritation of eyes, nose, and throat and increase sensitiveness to infections. Persistent dampness, condensation, and excess moisture (RH > 70%) can cause building damage and microbial growth. It is recommended to limit absolute humidity to 12 g/kg (EN 16798-1, EN ISO 7726).
Indoor air quality	Ventilation rate	X	X		X	To be addressed as part of system inspections pursuant to Article 23. Supply or removed air from space for the purpose of controlling air contaminant levels, humidity, perceived air quality or temperature within the space (EN 16798-1). If critical sources for health are identified, it must be checked that they remain below the health threshold values. Minimum 4 l/s per person is prescribed during occupied hours; 0.15 l/s per m^2 during unoccupied hours. Typically measured from supply and extract terminals.
	Carbon dioxide	X		X		Proxy for ventilation effectiveness in spaces where people are the main source of pollution. Indoor CO_2 concentration should be adjusted according to the outdoor CO_2 concentration. It should not exceed 1 350 ppm above outdoor concentration. Typically measured in extract terminals. (EN 16798).

	Indicator	D	C	M ([a])	I ([a])	Description and references
	$PM_{2.5}$	X ([c])		X ([d])		Particulate matter where particles have an aerodynamic diameter equal to or less than 2.5 µm. It can be generated indoors from combustion appliances or outdoors and has harmful effects on human health. Air filtration is required to control particulate matter from outdoor sources. Indoor particulate matter is controlled by reducing emission sources (e.g. electric instead of gas stoves) and adequate ventilation. Preferably below an annual mean of 10 µg/m³. Incremental steps are proposed for $PM_{2.5}$ limits (35, 25, 15, 10, 5 µg/m³) (EN 16798-1, WHO).
	Formaldehyde ([e])	X ([f])				Major sources are building materials and consumer products (e.g. furniture, cleaning). It can cause sensory irritation and respiratory health risks. Use of labelled low-emitting building and finishing materials and products can reduce exposure Measured near potential sources such as furniture and flooring (EN 16798-1, WHO).
	Nitrogen dioxide	X ([f])				Originating from combustion. Indoor contamination may be possible from attached garages and indoor combustion sources, in which cases sensors and/or measuring requirements would be recommended. It poses health risks related to the respiratory system. Measured near potential sources such as kitchens and garages. A 1 h mean limit of 200 µg/m³ and annual mean of 40 µg/m³ are proposed (EN 16798-1, WHO).
	Radon	X ([f])				Human carcinogen, originating from decay of radium in soil and rocks. Reference level of 100 Bq/m³ (or 300 Bq/m³ based on prevailing country-specific conditions). Measured in the lowest occupied level of the building (EN 16798-1, WHO).
	Carbon monoxide	X ([f])				Originating from combustion. Acute exposure-related reduction of exercise tolerance and increase in symptoms of ischaemic heart disease. A 24-hour mean limit of 4 mg/m³ is proposed with an interim target of 7 mg/m³ (EN 16798-1, WHO).
Lighting ([g])	Daylight provision	X				Daylight should be a significant source of illumination as it is favoured by building occupants, contributing to physiological well-being. Daylight can reduce energy use for electrical lighting. Shading devices should be provided to reduce visual and thermal discomfort in spaces where activities comparable to reading, writing, or using display devices are carried out. Daylight can be quantified using spatial daylight autonomy (sDA), representing the level of illuminance achieved from daylight across a fraction of a reference plane for a fraction of daylight hours within a space. An annual sunlight exposure (ASE) ([h]), i.e. percentage of regularly occupied floor area with illuminance higher than 1 000 lx, lower than 10 % is desired to prevent glare and overheating (EN 17037).
	Glare probability (DGP)	X				Used to assess protection against glare in rooms where activities such as reading, writing, or screen time take place. Glare represents discomfort or a reduction in the ability to see details or objects, caused by an unsuitable distribution or range of luminance, or by extreme contrasts. It can be quantified using daylight glare probability (DGP_e) in rooms with vertical or inclined daylight openings and is evaluated across the regularly occupied floor area. If DGP_e exceeds 0.45 in more than 5 % of the occupation time, glare protection should be installed or other interventions (i.e. change in orientation, field of view) should be implemented (EN 17037).

	Indicator	D	C	M (a)	I (a)	Description and references
	Illuminance	X	X			Luminous flux incident on a surface per unit area. The areas where an adequate illuminance level should be ensured are task and activity areas, the surrounding and background areas, walls, ceiling, and objects in the space. Required values are dependent on type of task or activity area. For writing, typing, reading and data processing, an illuminance of 500 lx is required (EN 12464–1).
Acoustics (g)	Sound pressure	X	X			Equivalent continuous sound pressure level from mechanical equipment. Sound pressure can be normalised using the reverberation time and standardised to a reference reverberation time. It does not include outdoor noise. Investigated at representative points in the occupied zone (EN 16798, EN 12354-5, EN 16032, EN 10052).
	Sound reverberation time	X	X			Duration required for the space-averaged sound energy density in an enclosure to decrease by 60 dB after the source emission has stopped. It takes into account the sound absorption of the room. Reverberation times over 1 s produce loss in speech discrimination and make speech perception more difficult and straining (i) (EN 12354-5, EN 16032, EN 10052).

D = Design, C = Commissioning, M = Monitoring, I = Inspection

(a) In assessing indoor values, consideration of outdoor values for air temperature, humidity, CO_2 and $PM_{2.5}$ as well as of other outdoor pollutant levels such as CO, NO_2 is necessary. Further indicators may be monitored or inspected in order to validate IEQ management performance.

(b) Khovalyg, D., et al., 2020. Critical review of standards for indoor thermal environment and air quality. Energy and Buildings, 213, p.109819.

(c) For non-residential buildings filters are specified in EN 16798-3.

(d) PM2.5 continuous monitoring may only be needed if the outdoor PM2.5 pollution levels are above those set in EN 16798-1 guidelines. If above, particulate matter should be controlled with filters in the ventilation system and infiltration through building envelope should be checked. Indoor pollution levels may also need to be considered (e.g., for residential buildings, in case of local space heaters with indoor emissions).

(e) Volatile Organic Compounds (VOC) refer to a variety of chemicals that can originate in a building, e.g. from building materials and furniture. They are not included here as an indicator, as newer requirements are more focused on specific indicators such as formaldehyde, benzene, etc.

(f) Where relevant, based on national, regional, or local health protection priorities or on specific identified issues which should be considered in the design and operation of the building. For example, nitrogen dioxide and carbon monoxide would be relevant when designing indoor parking areas, or if the building is located in polluted areas or in case of indoor pollution sources. Where relevant, e.g. in the case of specific issues such as indoor problems caused by combustion devices, measurement could be needed to address these specific pollutants. A map of the indoor Radon concentration is provided by the Joint Research Centre of the European Commission (http://data.europa.eu/89h/jrc-eanr-02_indoor-radon-concentration).

(g) Optional element of IEQ definition: it is recommended that it is at least addressed in the design of new buildings.

(h) Illuminating engineering society, IES LM-83-12, 2012.

(i) World Health Organisation (WHO). Guidelines for community noise, 1999.

Table 11

Example of optimal indoor environment limits for new buildings based on a medium expectation of occupants

	Parameter	Examples of optimal ranges						Deviation during occupancy for design outdoor conditions
	-	Heating season ([a]) (T_{rm} ([b]) ≤ 10 °C)		Cooling season ([a]) (15 °C ≤ T_{rm} ≤ 30 °C)		Transition season ([a]) (10 °C < T_{rm} < 15 °C)		
		With mechanical cooling ([c])	Without mechanical cooling	With mechanical cooling	Without mechanical cooling	With mechanical cooling	Without mechanical cooling	
Thermal comfort	Operative temperature (T_{op}) ([d])	T_{op} ≥ 20 °C	T_{op} ≥ 20 °C	T_{op} ≤ 26 °C	T_{op} ≤ 0.33×T_{rm}+21.8 °C	20 ≤ T_{op} ≤ 26 °C	20 ≤ T_{op} ≤ 0.33×T_{rm}+21.8 °C	Yearly: 6% and 3% Monthly: 25% and 12% Weekly: 50% and 20% Outside Category II and III, respectively (EN 16798)
	Draught rate ([e]) (Air velocity)	DR 20% (ISO 7730)	DR 20% (ISO 7730)	DR 20% (ISO 7730)	Openable window ([f]) T_o ≥ 10 °C	DR 20% (ISO 7730)	Openable window ([f]) T_o ≥ 10 °C	n.d. ([g])
	Relative humidity	25 - 60% ([h])						Weekly: 50% and 20% Outside Category II and III, respectively (EN 16798)
Air quality	Ventilation rate (q) ([i])	Supply air flow rate, $q = q_p \cdot n + q_b \cdot A$, where A is the area of the space, q_p is 7 l/s per person for *non-adapted* and 2.5 l/s per person for *adapted*, and q_b is 0.7 l/s per m² (non-residential) ([j]) and 0.15 l/s per m² (residential) ([j]). Extract air flow rates: 15 l/s for bathroom/toilet, 10 l/s for kitchen, and 10 l/s for other wet room. A 75% odour extraction from cooking hoods is considered as optimum for boost air flow rate from kitchen hoods (EN 13141-3)						5%
	Carbon dioxide	ΔCO_2 ≤ 800 ppm above outdoor CO_2 concentration, if people are the main source of pollution ([i]) (EN 16798)						5% ([k])
	$PM_{2.5}$ ([l])	Below an annual mean of 10 μg/m³ and a 24-hour mean of 25 μg/m³						Dependent on outdoor concentration and human behaviour
	Formaldehyde ([l])	30-minute mean: 100 μg/m³						
	Nitrogen dioxide ([l])	1 h mean: 200 μg/m³; Annual mean: 40 μg/m³						
	Radon ([l])	Reference level of 100 Bq/m³ (or 300 Bq/m³ depending on prevailing country-specific conditions)						
	Carbon monoxide ([l])	15-minute mean: 100 mg/m³; 1 h mean: 35 mg/m³; 8 h mean: 10 mg/m³; 24 h mean: 4 mg/m³						

	Parameter	Examples of optimal ranges	Deviation during occupancy for design outdoor conditions
Lighting	Daylight provision	sDA of 300 (100) lx over 50% (95%) of the reference plane within the space (vertical and inclined daylight openings) for 50% of daylight hours. sDA of 300 lx over 95% of the space fraction (horizontal daylight openings) for 50% of daylight hours.	n.d.
	Glare probability	Daylight glare probability (DGP_e) should not exceed 0.40 in more than 5% of the occupation time of the relevant space	n.d.
	Illuminance	100 to 750 lx required depending on type of task and activity area (e.g. 100 lx in corridor, 500 lx for writing, typing, reading, data processing, and 750 lx for technical drawing). Recommended to increase maintained illuminance based on context modifiers (e.g. low daylight provision, productivity, costly errors, impaired visual capacity) ([m])	n.d.
Acoustics	Sound pressure	A-weighted equivalent sound pressure level, $L_{A,eq,nT}$ [db(A)], normalised using reverberation time and standardised to the reference reverberation time. Non-residential ([n]): Small office ≤35 db(A), Landscape office ≤ 40 db(A), conference room 35 db(A) Residential: Living room ≤ 35 db(A), Bedroom ≤ 30 db(A)	5-10 dB(A)
	Sound reverberation time	0.6 - 1 s ([o])	n.d.

([a]) Heating season, cooling season, transition periods, and operative temperature limits may be defined according to national regulations.

([b]) Running mean temperature (T_{rm}) can be calculated as $T_{rm} = \left(T_{ed-1} + 0.8 \bullet T_{ed-2} + 0.6 \bullet T_{ed-3} + 0.5 \bullet T_{ed-4} + 0.4 \bullet T_{ed-5} + 0.3 \bullet T_{ed-6} + 0.2 \bullet T_{ed-7}\right)/3.8$, where $T_{ed\text{-}i}$ is the daily mean outdoor air temperature for the previous i^{th} day. (EN 16798-1, 7-day formula).

([c]) Cooling of the indoor environment by mechanical means used to provide cooling of supply air. Includes fan coil units, chilled ceilings and beams cooled surfaces. Opening of windows during night and daytime or mechanical supply of cold outdoor air is not regarded as mechanical cooling.

([d]) Temperature ranges for heating and cooling and transition periods should be used for hourly calculation of cooling and heating energy in building energy performance calculations. Occupant schedule examples can be found in EN 16798 by building type.

([e]) Draught risk (DR). Mostly due to high air velocities from opening of windows, ventilation and air-conditioning systems, but also due to cold vertical surfaces. Usually this is calculated based on a turbulence intensity (Tu) of 40 %.

([f]) Infiltration or small valves in envelope may be required if outdoor temperature (T_o) is below 10 °C for air quality purposes.

([g]) Deviation allowed during occupancy not defined (n.d.). Limits can be imposed for design, commissioning, and inspection but not for monitoring.

([h]) Humidification or dehumidification is usually only needed in special buildings like museums, certain healthcare spaces, process control, paper industry, etc. It is recommended that humidity recovery be used in very cold climates.

([i]) As occupant density in residential buildings may vary between Member States, a total air flow rate of 0.42 l/s per m^2 (including infiltration) can be used as reference. Use of air flow rates for *adapted* persons is only applicable to residential buildings.

([i]) Relative CO_2 concentration, i.e. difference between outdoors and maximum indoors concentrations. For an outdoor CO_2 concentration of 450 ppm, the limit becomes 1 250 ppm. CO_2 limit may vary depending on the required air flow rate for the perceived air quality.

([j]) Ventilation rate for diluting building emissions may be adjusted according to the pollution level of the building according to EN 16798-1.

([k]) Value proposed in this Guidance.

([l]) Only design and inspection. During design, pollution levels should be estimated based on building site and function. During inspection, measures can be recommended (e.g. filtration, air cleaning) if a specific contaminant is registered.

([m]) Illuminance can be increased according to the scale '5-7.5-10-15-20-30-50-75-100-150-200-300-500-750-1 000-1 500-2 000-3 000-5 000-7 500-10 000' (EN 12464-1).

([n]) Target values are dependent on additional parameters, for example tonal patterns. Noise criteria for other non-residential building and space types can be found in EN16798.

([o]) Dependent on room size and target group (e.g. lower reverberation time desirable for speech intelligibility for older people).

ELI: http://data.europa.eu/eli/C/2025/6438/oj

Table 12

Example of extreme outdoor conditions for residential and non-residential buildings

Domain	Parameter	Description	Purpose	Range
Thermal comfort	Standard effective temperature (SET)	Equivalent dry bulb air temperature of an isothermal environment at 50 % relative humidity, and still air, in which an imaginary subject, while wearing clothing standardised for activity concerned, would experience the same heat stress (skin temperature) and thermoregulatory strain (skin wetness) as in the actual test environment (ASHRAE 55). SET of >30 °C results in uncomfortable conditions for occupants ([a]). It can be used as an indicator for passive survivability.	Passive survivability during heatwaves ([b])	Residential: ≤ 5 °C SET-days (120 °C SET-hours) above 30 °C SET. Non-residential: ≤ 10 °C SET-days (240 °C SET-hours) above 30 °C SET. ([c])
	Percentage of occupied hours within a heat index range (PHHI)	The heat index (HI) represents the temperature expectation of the human body when both air temperature and relative humidity are taken into account. Can be normalised by the occupied hours and be used as an indicator for passive survivability. Heat exhaustion likely for a HI > 39.4 °C.		Caution: 26.7 °C ≤ HI ≤ 32.2 °C (fatigue possible with prolonged exposure and/or physical activity) Extreme caution: 32.2 °C < HI ≤ 39.4 °C (heat stroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity) Danger: 39.4 °C < HI ≤ 51.1 °C (heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity) Extreme danger: 51.7 °C ≤ HI (heat stroke highly likely) ([d])

Domain	Parameter	Description	Purpose	Range
Outdoor Air quality	Air quality index ([e])	European air quality index. Based on relative risks associated with short-term exposure to PM2.5, O_3, NO_2 as defined by WHO, relationship between PM10 and PM2.5 (1:2) and limit values for SO_2 set under the EU Air Quality Directive.	Passive survivability during periods with increased outdoor air pollution ([f])	Good: 0 < PM2.5 < 10 μm/m^3. Air quality is good. Enjoy usual activity. Fair: 10 < PM2.5 < 20 μm/m^3. Enjoy usual outdoor activity. Moderate: 20 < PM2.5 < 25 μm/m^3. Enjoy usual outdoor activity. Poor: 25 < PM2.5 < 50 μm/m^3. Reduce intense activity if symptoms such as sore eyes, cough, or sore throat arise. Very poor: 50 < PM2.5 < 75 μm/m^3. Reduce intense activity if symptoms such as sore eyes, cough, or sore throat arise. Extremely poor: 75 < PM2.5 < 800 μm/m^3. Reduce intense activity if symptoms such as sore eyes, cough, or sore throat arise.

([a]) Gagge, A., et al., An effective temperature scale based on a simple model of human physiological regulatory response, 1970.
([b]) Resilience to heat waves can be assessed during design using extreme future weather data.
([c]) Source: U.S. Green Building Council. *LEED BD+C: Passive Survivability and Back-up Power During Disruptions*. Standard effective temperature (SET) hours are calculated as the sum of the difference between the zone calculated SET and 30 °C, only if the zone SET is greater than 30 °C, for all hours of the extreme hot week.
([d]) US National Oceanic and Atmospheric Administration.
([e]) Outdoor air concentration, Air quality index, https://ecmwf-projects.github.io/copernicus-training-cams/proc-aq-index.html#about.
([f]) During short-term events with an air quality index of poor and above, windows should be closed, mechanical ventilation reduced, and air cleaning (if available) operated.

4. INSPECTIONS

4.1. Introduction and clarification of the scope

The provisions on inspections are grouped under Article 23 in the recast EPBD, whereas they were addressed in two separate articles in the 2018 amended EPBD: Article 14 dealt with the inspections of heating systems and systems for combined space heating and ventilation; Article 15 dealt with the inspections of air-conditioning systems and systems for combined air-conditioning and ventilation.

Article 23(1) expands the scope of systems to be inspected compared to the 2018 amended EPBD. In particular, it requires inspections of systems with an effective rated output over 70 kW but specifies that it is calculated on the basis of the sum of the rated output of the heat generators and cooling generators.

Before, to establish whether a system was over or under the 70 kW threshold, the respective heating and cooling effective rated outputs were treated separately. For example, a combined heating and air-conditioning system with a heating rated output of 50 kW and a cooling rated output of 30 kW would have been below the threshold of 70 kW for both heating and air-conditioning inspections.

In the recast EPBD, the sum of the rated output of the heat and cooling generators taken into account for the purpose of the 70 kW threshold. In the above example, it amounts to 80 kW (50+30), meaning that the system qualifies for the regular inspections under the recast EPBD. If a heat pump is used as the heating and cooling generator in a system that provides both heating and air-conditioning, then the rated outputs for heating and cooling should be added. When a heat pump has the possibility to provide both heating and cooling but only provides one of the two services, only the relevant power output effectively used for heating or cooling should be considered in the sum needed to identify the inspection threshold.

The heating system of a multi-apartment building, with four building units served by four autonomous heat generators each with a power output of 20 kW and with no air-conditioning system, would not qualify for the inspections under Article 23, as in this case the power of the heat generators would not need to be added. In the case of a centralised system (e.g. combining a heat pump and a boiler) serving the heating system of the units of a multi-apartment building, the power output of all generators serving the building must be added.

In practice, combined heating and air-conditioning systems may well exist. This is recognized in the recast EPBD, so there is now scope to treat them together for the purpose of their respective inspection requirements, reporting obligations, periodicity, certification of inspectors, etc. The new provisions support an integrated inspection scheme in these cases, ideally performed by the same inspector in order to avoid double inspections. However, Member States have flexibility and may still opt for separate inspections for the heating and cooling systems.

It is common for a ventilation system to be connected to both the heating and the air-conditioning system. In Member States that have decided to implement inspections for both heating and air-conditioning systems, the ventilation could be subject to a double inspection (once with the heating system and once more with the air-conditioning system). This scenario of double inspections should be avoided in order to limit the burden on buildings and users. The inspection of the ventilation system should only happen once. In the same way, the inspection of stand-alone ventilation systems (now in scope) should as far as possible be integrated with the inspection of heating and/or air-conditioning systems.

Reaching the threshold of 70 kW triggers the inspection of the whole system. This also means that, for example, when that threshold is reached, ventilation systems independent from the heating system, i.e. where the ventilation system is independent from the heating both in terms of heat source and operation, now fall within the scope of the inspections according to Article 23. This is the case, for example, of extract-only systems and supply and extract systems (without pre-heating). Article 23(4), in particular, mentions that where a ventilation system is installed, its sizing and its capabilities to optimise its performance under typical or average operating conditions relevant for the specific and current use of the building must also be assessed ([55]).

([55]) It is common for a ventilation system to be connected to both the heating and the air-conditioning system, specifically in non-residential buildings. The new provisions support an integrated inspection scheme in these cases, ideally performed by the same inspector to avoid double inspections.

Generally, if the systems are serving the building, they must be included. However, it is possible to exclude from the inspections very small stand-alone systems that have no significant impact on the building's energy performance, such as a stand-alone extraction fan only serving one room or individual bathroom extraction fans or kitchen hoods not connected to a central system.

Article 24 sets out the requirements for the reports on the inspection of heating systems, ventilation systems and air-conditioning systems, to be handed over to the owner or tenant of the building or building unit. Member States should evaluate whether the reporting methodology and templates need to be updated, based on the requirements introduced in Article 23. In addition to these, the inspection report must also indicate any safety issue (which may be, e.g., related to fire or electrical hazards) detected during the inspection. The inspection report must be uploaded into the national database for the energy performance of buildings in line with Article 22. This would also ensure adequate tracking of the inspections (e.g. in terms of number of inspections, type of systems, size, etc.) and could feed into the summarised analyses of the inspection schemes and their results that Member States are required to include as an annex to the national building renovation plan (NBRP) according to Article 23(9). The number of inspections, the type of systems inspected, the expected saving in terms of energy and greenhouse gas (GHG) emissions resulting from the recommended actions, and other relevant information may be included in the summarised analysis. Member States that have opted for the alternative measures (section 4.5) must instead annex to the NBRP a summarised analysis and the results of the alternative measures, which could include, e.g., the expected saving in terms of energy and GHG emissions.

4.2. **Setting inspection frequencies**

Article 23(3) introduces minimum frequencies of inspections: systems with generators of an effective rated output of more than 70 kW (calculated as explained above) must be inspected at least every five years; systems with generators of an effective rated output of more than 290 kW shall be inspected at least every three years. The new frequency should be counted from the date of the last inspection.

Member States are free to set different inspection frequencies, while respecting the above-mentioned minimum intervals, depending on the type and effective rated output of the system. For example, an inspection frequency shorter than five years could be dedicated to heating systems that involve a high risk of carbon monoxide intoxication (mentioned in Recital 73), depending on the type of heat generator, the type of fuel (coal, oil, biomass, gas) or the location of the heat generator (such as in living spaces or in spaces not properly ventilated). It is up to Member States to establish the inspection schemes: besides what is identified in Article 23(4), last paragraph, some elements that might not need to be reassessed in each inspection may be identified in this process, if justified by the presence of measuring devices providing the relevant information.

4.3. **New inspection requirements**

Article 23(4) introduces a series of new requirements for the periodical inspections of technical building systems. This means that, where needed, the existing inspection schemes need to be revised to include these new requirements.

The inspection scheme still includes an assessment of efficiency and sizing of the heat and cooling generator or generators and of the main components thereof. In this context, Article 23(4) adds a reference to the use of available energy-saving technologies as well as the requirement to also consider the capabilities of the system to optimise its performance under changing conditions, due to use variation.

Among the elements that need, where appropriate, to be included in the inspections are components of ventilation systems, air and water distribution systems, hydronic balancing of systems (relevant for hydronic heating and cooling systems, see sub-section 0) and control systems. Member States may include additional building systems as indicated in Annex I of the recast EPBD. If the heating generator also serves the DHW system, it is recommended that the latter also be included in the assessment. If an energy storage system is part of a heating or cooling system, they should be assessed jointly.

In addition, where a ventilation system is installed, its sizing and its capabilities to optimise its performance under typical or average operating conditions relevant for the specific and current use of the building must also be assessed. The inspection should also be able to identify issues in terms of inadequate IEQ, e.g. by assessing the ventilation rate ensured by the equipment, and to provide recommendations.

The inspection schemes should include new elements for ventilation systems, which can be as detailed in EN 16798-17 ([56]) and summarized in Table 13.

Table 13

New elements for inspection of ventilation systems

System category	Examples of what inspections may cover	Examples of components that may be included
Mechanical exhaust and/or supply systems	Requirements in EN 16798-17 including components indicated in chapter 6.4.2 Mechanical exhaust and/or supply systems.	Ductwork, air handling units or fan, air filters, heat exchangers and heat recovery, externally or internally mounted air transfer device/supply or exhaust in rooms, air intakes and air exhaust openings of the system, controls and settings, recirculated air.
Natural ventilation	Requirements in EN 16798-17 including components indicated in chapter 6.4.3 Natural ventilation. It is advised also to include controls of natural ventilation in the inspection.	Inlets, exhausts, air volumes and air velocity, motors, control, sensors.
Hybrid ventilation	Requirements in EN 16798-17 including components indicated in chapter 6.4.4 Hybrid ventilation; above categories in 6.4.2 and 6.4.3.	A combination of the examples mentioned above in this table.

To address, where necessary, the new requirements of the recast EPBD, Member States are advised to take account of the standards EN15378-1 and 2 for the inspection of heating and DHW systems; EN16798-17 and 18 for the inspection of ventilation and air-conditioning systems. These standards detail the methods, measurements, and content of inspections.

The inspection must, where relevant, assess the feasibility of the system to operate under different and more efficient temperature settings, such as low temperature for water-based heating systems, including via the design of thermal power output and temperature and flow requirements, while ensuring the safe operation of the system. The guidance on energy performance certificates and independent control systems in Annex 3 to this Commission Notice on Energy performance certificates (Articles 19-21, Annexes V) and independent control systems (Annex VI) provides, at section 4.4, information on low-temperature heating in hydronic systems, together with the recommended assessment steps needed to determine the potential of heating systems to achieve energy-efficient performance within residential buildings (including a calculation tool for assessing the low-temperature feasibility in existing dwellings).

The inspection shall, where relevant, include a basic assessment of the feasibility to reduce on-site use of fossil fuels ([57]), for example by integrating renewable energy, changing energy source, or replacing or adjusting the existing systems. For example, if the building is located in a district heating area (e.g. based on renewables and waste heat), the basic assessment could result in the recommendation to connect the inspected building to the district heating system (in the context of the report introduced in Article 24). Alternatively, solutions relying on renewable energy could be assessed: for example, installing heat pumps, bio-energy boilers, solar thermal systems, and combinations thereof, or replacing the fossil fuels burnt in the existing equipment with renewable fuels such as biofuels, bioliquids, biomass fuels and renewable fuels of non-biological origin.

([56]) It should be noted that EN 16798-17 was produced to meet the requirements of the previous directive. It also covers air conditioning system(s) without mechanical ventilation and air conditioning system(s) with mechanical ventilation. Therefore some, but not all, ventilation systems were covered previously.

([57]) See the guidance on what qualifies as a fossil fuel boiler, as referred to in Article 13(8) (Annex 11 to this Commission Notice on Fossil fuel boilers).

4.4. **Exemptions from inspections**

The exemptions from regular inspections for non-residential buildings equipped with BACS in line with Article 13(10) and for residential buildings with the monitoring and control functionalities detailed in Article 13(11) still apply and must be granted by Member States. As of the transposition date (29 May 2026), for a building to be exempted as provided for in Article 13(10), the additional functionality of IEQ monitoring needs to be ensured. The exemption was introduced in the 2018 amended EPBD to support the deployment of these technologies and functionalities and to release those buildings where they are installed from the periodical costs of inspections. If necessary, leaner dedicated maintenance schemes ([58]) could help verify the proper installation and functioning of monitoring and control systems and functionalities.

The exemptions laid down in Article 23(5), previously covered by Article 14(2) and 15(2) of the 2018 amended EPBD, continue to apply, provided that the overall impact is equivalent. Those exemptions cover technical building systems:

— that are explicitly covered by an agreed energy performance criterion or a contractual arrangement specifying an agreed level of energy efficiency improvement, such as energy performance contracting, or

— that are operated by a utility or network operator and therefore subject to performance monitoring measures on the system side ([59]).

An energy performance contract as defined in Article 2(33) of the Directive (EU) 2023/1791 (recast Energy Efficiency Directive, EED) fulfils these requirements.

The recast EPBD does not indicate how the equivalence of such exemptions should be determined. One possibility could be to ascertain whether the technical building system already undergoes a regular inspection under the contract or agreement, and that it is similar in nature to inspections under Article 23(1). If the technical building system undergoes such an inspection, an exemption from the requirements set out in Article 23(1) could be granted. It is safe to assume that most energy performance contracts or agreements already include some level of regular inspection. However, the full extent of those inspections may not be completely in line with the requirements of the recast EPBD (also given the expansion of the scope and the requirements for inspections).

Among other measures, the recast EED also introduces provisions on energy services. Article 28 requires Member States to ensure that certification or equivalent qualification schemes, including, where necessary, suitable training programmes, are available for energy efficiency-related professions including providers of energy services and that providers of certification or equivalent qualification schemes, including, where necessary, suitable training programmes are accredited in accordance with Regulation (EC) No 765/2008 of the European Parliament and of the Council or approved in line with converging national legislation or standards. Article 29 of the recast EED requires Member States to support the public sector by providing model contracts for energy performance contracting. Under Article 28 of the EED, these model contracts must include at least the items which are listed in Annex XV. For the purposes of the equivalence requirements indicated in Article 23(5) of the recast EPBD, energy performance contracts signed by an accredited/certified company which adequately follows a model such as the one specified in Annex XV to the recast EED could be considered to have an equivalent impact to that of inspections. Member States would therefore need to have a publicly available list of accredited or certified companies together with publicly available model contracts.

([58]) For example, France has developed a dedicated periodical inspection scheme for BACS introduced by the aforementioned 'Décret n° 2023-259 du 7 avril 2023'. A subsequent Decree of the Ministers responsible for energy and construction further details the scheme in terms of frequency, technical specifications and methods for the inspection, including the content of the inspection report.

([59]) There can be many configurations of these systems: e.g. in the case of a district heating (DH) system serving a building, if the DH operator owns a meter with sufficient capabilities (e.g. measuring temperature difference between supply temperature and return temperature from the building), this can be considered as fulfilling performance monitoring measures on the system side. This means that there is no obligation for an inspection, but the effect must be equivalent: the DH operator monitors the system performance and can detect performance issues and make the necessary adjustments, where a need for them is identified. Additional measures (information for the receivers of the service, installation of control and regulation systems, etc.) may be needed to ensure full equivalence.

For the purposes of record keeping, the status of a system exempted from inspections due to an energy performance contract should be recorded in the inspection database. This should include a reference to the duration of the contract and, thus, the period for which the exemption applies.

4.5. **Alternative measures**

Article 23(6), replacing Articles 14(3) and 15(3) of the 2018 amended EPBD, confirms that Member States may opt to take alternative measures ([60]) to the inspections of technical building systems such as financial support or the provision of advice to users concerning the replacement of generators, other modifications to the system and alternative solutions to assess the performance, efficiency and appropriate size of those systems. In such cases, Member States are required to ensure that the measures have an overall impact that is equivalent to the impact that would have been achieved had an inspection scheme been in place, as set out in Article 23(1). This means that a baseline of what would be achieved under the measures set out in Article 23(1) should be calculated, in order to ascertain whether the alternative measures will have the same impact. Article 23(6) of the recast EPBD now also specifies that such impact must be **expressed in terms of energy savings and greenhouse gas emissions.**

According to Article 23(6), Member States must report alternative measures to the Commission **before starting to apply them**. The notification of those alternative measures should be accompanied by an equivalence report. The existing reporting obligation of notifying this report also under the national energy and climate plans (NECP) is now removed. However, Member States that have opted for the alternative measures introduced at Article 23(6) must include, every five years, a summarised analysis and the results of the alternative measures as an annex to the national building renovation plan (NBRP)referred to in Article 3 of the recast EPBD. It is recommended that the summarised analysis include an assessment of the need to update or revise the equivalence report or the calculations of impacts in the future. If the assessment finds such a need, a new equivalence report should be submitted in due time.

For Member States that have not opted for alternative measures, a summarised analysis of the inspection schemes and their results must instead be included as an annex to the NBRP.

Although the recast EPBD groups the provisions on inspections under one single Article (Article 23) – while they were previously covered by two separate articles (14 and 15) in the 2018 amended EPBD with heating and air-conditioning systems treated separately – Member States may decide to adopt a 'hybrid' approach and to cover, for example, heating systems with regular inspections and air-conditioning systems with alternative measures (e.g. in those countries where the number of air-conditioning systems above 290 kW is very limited). In these cases, the above-mentioned reporting obligations would apply separately, so the summarised analysis of the results of both the inspection schemes and the alternative measures will have to be provided.

4.6. **New inspection scheme after construction and renovation works**

Article 23(8) requires Member States to put in place inspection schemes or alternative measures such as digital tools and checklists to certify that the delivered construction and renovation works meet the designed energy performance and are compliant with the minimum energy performance requirements laid down in the building codes or equivalent regulations. This provision aims to address quality issues and lack of adequate tracking of existing construction and renovation works as well as 'as built' vs 'as designed' performance gaps. In principle, this will target major renovations and new constructions, for which procedures such as commissioning and on-site 'as built' controls are in place (also for aspects other than energy performance) and for which energy performance certificates (EPCs) are issued according to Article 20(1)(a) of the recast EPBD.

([60]) An overview of the alternative measures implemented in Member States, based on the analysis of the latest equivalence reports notified to the Commission in line with Articles 14(3) and 15(3) of the 2018 Amended EPBD is provided in European Commission: Joint Research Centre, Maduta, C., Tsemekidi-Tzeinaraki, S., Castellazzi, L., D'Agostino, D., Melica, G., Paci, D. and Bertoldi, P., *Updates on the Energy Performance of Buildings Directive implementation in the EU Member States,* Publications Office of the European Union, Luxembourg, 2025, https://data.europa.eu/doi/10.2760/9619902, JRC140950.

Provided that Member States are free to opt for alternative measures, the inspection introduced in Article 23(8) should be on-site and must be carried out by an independent expert, who must ensure visual inspection, verification and collection of relevant building data (such as technical product documentation) and of any relevant documentation from the testing and functional measurements of building systems. Compliance with the minimum requirements and achievement of the designed energy performance can be verified through the collection and assessment of the EPC. The inspection could be carried out by the same expert who drafts the EPC. The building owner must receive all relevant documentation resulting from the inspection. This also complements and integrates the existing provisions, which are now in Article 13(6), as regards ensuring that, when a technical building system is installed, the overall energy performance of the altered part and, where relevant, of the complete altered system is assessed and that the results of this assessment are documented and passed on to the building owner, so that they remain available and can be used for the verification of compliance with the minimum requirements of technical building systems (laid down in Article 13(1)) and the issue of EPCs.

Alternative measures, such as digital tools and checklists, will need to meet the same quality level as the inspections scheme, and will require documentation from Member States. An example could be 'as built' building information models (BIM) providing the necessary information on installed products, digital product data sheets, and links to additional documentation (e.g. EPCs).

5. TECHNICAL, ECONOMIC AND FUNCTIONAL FEASIBILITY

The notion of 'feasibility' is relevant for several system requirements in Article 13 as well as for several other articles (such as Articles 10, 11, 14, 17). This section introduces the notion in general terms, while specific examples of how to approach technical, economic and functional feasibility for the different provisions of the recast EPBD are provided in the corresponding guidance documents.

Note that if an obligation is subject to 'conditionalities' of technical, economic and functional feasibility this is an exception that should be narrowly interpreted and as such it is for the Member States to detail the specific cases in which meeting the requirements is not feasible from a technical, economic and/or functional perspective. Member States should ensure that these cases are clearly identified, framed and justified ([61]).

The interpretation of technical, economic and functional feasibility should not be left solely to the judgment of interested parties (e.g. owners or system installers ([62])). The conditions under which feasibility is evaluated should be defined and made public at Member State level or, where regional conditions affect only part of a Member State's territory, at regional level, so that there is clarity on when and how they apply. However, in the latter case, regional conditions should be defined in national transposition measures. In all cases, these conditions should be documented (e.g. in technical guidelines) and should apply uniformly on the national, or, where applicable, regional, territory. Finally, the non-application of system requirements should be assessed with clear procedures established and supervised by public authorities.

These procedures may differentiate between different types of buildings, in particular to address specific types for which technical, economic or functional feasibility is an issue. One example is historical or listed buildings, which can have specific constraints that make it more difficult to apply some of the requirements. In this context, note that compliance with these requirements should not, in principle, alter the character or appearance of historical or listed buildings. To avoid any doubt, also note that the requirements are also applicable to all categories of buildings for which the recast EPBD allows Member States to introduce derogations in the application of minimum energy performance requirements (Article 5(3)). However, the specificities of certain buildings can be taken into account when evaluating the technical, economic and/or functional feasibility of meeting the requirements. In exceptional cases, where the evidence shows that compliance with the requirements is technically, economically or functionally impossible for a specific building, requirements can be disregarded. Such a conclusion can only be reached on a case-by-case basis, and Member States should not introduce systematic exemptions for any category of buildings.

([61]) It is recommended that Member States ensure the adequate involvement of stakeholders in defining the conditions for technical, economic and functional feasibility.

([62]) Meaning that, in cases where those parties are responsible for assessing feasibility, their interpretation should be supported by guidelines and procedures provided by public authorities. This should also ensure a degree of consistency, supervision and control when applying the guidelines and procedures.

The following table sets out how each type of feasibility can be interpreted and provides examples.

Table 14

Interpretation of technical, economic and functional feasibility

Type of feasibility ([a])	Meaning	Examples
Technical feasibility	There is technical feasibility when the technical characteristics of the system and the building (or building unit) make it possible to apply the requirements. There is no technical feasibility when it is impossible to apply them from a technical perspective, i.e. when the system's technical characteristics prevent the requirements from being applied.	Technical feasibility would be an issue if a system does not allow for the installation of the devices needed to comply with the requirements, for example if: — for requirements on heat recovery for ventilation systems, the air intake and exhaust are not located in the same areas; — for requirements on the insulation of pipes, portions of pipes are not accessible.
Economic feasibility	Economic feasibility relates to whether: (i) the expected benefits outweigh the costs of the specific required intervention ([b]) taking into account the expected lifetime of the system; (ii) the costs of the specific required intervention (e.g. system upgrade) are proportionate with regard to the usual costs of applying the requirements.	Economic feasibility can, for example, be calculated based on: — a maximum payback period, taking into account the monetary benefits of applying the requirements (which should be correlated with the expected lifetime of the system in question); — a maximum ratio between the usual costs of applying the requirements and the costs of the specific required intervention (e.g. heat generator replacement).
Functional feasibility ([c])	It is functionally not feasible to apply requirements if these would lead to changes that would impair the operation of the system or the usage of the building (or building unit), taking into account the specific constraints (e.g. regulations) that may apply to the system and/or building.	The application of system requirements may not be functionally feasible for example when: — applicable regulations (e.g. on safety) contradict the requirements; — applying the requirements would result in a significant loss of usability of the building or building unit (e.g. substantial loss of space).

([a]) The two first rows (technical and economic feasibility) apply to Article 10(3), 11(1), 11(7), 13(1) para. 2, 13(3), 13(5), 13(9), 13(11), 13(12), 14(1) para. 3.

([b]) This means that a cost-benefit assessment would be carried out. This cost-benefit assessment approach is probably the most relevant, as applying the requirements will generally result in the costs being recovered (in particular due to energy cost savings).

([c]) Applies only to 10(3), 13(1) para. 2, 13(11).

ANNEX 11

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Fossil fuel boilers (Article 13, Annex II)

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1. INTRODUCTION

Space heating and domestic hot water generation ([1]) accounts for more than three quarters of the final energy consumed by EU households ([2]). Almost two thirds of that energy use is still based on fossil fuels, mostly natural gas ([3]). The decarbonisation of the building sector therefore depends on phasing out the use of fossil fuels for heating from a variety of appliances, most notably boilers.

2. SUMMARY OF THE LEGAL PROVISIONS

The recast Energy Performance of Buildings Directive (the 'recast EPBD') ([4]) sets a long-term vision for achieving a zero-emission building stock by 2050 and steers Member States in their efforts to this end. It provides the framework for the gradual phase-out of fossil fuels in boilers and requires Member States to set out policies and measures to achieve this in 2040.

The recast EPBD contains several provisions related to the phase-out of fossil fuels:

— Article 17(15) mandates the phasing out of **financial incentives** for stand-alone boilers powered by fossil fuels ([5]).

— Article 3 / Annex II provides that Member States' national building renovation plans (NBRPs) must include **policies and measures** with a view to a complete phasing out fossil fuel boilers by 2040, setting 2040 as an indicative target date for phasing out fossil fuel boilers.

— Article 13(1) contains a **clear legal basis for Member States to set requirements** for heat generators based on GHG emissions, share of renewables or type of fuel. In other words, it contains a legal basis for national bans.

— Article 13(7) **obliges Member States to make best efforts** to phase out stand-alone boilers powered by fossil fuels in existing buildings, in line with the national phase-out plans for fossil fuel boilers.

— Article 13(8) stipulates that '*The Commission shall issue guidance on what qualifies as a fossil fuel boiler*.' While the recast EPBD does not define 'fossil fuel boiler', the notion is used in Article 13(7) and (8), Article 29(2) and Annex II.

3. PURPOSE

The legal provisions summarised above and the notion of 'fossil fuel boilers' must be seen in the context of the recast EPBD objective to set a long-term vision for achieving a zero-emission building stock by 2050.

This annex provides guidance on what qualifies as a fossil fuel boiler, pursuant to the obligation under Article 13(8). It provides guidance on how Member States may comply with (i) the requirement for the NBRPs to include policies and measures with a view to a complete phase-out of fossil fuel boilers by 2040 (Article 3 and Annex II(c) point f); and (ii) the obligations to strive to replace stand-alone boilers powered by fossil fuels in existing buildings, in line with the national phase-out plans for fossil fuel boilers (Article 13(7)).

([1]) Hereafter space heating and domestic hot water generation is referred to as 'heating'.

([2]) In 2022 space heating accounted for 63.5 % of the final energy consumption in the residential sector and water heating accounted for 14.9 %. See Energy use in EU households in 2022 lowest since 2016 - Eurostat (europa.eu).

([3]) Based on Eurostat data ([nrg_d_hhq__custom_14333299] and [nrg_bal_s__custom_14295506]) at EU level in 2022 about 60 % of space and water heating in households came from direct (boilers onsite) and indirect (district heating) use of fossil fuels. In 2022 direct use of fossil fuels for space and water heating in households accounted for more than 80 % of individual heating in Ireland, Luxembourg, the Netherlands and Belgium but less than 10 % in Sweden, Finland, Estonia, and Malta.

([4]) Directive (EU) 2024/1275.

([5]) See Commission Notice on phasing out financial incentives for stand-alone boilers powered by fossil fuels under the recast Energy Performance of Buildings Directive.

4. GUIDANCE ON THE NOTION OF FOSSIL FUEL BOILER AND NATIONAL PHASE-OUT PLANS

4.1. Relevant definitions

Pursuant to Article 2(48) of the recast EPBD, **'boiler'** means the combined boiler body-burner unit, designed to transmit to fluids the heat released from burning ([6]).

'Fossil fuels' are not defined in the recast EPBD but are understood in the same manner as in Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, which defines in Article 2(62) 'fossil fuel' as 'non-renewable carbon-based energy sources such as solid fuels, natural gas and oil'.

'Renewable fuels' as defined in Article 2(22a) of the amended Renewable Energy Directive ([7]), i.e. 'biofuels, bioliquids, biomass fuels and renewable fuels of non-biological origin' are not considered fossil fuels.

4.2. Interpretation

The notion of 'fossil fuel boilers' is particularly relevant for the national policies and measures with a view to a complete phasing out of fossil fuel boilers by 2040. Member States need to include these policies and measures in their NBRPs pursuant to Annex II(c) point f. These policies and measures are referred to as 'national phase-out plans for fossil fuel boilers' in Article 13(7). The wording of Annex II(c) point f indicates that the long-term objective is 'the phasing out of fossil fuels in heating and cooling'. In the context of the phasing out of 'fossil fuel boilers', the objective is therefore phasing out the combustion of fossil fuels in boilers for heating. For this reason and in line with the technology neutrality of the EPBD, **it is the fuel that is used in the boiler that defines whether a boiler is a 'fossil fuel boiler' or not.** In that respect, the notions of 'fossil fuel boiler' and 'boiler powered by fossil fuels' (used in Article 13(7) and Article 17(15)) are interchangeable. With respect to the timeframe for the policies and measures to be included in the NBRPs, **it is the fuel used in the boiler in 2040 that defines whether in 2040 a boiler is to be considered a 'fossil fuel boiler' or not.**

Phasing out the use of fossil fuels in boilers in buildings can be achieved through different measures at national, regional and/or local level, including combinations of such measures. Three possible categories of such measures are set out in the points below.

— Replacing, partly or completely, individual boilers with alternative solutions such as heat pumps, solar thermal installations, or efficient district heating.

— Replacing the fossil fuels burnt in boilers with renewable fuels such as biofuels, bioliquids, biomass fuels and renewable fuels of non-biological origin. In particular, biomethane can be used without the need for any changes in the end-user equipment employing the same pipeline and storage infrastructure.

— Combinations of measures from the above two broad categories.

4.3. Planning obligation

The recast EPBD requires Member States to include policies and measures in their NBRPs with a view to a complete phasing out of fossil fuel-boilers by 2040. 2040 is an indicative target date; the obligation on Member States is to set out **credible policies and measures** with a view to achieving a complete phasing out of fossil fuel boilers by that year.

To this end, **Member States need to plan policies and measures to (i) replace the fossil fuels that boilers combust; and/or (ii) replace the boilers themselves**. Due to the diversity of the energy systems across Member States, the strategy and pace of decarbonisation of heating will be set at national, regional and/or local level in view of the decarbonisation objective in 2040. This strategy supports compliance with the requirement of the Renewable Energy Directive for Member States to contribute to an EU-wide share of 49 % renewables in the building sector by 2030 ([8]).

([6]) This definition covers space heaters, water heaters and combinations of such in buildings.
([7]) Directive (EU) 2018/2001 as amended by Directive (EU) 2023/2413.
([8]) In the buildings sector, an indicative target of 49 % for the share of renewable energy by 2030, in addition to binding national obligations to increase the share of renewables in heating and cooling on average by 0.8 percentage points per year until 2025 and by 1.1 percentage points from 2026 to 2030, and indicative targets for higher annual increases.

This notice provides **examples** of pathways and measures that – on their own or combined – can be the basis for a national or regional implementation plan to (i) replace the fossil fuels that boilers combust and/or (ii) replace the boilers themselves. Member States are advised to take the following methodological steps when drawing up their national phase-out plans, without any obligation to deploy all steps:

— consider whether and which measures to take for the full decarbonisation of the gas grid to the extent it will be used to heat or cool buildings in 2040;

— estimate the share of boilers in the country that would be burning renewable fuels in 2040;

— draw up a plan for phasing out the remaining boilers that would be burning fossil fuels in 2040.

The above list is not ranked by order of preference, but merely reflects a move from the energy system perspective to the individual boiler perspective. National circumstances and policy choices will determine which pathways will be deployed and through what measures. As with other aspects of the NBRPs, the Commission will assess to which extent the measures planned and reported offer realistic and achievable prospects for a complete phasing out of fossil fuel boilers by 2040, taking into consideration both (i) the degree to which these measures account for the trends across all energy vectors and energy end-uses; and (ii) developments in the relevant infrastructure.

4.3.1. *Measures for the full decarbonisation of the gas grid to the extent it will be used to heat buildings in 2040*

Decarbonisation of the gas grid could play a role in phasing out fossil fuels from heating and ensuring that all boilers in buildings combust 100 % renewable fuels.

To the extent that Member States intend to rely on the decarbonisation of the gas grid to phase out fossil fuels from heating buildings, Member States will need to:

— decide whether and to what extent decarbonisation of the gas grid should contribute to the decarbonisation of buildings;

— ensure the sufficient production/supply of sustainable renewable fuels [9] and their large-scale and cost-effective injection into the grid [10];

— take into consideration (i) energy-infrastructure developments across all energy vectors, (including production, transport, distribution and storage for each type of renewable fuel); and (ii) the decarbonisation plans and pathways of all end-use sectors.

Energy efficiency measures to reduce the consumption of gas for heating in buildings would greatly facilitate the decarbonisation of the gas grid by reducing the amount of natural gas that needs to be replaced by renewable gases.

Decarbonising the gas grid could rely on a commitment to progressively increase the share of renewables being fed into the grid. Examples of policies and measures to ensure such a progressively increasing share of renewables in the natural gas grid include **blending obligations, gas network transformation plans drawn by distribution system operators (DSOs) and/or other targets** [11]. Such measures need to be sequenced, financed and monitored.

[9] In line with Article 29 of Directive (EU) 2018/2001.

[10] Some countries already have high shares of biomethane in their grids (Denmark achieved 37.9 % in November 2023), others are at earlier development stages. While the full utilisation of the sustainable potential of biomethane could cover a growing share of current natural gas demand in buildings and, in some countries, even exceed annual demand requirements for natural gas, this is not happening at a scale that suggests that biogas and biomethane are set to become business-as-usual in heating in buildings. In the case of hydrogen, a meta-review of 54 studies on hydrogen heating concludes that the scientific evidence does not support the widespread use of hydrogen for heating buildings, see A meta-review of 54 studies on hydrogen heating.

[11] For example, in the German GEG there is a reference to binding transformation plans for DSO and the DSO needs to compensate customers if hydrogen networks cannot be built.

Whether or not network-based measures on their own can be sufficient to decarbonise the heating of buildings depends, in part, on the decarbonisation pathways of other end-use sectors. For example, whether a gas grid can be completely decarbonised by using renewable gas available in sufficient quantities depends on the overall demand for renewable gas, which in turn depends on developments in gas consumption in buildings and in other end-uses.

4.3.2. *Estimating the share of heating appliances that will burn renewable fuels in 2040*

Taking into consideration the expected level of decarbonisation of the gas grid, Member States can estimate **the expected share of the boiler fleet that will combust renewable fuels in 2040** and thus not be considered as 'fossil fuel boilers', both for on-grid and off-grid boilers ([12]). This forecast would provide transparency as to the role of renewable fuels in the heating of buildings in 2040.

In doing this, national authorities need to give useful effect and deliver on the objective to phase out fossil fuels in heating in buildings with a view to a complete phase-out of fossil fuel boilers by 2040. Where relevant, national authorities should ensure **consistency with – and coordination between – existing strategic plans**, including in particular on heat planning, infrastructure planning across energy vectors, and building and boiler regulations. This consistency and coordination should focus on planning at national and/or regional level, in particular through:

— the National Energy and Climate Plans (NECPs) ([13]);

— the network development plans at distribution level that will take into consideration heating and cooling plans ([14]), ([15]);

— local heating and cooling plans in municipalities, particularly those with a population greater than 45 000 ([16]);

— the comprehensive national heating and cooling assessments ([17]) and the assessment of the potential to use renewable energy and waste heat and cold in the heating and cooling sector ([18]);

— the National plans to support EU action to phase out Russian gas ([19]).

In particular, compliance with all the provisions of the Energy Performance of Buildings Directive, as well as with the obligations and provisions of the Renewable Energy Directive, the Energy Efficiency Directive and the Electricity Directive will help achieve the phase-out of fossil fuel boilers. Success in replacing fossil fuels in the heating of buildings with other heating solutions at the individual and/or collective/ district level will depend on choices by national, regional and local authorities and operators in implementing the interlinked provisions in the body of energy legislation.

([12]) As indicated in the Commission notice on phasing out financial incentives for stand-alone boilers powered by fossil fuels under the recast Energy Performance of Buildings Directive (C/2024/6206), for off-grid boilers not to be considered powered by fossil fuels', the competent authorities in Member States need to require and verify in a robust and credible manner that in reality the unit will operate on renewable fuels at the time of installation and also over its lifetime, given that the beneficiary remains in control of the fuel used in an off-grid boiler during that off-grid boiler's entire lifetime.

([13]) Regulation (EU) 2018/1999.

([14]) For electricity distribution the network development plans are prepared every 2 years (Article 32(3) of Directive EU 2019/944); for hydrogen distribution and for gas decommissioning network development plans are prepared every four years (Article 24(8) of Directive EU 2018/2001.

([15]) There is a requirement for consistency of the distribution network development plans with the Union-wide Ten-Year Network Development Plans (TYNDPs). There are also requirements for cooperation among system operators (DSO-TSO and among DSOs in electricity, gas, etc.) (Article 31(9) of Directive EU 2019/944). Directive (EU) 2024/1788 places the responsibility on Member States to ensure that DSOs develop plans for decommissioning of natural gas networks in the event that there is a reduction in demand for natural gas. The plans should be based on the heating and cooling plans in the Energy Efficiency Directive.

([16]) Article 25(6) of Directive (EU) 2023/1791.

([17]) Article 25(1) and Annex X of Directive (EU) 2023/1791.

([18]) Directive EU 2018/2001.

([19]) COM (2025) 440 'Roadmap towards ending Russian energy imports'.

As an example, the revised Renewable Energy Directive requires Member States to assess the potential of renewable energies and waste heat for heating and cooling. This assessment must also (i) include an analysis of areas suitable for the development of renewable energy and waste heat for heating and cooling at low ecological risk and areas with the potential for small-scale household projects using these technologies and (ii) consider available and economically feasible technology for industrial and domestic uses of renewable energy and waste heat for heating and cooling in order to set out milestones and measures (Article 23(1b)).

The revised Renewable Energy Directive also requires coordinated planning of electricity and district heating systems. Member States must put in place a framework under which electricity distribution system operators will assess, at least once every four years and in cooperation with the operators of district heating and cooling systems in their respective areas: (i) the potential for district heating and cooling systems to provide balancing and other system services, including demand response and thermal storage of excess electricity from renewable sources; and (ii) whether the use of the identified potential would be more resource- and cost-efficient than alternative solutions (Article 24(8)). In addition, Member States must ensure that electricity transmission and distribution system operators: (i) take due account of the results of this assessment in grid planning, grid investment and infrastructure development in their respective territories; and (ii) facilitate coordination between operators of district heating and cooling systems and electricity transmission and distribution system operators. This assessment and coordination may be extended to gas networks.

Local heating and cooling plans, pursuant to Article 25(6) of the Energy Efficiency Directive must include an analysis of heating and cooling appliances and systems in the local building stock.

The next comprehensive national heating and cooling assessments, as part of the integrated national energy and climate plans, are due by 1st January 2029. These plans must provide information on the heating and cooling sector on an aggregated level, but the analysis of economic potential in those assessments may provide insights into the deployment of renewable energy in heating, further complemented with information on measures to be taken to promote the use of heating and cooling appliances that use renewable energy.

Heating and cooling plans need to become part of the scenarios used for network development at all levels and across all energy sectors ([20]). For example, replacing gas boilers with heat pumps or district heating will play a key role in determining the need for electricity or heat networks, and this needs to be reflected in the demand scenarios set out in the electricity DSOs' network development plans (DSO NDPs) but also in the gas DSOs' NDPs. These scenarios for network development must be consistently integrated into the national plans (transmission NDPs) and EU plans (the ten-year network development plans).

4.3.3. *Drawing up a plan for phasing out boilers that will burn fossil fuels in 2040*

Replacing individual boilers that would burn fossil fuels with other appliances may be:

— a complementary pathway, in addition to decarbonising the gas grid, in order to reduce gas demand to a level that can be provided by renewable fuels; or

— a stand-alone pathway to phasing out fossil fuel combustion in boilers by 2040.

In either case, Member States need to plan policies and measures to gradually phase out these boilers that would still burn fossil fuels in 2040 and replace them with alternative heating solutions, such as heat pumps, solar thermal solutions, district heating or direct use of waste heat.

The recast EPBD provisions on zero-emission buildings require that no fossil fuel combustion take place in **new buildings** at the latest from 2030 ([21]). For **existing buildings**, Member States need to draw up measures that will move from progressively reducing the reliance on fossil fuel boilers to setting out a plan the ultimate aim of which is to completely phase out such boilers and replace them with alternative heating solutions.

([20]) Regulation EU 2022/869.
([21]) Article 7(1) and Article 11(1).

When it comes to replacing boilers in existing buildings, Member States may deploy requirements set pursuant to the recast EPBD. Pursuant to the first subparagraph of Article 13(1), Member States must set system requirements for technical building systems (which include heating systems) to be installed in buildings. In addition, the third subparagraph of Article 13(1) of the recast EPBD introduces a clear legal basis for national bans on fossil fuel boilers by introducing requirements related to the greenhouse gas emissions, or to the type of fuel used by heat generators or to the minimum part of renewable energy used for heating at building level.

Examples of such requirements that may be introduced at national level with a view to phasing out boilers include:

— a maximum specific consumption at system level (in kWh/m^2 for heating);

— thresholds for a minimum share of renewables in a heat generator (in % of the energy output);

— emission thresholds (in gCO_2/kWh output).

ANNEX 12

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Common general framework for the calculation of the energy performance of buildings (Annex I)

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INTRODUCTION

This document aims to provide guidance to Member States on the transposition of Annex I – Common general framework for the calculation of the energy performance of buildings ('the calculation methodology') of Directive (EU) 2024/1275 [1] on the energy performance of buildings ('the recast EPBD'). It also aims to provide guidance on the relevant elements related to the calculation methodology throughout the recast EPBD, such as definitions in Article 2 and zero-emission buildings in Articles 7 and 11. The guidance covers all new provisions and modifications to existing provisions. In addition, it provides further recommendations on existing provisions where relevant.

1. POLICY AND LEGAL CONTEXT

The methodology for assessing the performance of buildings is a key element of the EPBD. It is used directly in several Articles on cost-optimal calculation, minimum energy performance requirements, energy performance certificates (EPCs), building renovation passports (BRPs), zero-emission buildings and databases for the energy performance of buildings. It is also used when carrying out renovations and it is necessary to identify the potential or actual improvement in performance due to subsidies or loans. Its relevance goes beyond the EPBD. For example, it is also widely used in building design (as a tool to identify and benchmark design solutions. The EU green taxonomy [2] also indirectly relies on its framework at national level to identify if an activity fulfils the requirements in place.

The calculation methodologies in use in all Member States rely on common and established physics, but their application must be able to adapt to the needs and particularities of different Member States. While climate is an obvious factor, there are other factors that may be considered, such as building typologies, technologies, the availability of renewable energy sources on-site or on the grid, and social and cultural aspects.

The energy performance of buildings has been improving significantly since the EPBD was first introduced in 2002. Modern buildings consume less than half of what was typical before 2002, and this is likely to continue improving in the coming years. As requirements are steadily becoming more ambitious, the calculation methodology needs to also improve and allow for a better representation of the energy performance of buildings at multiple levels: the building as a whole, its individual components and the building as part of the larger energy system.

The calculation methodology also needs to be able to adapt to new technologies and products, new practices in the construction sector, the evolution of the building sector itself (as it responds to different user needs) and the larger energy sector (e.g. the progressive introduction of renewable energy sources in the energy mix).

Together with the Member States, the Commission established a set of standards (EPB standards) and accompanying technical reports to support the EPBD through Mandate M/480 to the European Committee for Standardisation, CEN 2012-2017. There is no obligation to adopt the standards and Member States may use their national calculation methodologies. However, the EPBD does require that Member States use a set of EPB standards to communicate the national calculation methodology to the Commission (see Chapter 4.6).

The calculation methodology aims to:

— provide a clear framework for the calculation of energy performance;

— identify the main energy needs of the building, including user needs and behaviour;

— represent the effects of the different building elements and systems;

— represent the integration of the building with the rest of the building energy uses (e.g. white goods or office equipment) and the larger energy grid;

— make it easier to introduce new technologies (e.g. energy storage).

(1) Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast).

(2) EU taxonomy for sustainable activities – European Commission.

2. SUMMARY OF OBLIGATIONS UNDER ANNEX I AND THE CALCULATION METHODOLOGY

Annex I builds upon and complements the provisions related to the calculation methodology already established in the original EPBD in 2002, its 2010 recast and the amending 2018 EPBD.

Table 1 presents an overview of the obligations related to the calculation in Annex I and elsewhere in the recast EPBD.

Table 1

Summary of obligations in Annex I (including new, modified and existing)

Scope	Member State (MS) obligation
Reflect typical energy use	— MS to identify the typical energy uses for buildings (existing)
Use of metered energy in calculation methodology	— MS to define the boundaries for the use of metered energy in the calculation methodology (new option)
Use of indicators	— MS to define primary energy use (modified) — MS to define additional indicators, including greenhouse gas emissions (modified)
Use of primary energy or weighting factors	— MS to define primary energy factors or weighting factors for energy carriers (modified) — MS to consider the integration of the building into the energy grid and its evolution over time (modified)
Consideration of building and system aspects	— MS to lay down the methodology considering at least the aspects identified in Annex I(4) (including new aspects in the recast) (modified) — MS to consider the positive influence of multiple aspects identified in Annex I (5) (including new aspects) (modified)
Classification of buildings in categories	— MS to classify buildings according to classes identified in Annex I (6) (existing)
Reporting of calculation methodology	— MS to report their calculation to the Commission using the national annexes of the standards identified in Annex I (modified)

3. IMPLEMENTATION OF OBLIGATIONS UNDER ANNEX I

3.1. Determination of energy use

3.1.1. *Energy uses identified in the EPBD*

To calculate the energy performance of a building, the energy needs must first be defined (for example by EN ISO 52016-1 (Article 1, Annex I)). They refer to the amount of energy (regardless of its source and efficiency of systems) to be supplied or extracted in order to maintain the requirements for indoor environmental quality (IEQ). This gradually expands the system boundary from energy needs to delivered energy and finally to primary energy use.

To fulfil the building's requirements for IEQ, the EPBD identifies the 'services related to the energy performance of buildings' or 'EPB services' (Article 2(56)). These services comprise heating, cooling, ventilation, domestic hot water, lighting and others. These are the systems applicable in most buildings, although in some cases additional services may be needed. For example: humidification or de-humidification in specialised rooms or uses, specialised cooling in server rooms, domestic cold water pumping, parking or external lighting, internal mobility, etc.

Member States should decide themselves if additional energy needs from the broader definition of technical building systems are to be considered when calculating the energy performance. The Commission recommends that Member States consider the needs of these other technical building systems when these are responsible for controlling the IEQ of a building [3]. This should help differentiate between systems that have an effect on IEQ (e.g. printers or cooking appliances) from those that control IEQ (e.g. humidity and purification devices).

EPB services exclude energy uses that are also typical in buildings, but that are not directly related to maintaining IEQ. This applies for example to the energy loads of white goods, home electric appliances,, office equipment or industrial processes. However, because these (non-EPB) energy loads have a significant effect on (EPB) energy needs, it is important to identify them and take into consideration their effects on EPB services. For example, the energy use for office equipment (because of its internal heat gains) will play a key role in the calculation of heating and cooling needs in office environments.

Electricity for charging e-vehicles is not considered an EPB service. However, renewable energy generated on-site may be exported to the vehicle. This would have the advantage of avoiding losses related to extraction, refinement, conversion and transport, which could be reflected in the calculations (see Chapter 4.3). It would also make it easier to represent the integration of buildings into smart energy grids, and would enable smart grid integration.

3.1.2. *Key definitions*

Clarification on definitions available in the EPBD

EPB uses or EPB services – Article 2(56) defines the uses that are relevant for the energy performance assessment of buildings. Services such as heating, cooling, ventilation, domestic hot water and lighting are directly mentioned and must therefore be included in the assessment. Member States should also include other services if relevant. Article 1 establishes the relationship between energy performance and among other things the requirements of IEQ. Based on this relationship, other services that have an impact on IEQ should be considered by Member States where relevant. This could include, for example, services related to treating outside air in specific cases (e.g. humidifiers or purifiers for specific room uses which differ from the typical conditions). Additional building services could also be considered (e.g. escalators or elevators).

Energy needs – Article 2(57) defines energy needs as the energy supplied (or extracted) from a conditioned space to maintain intended conditions. These are the requirements of a given building space or building before the efficiencies of technical building systems or primary energy factors are considered.

Energy use and energy consumption – Defined in Article 2(58) as the input to a technical building system, including the inefficiencies of the system. Both terms (use and consumption) are interchangeable for the purposes of the EPBD. Energy use may be calculated in primary energy use or in final energy use.

Primary energy – Defined in Article 2(9) as the energy from a renewable or non-renewable energy source that has not undergone any conversion. It is calculated by applying a primary energy factor to the final energy use. Depending on the energy source, this can be: renewable primary energy, non-renewable primary energy or total primary energy (the result of adding renewable and non-renewable).

Clarification on terms used in the EPBD, but not defined in the legal text

Typical energy use – This represents the conditions used as a baseline in the calculation methodology. They often include patterns and profiles of use that reproduce how buildings are generally used. For example: pre-warm up period, opening hours, temperature settings or use of temperature set-back conditions in the case of demand-controlled systems. Typical energy use should be representative of the building stock for a given building category, although this may result in differences between an individual building and the specific energy use. Typical energy use is the opposite of specific energy use, which would apply to an individual building under distinct circumstances.

(3) For the definition, see the Guidance on Technical Building Systems, Indoor Environmental Quality and inspections in Annex 10..

Final energy use – This represents the energy use of a building and its system, taking into consideration the inefficiencies of the system, but before primary energy factors are applied. Final energy use can be understood as being applied to the whole buildings, or it can be applied to a single system (e.g. final energy use for the domestic hot water system). Because the primary energy factor is applied to energy carriers, final energy use should be recorded separately per energy carrier.

Energy delivered – This represents the energy supplied (delivered) to a system or a building through the building assessment boundary per energy carrier.

Energy exported – This represents the energy supplied (delivered) from the building to the grid through the building assessment boundary per energy carrier.

3.1.3. *Building categories*

Buildings are very different from one another and respond to very different needs. However, they can be broadly grouped into the categories identified in paragraph 6 of Annex I.

(a) single-family houses of different types;

(b) apartment blocks;

(c) offices;

(d) educational buildings;

(e) hospitals;

(f) hotels and restaurants;

(g) sports facilities;

(h) wholesale and retail trade services buildings;

(i) other types of energy-consuming buildings.

The aim of the categories is to group similar buildings that share similar energy uses and patterns.

Member States may identify additional categories of buildings or subdivide the categories already identified in the EPBD. For example, they could define a subcategory for primary schools and secondary schools.

3.1.4. *Typical energy use and user behaviour*

For the calculation of energy performance, it is important to determine the typical use of a building. Typical energy use includes aspects directly related to energy (e.g. operating temperature), but also how users behave and use a building (e.g. operating hours).

It is common for buildings to actually have multiple uses (e.g. a multi-residential building with retail shops on the ground floor). In this case, the calculation must be based on the typical use per building category of space. Benchmarks and minimum energy performance requirements should be applied based on the weight of the different spaces (e.g. based on floor area).

The EPBD requires that typical energy use is representative of actual operating conditions in the building categories identified. This is a key element in ensuring that the calculation methodology can be applied consistently throughout the building stock and allows for benchmarking between buildings.

The EPBD indicates that typical energy use and typical user behaviour should, where possible, be based on available national statistics, building codes and metered data. Member States may use additional methods such as sampling, questionnaires or interviews with professionals in the given sector. The aim is to ensure that the defining elements are representative.

Typical use and behaviour may vary over time, for the whole building stock or for individual building categories. For example, the COVID-19 pandemic saw a significant increase in the use of teleworking, even when workers were allowed to return to the office. The gradual introduction of computers in schools has also seen changes in energy patterns (e.g. higher internal gains).

The evolution and changes in the use in buildings should be represented in the typical use and behaviour when calculating the performance of buildings.

Member States should revise these parameters at regular intervals. For example, they could revise them before each cycle or every two cycles of the cost-optimal methodology (equivalent to revising them every 5 or 10 years). See Chapter 4.7 on changes to the framework for the calculation of energy performance.

3.1.5. *Energy use in an individual building and user behaviour*

The main uses of the framework for the calculation of energy performance are to allow for the evaluation of compliance of minimum energy performance requirements and the issuance of EPCs. For these purposes, the calculation methodology must use the typical energy use and behaviour.

The energy performance calculation framework could also be used to provide tailored information about the performance of an individual building. For example: energy audit or to identify design parameters. In order to do so, the use and behaviour would need to be modified and tailored to suit the actual or expected conditions. For example, a developer may be interested in benchmarking different options for a building where it is known that its use will be substantially different from a typical building (e.g. an office building that will be used 24/7). In this case, it is relevant for developers to be able to better model these conditions in order to identify the best system or solution.

In order to facilitate this flexibility in the calculations, Member States should allow the framework and any related calculation engines (i.e. software) to modify the operating condition for the production of specific and tailored calculations.

The results of these specific calculations should not be used to demonstrate compliance with energy performance requirements. In some very specific cases, where the building use characteristics are clearly identified, are different from typical patterns and cannot be modified without substantial changes to the building, it may be advisable to use specific calculations. Such uses should be authorised through specific waivers provided by the relevant authorising body in the Member State.

The results of these specific calculations cannot be used to issue an EPC, which must always be dependent on the building category in order to allow for benchmarking.

3.1.6. *Energy use when a system is not present*

It is common for an EPB need to not have a system associated to it in a building. For example, many buildings or building units in southern European Member States do not have central heating systems installed, and instead rely on portable space heaters. Similarly, many buildings rely on natural ventilation or passive means to provide thermal comfort in summer, while others may have cooling systems installed. In addition, some buildings may rely on natural ventilation to provide fresh air, while others may rely on mechanical ventilation.

The EPBD requires that IEQ in buildings is maintained. This is associated with the various energy needs (e.g. heating to maintain the temperature in winter, ventilation rate to ensure sufficient fresh air).

When there is no fixed system directly associated to an energy need, Member States should allocate a notional service to the energy need. This service should enable the fulfilment of building requirements (e.g. minimum temperature settings) be representative of typical solutions used in such cases, have a performance associated to it and an energy source, which would in turn require a primary energy factor (or weighting factor).

The following are three examples of how most typical scenarios could be approached:

— **Building without a fixed heating system** – In this case, it would be safe to assume that the building would rely on space heaters to supply the necessary heating. They would have an efficiency rating associated with them (e.g. 98%) and would rely on electricity (e.g. PEF 2.5 for grid electricity). This artificial system would then be used to calculate the building performance.

— **Building with natural ventilation** – In this case, buildings with good airtightness would rely on the manual opening of windows or dedicated passive ventilation devices to ensure sufficient fresh air. Manual openable windows usually offer less control over the flow of fresh air, but they can still provide the necessary service. Therefore, Member States must assume that the comfort air exchange rate is provided anyway. Member States might consider reflecting the lack of control in the calculation methodology, for example through the application of control coefficients. Member States should differentiate between alternatives. For example, dedicated passive ventilation devices (e.g. grilles in windows or walls designed to allow for small volumes of air) are usually better at performing their role compared to a large window given that they are purposedly designed for a limited but constant flow of air. If windows or passive ventilation devices rely on automated control (e.g. automated windows), it would be safe to assume that the ventilation rates are also better controlled and therefore the improved performance should be reflected.

— **Building with undersized systems** – In this case, it is safe to assume that the existing system would carry out the proportion of the load ([4]) corresponding to its size. The remaining load would still need to be covered, in which case the calculation could use the same approach as for buildings without a fixed system.

The assumed system approach is not mandatory. If used, it should be clearly visible in the EPC as important information for the owner and EU databases.

If the assumed system approach is not used, then the EPC and EU databases should clearly report the inability to maintain the required conditions (e.g. temperature settings). This approach is not recommended, since it may be difficult to explain and users may still concentrate on the apparent better performance value.

3.1.7. *Calculation intervals*

Paragraph 2 of Annex I requires that the energy needs are calculated using monthly, hourly or sub-hourly time calculation intervals. This is a modification from the EPBD in 2010 and 2018, which also allowed for yearly intervals in the calculation.

Smaller calculation intervals allow for a better representation of the building needs, system performance and overall energy use. This is particularly relevant when advanced control systems, renewable energy sources or energy storage are available in the building.

The Commission recommends the following intervals according to the type of building, its systems and the purpose of the calculation.

Table 2

Recommended calculation intervals for energy performance assessment

	Calculation interval			
Building type	New building requirements	Major renovation requirements	Issuing EPC	Issuing BRP
Residential simple	Hourly or sub-hourly	Hourly or sub-hourly	Monthly or hourly	Hourly or sub-hourly
Residential multi	Hourly or sub-hourly	Hourly or sub-hourly	Monthly or hourly	Hourly or sub-hourly
Non-residential small	Hourly or sub-hourly	Hourly or sub-hourly	Monthly or hourly	Hourly or sub-hourly
Non-residential medium or large	Hourly or sub-hourly	Hourly or sub-hourly	Hourly or sub-hourly	Hourly or sub-hourly
All types (with advanced systems, renewable energy sources on-site or storage)	Hourly or sub-hourly	Hourly or sub-hourly	Hourly or sub-hourly	Hourly or sub-hourly

([4]) The load would refer to the load of the technical system it applies to (e.g. heating, ventilation, air conditioning or domestic hot water).

Modern products and systems have better defined performance information and allow for better adaptation to the building's needs. In part, this is a result of ecodesign and energy labelling but is also due to improved technologies.

One example is performance curves for different systems. These curves can provide better information on the performance of a system at a given speed and indoor/outdoor conditions. Hourly calculation intervals would allow a system to much better represent its performance as the calculation methodology could match the performance curve with the conditions at any given moment. This would also be of great assistance to designers and installers as it would allow them to tailor the system to the specific building conditions.

3.1.8. *Use of metered energy for the calculation of energy performance*

Annex I(1) of the recast EPBD indicates that the energy performance of a building can be determined on the basis of calculated or metered energy.

The recast EPBD also requires that the calculation reflects typical energy uses for the various energy uses. The consideration of typical energy uses is one of the key elements that allow for an asset rating of buildings and a comparison between different buildings of the same category (e.g. for EPCs).

In addition to the physical characteristics of the building and its technical systems, metered energy is subject to two main influences: the behaviour of occupants and the local climate. Directly using metered energy without accounting for these influences would not allow for asset rating and comparison between buildings. For this reason, the recast EPBD requires that, when using metered data, the influence of the behaviour of occupants and the local climate must not be reflected in the result of the energy performance calculation.

In order to extract the influence of behaviour and climate, a calculation method States should:

— Correct the measured performance according to the actual operating conditions compared to the typical operating conditions used in standard calculations (e.g. same temperature settings and same conditions for air quality);

— Correct the measured performance according to the actual use patterns of occupancy, compared to the typical operating use patters used in standard calculations, for example similar use hours during the day and same number of occupants;

— Correct the measured performance for the actual climate conditions compared to the standard ones.

Member States may use different means to identify these differences:

— provision of detailed metered data from building monitoring (at least indoor temperature at hourly intervals);

— provision of performance data stored in technical building systems (e.g. sensor readings or operating hours for generators);

— Measurements and evaluation by the independent expert during the assessment;

— readings from on-site weather stations or nearby official weather stations.

In order to support the use metered data for the calculation of the energy performance, Member States should make freely available climatic data measured from public owned outdoor air quality measurement stations.

The use of metered data as a basis for the calculation methodology or as a means of verifying the correctness of calculations requires that metered data is available at least on monthly readings. These readings must be actual readings (i.e. not estimates) and should be able to differentiate between EPB services and non-EPBD services per energy carrier. Where possible, especially for complex buildings, the readings should also differentiate between EPB services.

Long spans of time between intervals make it difficult to analyse and make a comparison between the readings and the typical operating conditions. In order to correct for this, the Commission recommends that metered data is available at least on hourly readings. This should be feasible given the availability of smart metering systems already available in buildings or their easy installation if retrofitted.

The use of metered energy would require that the technical systems of the building include the needed measurement instruments and a measurement plan with roles, responsibility and essential quality insurance provisions. Specific measurement systems or products tailored to the assessment of a buildings energy performance could also be used.

3.2. **Indicators of energy performance and their use in requirements**

Paragraph 1(4) of the EPBD requires that the energy performance is expressed by a numeric indicator of (total) primary energy use per unit of reference floor area (kWh/(m^{2}y)) for the purposes of energy performance certification and compliance with minimum energy performance requirements.

For the purposes of the EPBD: total primary energy use is the sum of total non-renewable primary energy use and total renewable primary energy use.

Member States must also define additional indicators for (paragraph 3):

— total non-renewable primary energy (kWh/m^{2}y);

— total renewable primary energy use (kWh/m^{2}y);

— operational greenhouse gas emissions (kg$CO_{2\ eq}$ (m^{2}y)).

Given that energy needs [5] is a required indicator in the EPC template (Annex V, paragraph 1(2c)), Member States must also define an indicator for energy needs. As indicated in Chapter 4.1.1, the energy need is the energy to be delivered in order to maintain the requirements for IEQ or other requirements (e.g. lighting or DHW) regardless of its source and the efficiency of the technical building system fulfilling the need. Energy needs are calculated for each EPB service and per energy carrier.

Member States may define additional indicators.

Member States must set minimum energy performance requirements based on total primary energy use (i.e. total non-renewable + total renewable). They may set additional requirements for any other indicator.

3.3. **Use of primary energy factors or weighting factors**

The energy performance of a building must be expressed by a numeric indicator of primary energy use, which is the energy used to satisfy the energy needs of a building. ‘Primary energy’ is calculated from the amount of energy flows within and across the boundary of the assessment, using primary energy factors or weighting factors for the conversion between final energy and primary energy.

Primary energy factor is the term generally used in the EPBD, while weighting factor is the term used in CEN overarching standards to refer to primary energy factors when dealing with primary energy [6]. Both terms have an equivalent meaning and are subject to the same provisions. For the purposes of this guidance, any reference to primary energy factors must be understood as also referring to weighting factors, with no exception.

Energy flows include electric energy drawn from the grid, gas from networks, oil or pellets transported to the building for feeding the building’s technical systems, as well as heat or electricity produced on-site. Each energy carrier must have their respective primary energy conversion factors.

3.3.1. *Definition of primary energy factors (PEFs)*

PEFs are a key element in the calculation of energy performance as they allow the interaction between the building and the energy grid(s) to be represented and also highlight the impact the building has on the broader system.

(5) For example, for heating, cooling and ventilation assessed according to EN ISO 52016-1, and for domestic hot water needs EN 12831-3.

(6) In CEN overarching standards, weighting factors may also be used to calculate greenhouse gas emissions, costs or additional factors. When weighting factors are applied to primary energy, they are equivalent to primary energy factors. When they are applied to greenhouse gas emissions, they are equivalent to greenhouse gas emission factors. See ISO 52000-1, Chapter 9.6.1 ‘Weighted overall energy balance’.

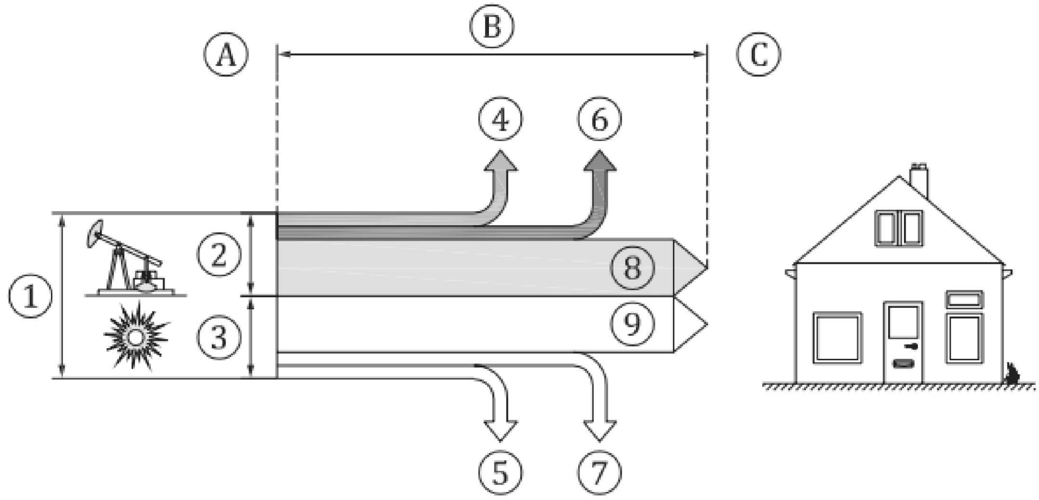
The calculation of primary energy must be based on PEFs per energy carrier, with a distinction between non-renewable, renewable and total primary energy. This means that Member States must define for each energy carrier their:

— renewable primary energy factor;

— non-renewable primary energy factor;

— total primary energy factor (the sum of renewable and non-renewable primary energy factor for a given carrier).

Figure 1: Figure taken from ISO 52001-1:2017 (page 39) representing the inefficiencies and losses in energy distribution and how they affect primary energy factors



$$f_{Ptot} = \frac{(1)}{(8)+(9)} \qquad f_{Pnren} = \frac{(2)}{(8)+(9)} \qquad f_{Pren} = \frac{(3)}{(8)+(9)}$$

Key

A	energy source	4	non-renewable infrastructure related energy
B	upstream chain of energy supply	5	renewable infrastructure related energy
C	inside the assessment boundary	6	non-renewable energy to extract, refine, convert and transport
1	total primary energy	7	renewable energy to extract, refine, convert and transport
2	non-renewable primary energy	8	delivered non-renewable energy
3	renewable primary energy	9	delivered renewable energy

Energy carriers can be broadly allocated to three groups:

— **Pure renewable carriers**: these are carriers that are completely based on renewable energy. For example: on-site solar generation or ambient heat. They will have a value for non-renewable PEF equal to 0.

— **Pure non-renewable carriers**: these are carriers that are completely based on fossil fuel energy. For example: coal or oil. They will have a value for renewable PEF equal to 0.

— **Mixed carriers**: these carriers have a mix of renewable energy and fossil fuel energy. For example: electricity from the grid or biomass. They will have a value for renewable and non-renewable PEF both different from 0.

The EPBD requires that the calculation of primary energy is based on PEFs that have to be defined and recognised by the relevant authorities (e.g. national or regional).

When defining PEFs, Member States must take into account the following aspects:

— Forward-looking: when evaluating the performance of a building (new, existing, under construction, etc.), the calculation methodology will reflect the performance of the building at a given moment. However, the building may be operating for a significant amount of time in the future. For example, the performance of electricity grids or district heating systems is continuously improving, particularly as the share of renewable energy sources increases.

— The expected energy mix on the basis of its national energy and climate plans (NECPs). NECPs contain information on the current performance of different energy carriers according to their sources. They also include information about their expected progress in the future in line with the objective of achieving decarbonisation by 2050.

The EPBD provides Member States with flexibility on how to reflect the forward-looking aspect of PEFs or the relationship with NECPs. Member States may decide how to apply these elements, which can differ depending on the use. For example:

— Member States may decide to apply a value for PEF considering their five-year forecast in line with the NECP. This value would be used to calculate energy performance in new buildings and in EPCs. This would allow for short- and medium-term changes to be considered in the value of different PEFs, which is relevant for the choice of systems in use.

— Member States may decide to apply a value for PEF considering their 20- or 25-year forecast in line with the NECP, for example an average of the PEF during this period or a weighted average to consider the higher impact in the initial years. This value would be used to calculate the cost-optimal reports. This would allow for long-term changes to be considered in the value of different PEFs, which is relevant as 'cost-optimal' takes into consideration the overall lifetime of the building.

Since two of the main uses of the calculation methodology are to produce EPCs and apply minimum energy performance requirements, the Commission recommends the use of a forward-looking PEF that includes only a short- to medium-term forecast (e.g. five years). A longer forecast would be difficult to communicate to building users, who would not see the benefits of the improvements in the grid for a long period of time.

It is important to underline that PEFs must remain neutral and reflect all technologies equally. If, for example, the PEF for a given carrier takes into account progress over the next five years (in line with the NECPs), the PEFs for other carriers must follow the same criteria. Otherwise this could result in inequalities and unfair treatment between technologies.

PEFs may be set on an annual, seasonal, monthly, daily or hourly basis or be based on more specific information made available for individual district systems. Given the increasing use of energy storage or demand flexibility, the Commission recommends that PEFs are set on an hourly basis or at least monthly. This is particularly relevant for energy carriers that are more variable, such as electricity or district heating. It would allow integration between the building and the energy grid to be better represented. In a similar way, it would also better reflect the performance of systems with efficiencies that may vary depending both on outdoor conditions and the PEF (e.g. heat pumps). In addition, local conditions can also be taken into account when defining PEFs for the purpose of calculating the energy performance of buildings.

The choices of primary factors must be reported according to EN-17423 or any superseding document. Member States must fill in Annex A of the standard, specifying the choices between methods, reference data and references to other documents.

3.3.2. *PEFs for renewable energy produced and used on-site*

Renewable energy produced and used on-site is delivered directly to technical building systems. In doing so, it displaces energy from the grid, which would otherwise be used instead. This is typically the case for PV electricity, solar thermal, ambient energy or geothermal energy.

The value of on-site production and use is that it significantly reduces the impact of the building on the energy grid, which is one of the main reasons for total primary energy use. To represent the benefits of on-site use of renewable energy sources (RES), the Commission has evaluated the following approaches:

(a) The PEF for on-site RES is given a value of 0.

(b) The PEF for on-site RES is given a value of 1. In the calculation of total primary energy, the PEF is combined with a factor (e.g. 'k_{exp}f') of value equal to 0:

  (a) $k_{exp} = 0$, therefore $PEF*k_{exp} = 0$.

Both approaches have an equivalent end result in terms of total primary energy use.

However, the use of the combination of PEF with a factor (e.g. 'k_{exp}')allows for a better representation of the nature of energy generation and use, and in particular the energy flows within the assessment boundary, which is relevant in intermediate steps of the calculation methodology. This approach would be in line with EN ISO 52000-1. Because of these reasons, the Commission recommends the use of option b) (i.e. use of 'k_{exp}' factor).

Recital 22 refers to the combustion of renewable fuels (e.g. biomass or biogas), which should be considered as energy produced on-site where the combustion of the renewable fuel takes place on-site. Accordingly, energy from these sources should be considered as energy produced on-site when calculating the share of RES use in a building. However, the energy flow of the combustible material will, in the vast majority of cases, cross the assessment boundary and therefore has an impact on the energy grid and commodities. For the purposes of calculating primary energy use, the combustion of renewable energies should therefore not be given a PEF of 0 nor should it have a factor equal to zero applied (e.g. 'k_{exp}=0').

3.3.3. *PEFs for renewable energy generated on-site and exported to the grid*

RES energy generated on-site may not be fully absorbed by the building's technical building systems.

The excess energy can be calculated by deducting the self-consumed energy from total on-site renewable energy production. The self-consumed energy can be the energy consumed within the scope of the EPBD as defined in Annex I(1) or can also include the self-consumption of other on-site uses outside the EPBD scope (see Chapter 4.3.4). The excess energy may also be stored on-site ([7]) for further use or exported to the grid. In some cases, the energy generated on-site may also be directly exported to the grid, without being used on-site at all. The variation in energy needs throughout the operation of the building, in combination with the variation in RES availability and local climate conditions (which vary throughout the day) are one of the reasons why detailed hourly calculation methodologies are more capable of representing actual operating conditions.

To recognise the benefits of exporting energy, the Commission recommends that the calculation methodology deducts the renewable energy produced on-site and exported to the grid (beyond the building's assessment boundary) from total primary energy use.

As with any energy flow, it is necessary to allocate a PEF to the energy carrier. Since RES generally have a base value of 1 (before infrastructure, refining, conversion and transport losses are applied), for exported energy from RES generated on-site, the PEF should not be greater than 1. The Commission recommends that, similar to RES in the grid all infrastructure, refining, conversion and transport losses are also considered. For example, if the total transmission losses for Solar PV in the grid are equal to 10 %, the PEF for solar exported to the grid should also apply these losses. In this case the PEF for exported solar PV energy would have a value of about 0.9.

A similar approach could be used for other types of on-site renewables. While solar PV has generally been the most common energy export from buildings, the decentralisation of heat generation in district heating and the growth of waste heat (e.g. from industrial processes or from buildings with high internal gains) means that the export of heat from a building (across the assessment boundary) is becoming more common. To better represent the possibility of heat export, the Commission recommends that Member States also define PEFs for heat exported to the grid (e.g. to district heating systems) for thermal energy generated on-site (e.g. solar thermal, ambient heat or waste heat).

3.3.4. *PEFs for renewable energy generated and used on-site for non-EPBD uses*

RES energy generated on-site may not be fully absorbed by the building's technical building systems. In this case, the energy may still be used on-site, although for non-EPBD uses. For example, energy from solar PV could be used to power white goods or other electric appliances on-site. Similarly, it could also be used to charge batteries for electric vehicles.

To represent these benefits, the Commission recommends that Member States consider the energy used on-site for non-EPBD uses as if it were exported. As in the case of exported energy, energy used on-site for non-EPBD uses requires a PEF. In this case, however, there are no grid infrastructure losses. Member States can therefore choose to represent the benefit with a PEF value of 1.

([7]) Energy storage has its own losses, which should be reflected in the calculation. See Chapter 4.5.3.

3.4. EPBD and the Ecodesign for Sustainable Products Regulation

The recast EPBD (Annex I, paragraph 2(2)) indicates that where product-specific regulations for energy-related products adopted under the Ecodesign Regulation (now repealed by the Ecodesign for Sustainable Products Regulation ([8])) include specific product information requirements for calculating energy performance and life cycle Global Warming Potential national calculation methods do not require additional information.

Member States should therefore not require additional information from products or set specific requirements at product level. The aim is to protect manufacturers from excessive testing, which could represent a significant burden.

This does not prevent Member States from setting requirements at system level (i.e. not at product level).

For example: a toilet space in a building that requires a given ventilation rate, which is set in building regulations. The Member State may set requirements for the specific volume and the performance of the system under these conditions. In this example, the ventilation system would need to provide at least 40 l/s of fresh air with specific system power (as opposed to specific fan power) no greater than 1.25 W/l/s. The specific system power would consider the overall installation (e.g. fan, ductwork, filters, dampers and terminal supply units).

The calculation methodology should therefore allow for the setting of input and output parameters so that the system can be represented.

3.5. Consideration of aspects in energy performance

3.5.1. *User behaviour*

The influence of user behaviour (behavioural measures) must not be considered in the calculation of energy performance.

User behaviour may be used as a means to provide additional and tailored information.

As indicated in Chapter 4.1.4, it is recommended that the calculation methodology allows for the modification of user behaviour for modelling and information purposes only. This could be used to provide advice and guidance on how users can adapt their behaviour, such as modifying temperature settings or limiting the opening/closing of windows when it is required. It could also be used to showcase how to adapt buildings in terms of how they operate, such as modifying operating hours.

Recommendations that are linked to data on the behaviour of the building occupant do not replace the required recommendations in EPCs or building renovation passports, which are based on an asset rating approach. They can only be provided in addition to those requirements and must clearly indicate that they apply only to the user.

3.5.2. *Water use*

The reduction of domestic hot water use due to behavioural measures should not be considered in the calculation methodology.

There are products currently available on the market (e.g. flow restrictors) that can be installed in buildings and offer a permanent reduction in water flow. If these products can be identified by an independent expert and their improved performance can be determined (e.g. through the use of labelling or certification), Member States may allow for reduced volumes in domestic hot water to be considered.

This is particularly relevant for Member States where there are constraints on water availability. Because of this, the presence of these devices could also be indicated in the EPC as it would provide the building user with valuable information.

3.5.3. *Energy storage*

Energy storage – electric or thermal – is becoming more typical as technology develops. This is for example the case for PV combined with batteries.

([8]) Regulation (EU) 2024/1781 replaces Ecodesign Directive 2009/125/EC.

Energy storage is not defined in the EPBD. Nevertheless, it should be differentiated from typical applications that also use some form of storage (e.g. domestic hot water tanks). For the purposes of differentiating, Member States could consider multiple aspects, where energy storage is used:

— to store excess energy generated on-site;

— to improve the performance of the system;

— over the course of multiple hours or longer;

— to provide flexibility to the building or the grid.

The calculation methodology should consider at least the following four aspects when assessing how storage systems influence the performance of buildings:

— the efficiency of transferring energy to/from the storage depending on the product (e.g. manufacturer's information) – Member States may set minimum requirements;

— energy losses during storage;

— the primary energy factor associated to its energy carrier (especially when using energy from the grid);

— the control of the storage and its delivery;

— the capacity of the energy storage in relation to the renewable energy generation or energy need.

The efficiency of energy transfer and storage will depend on the individual product and the energy source (e.g. manufacturer's information). Member States may set specific minimum requirements at this level. For example: the energy losses of a thermal storage may not exceed a certain amount of kWh / day as a function of the storage volume.

The primary energy factor will depend on the energy carrier used.. For example, if the energy storage uses energy from the grid at off-peak times, then it should use the relevant grid-PEF.

Batteries in electric cars should only be considered electric storage for buildings if the battery allows for bi-directional flow and the stored energy can be used within the building

3.6. **Reporting to the Commission using EPB standards**

The recast EPBD requires Member States to describe their calculation methodology on the basis of Annex A for the following standards:

(a) EN ISO 52000-1: Overarching EPB assessment – Part 1: General framework and procedures.

(b) EN ISO 52003-1: Indicators, requirements, ratings and certificates – Part 1: General aspects and application to the overall energy performance.

(c) EN ISO 52010-1: External climatic conditions – Part 1: Conversion of climatic data for energy calculations.

(d) EN ISO 52016-1: Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads.

(e) EN ISO 52018-1: Indicators for partial EPB requirements related to thermal energy balance and fabric features.

(f) EN ISO 52120-1: Contribution of building automation and controls and building management.

(g) EN 16798-1: Ventilation of buildings – Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics.

(h) EN 17423: Determination and reporting of Primary Energy Factors (PEF) and CO2 emission coefficient.

Member States must submit the filled in Annexes for all these standards as part of their transposition obligations. The reporting based on the standards from A to E were already part of the obligations in the EPBD Amending Directive in 2018 ([9]). Member States must resubmit these Annexes as part of the transposition, including updating any of the information if the calculation methodology has been modified since then.

Since 2018, the EPB Center ([10]) has published information and guidance on how to fill in the Annexes from A to E. At the time of writing this guidance, the information was still available on their website. The Commission recommends that Member States use this resource.

3.7. **Changes to the framework for the calculation of energy performance**

The recast EPBD requires that the calculation methodology reflects the typical energy use of buildings and that this energy use is representative of actual operating conditions and user behaviour.

The way buildings have operated over the years has significantly changed. Higher comfort standards and climate change now require increased cooling. This can be due to technological or societal changes. For example, buildings nowadays contain more electronic equipment than 50 years ago (which has an effect on internal gains). Buildings are also increasingly used for charging electric vehicles. The typical occupancy of buildings also reflects the changes in family composition. The COVID-19 pandemic brought about a very substantial increase in work from home, which significantly changes occupancy patterns in buildings (both residential and non-residential). Last but not least, buildings are also subject to climate change and increasing temperatures.

To represent these changes, it is to be expected that the calculation methodology and its underlying elements (e.g. building use patterns) also evolve over time.

As indicated in Chapter 4.1.3, the Commission encourages Member States to evaluate their calculation methodology at regular intervals (e.g. every 5 or 10 years), particularly in terms of climate, user behaviour types of systems, new technologies and innovation. Modifying the calculation methodology is a complex process with multiple consequences. While the Commission recommends that Member States evaluate the calculation methodology at regular intervals, it also recommends they only revise or modify the methodology when significant differences are identified. For example, Member States may decide to modify the calculation methodology only when the difference between the typical conditions in the methodology and the typical operating conditions results in differences greater than 15 % in multiple cases. This threshold is similar to the one used in the cost-optimal methodology to identify significant differences.

Member States may also decide to apply changes in smaller scales. For example, they may decide to only apply changes to a specific building category.

Primary energy factors are also relevant, particularly as their evolution is monitored by the NECPs.

When modifying the calculation methodology, Member States should carefully consider the effects on the following aspects:

— **Effects on cost-optimal methodology**: if the calculation methodology has been modified since the last cost-optimal report was submitted, the next cost-optimal report should include a section indicating the changes to the methodology and their effects. In particular, it should include an estimate of the value of the previous cost-optimal results according to the new methodology.

— **Effects on minimum energy performance requirements**: changes to these requirements should be communicated like any other transposition measure subsequently modified. Member States may also use regular reporting through the national building renovation plans by including a section on the changes.

([9]) Directive (EU) 2018/844 of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.
([10]) EPB Center | EPB Standards.

— **Effects on zero-emission building (ZEB) and nearly-zero energy building (NZEB) levels**: these changes are particularly important given the fact that ZEB levels are linked to NZEB levels (ZEBs must be at least 10 % better than NZEBs). Both NZEBs and ZEBs are linked to cost-optimal reporting. Following an update to the calculation methodology, Member States should communicate to the Commission the effects on ZEB levels and provide an estimate of the value of NZEBs when applying the new methodology. This reporting should be carried out at the earliest opportunity or through the regular reporting of the national building renovation plans.

— **Effects on EPCs**: EPCs have a validity of 10 years. A change in the calculation methodology will affect the value of all EPCs that were issued before the change and which are still legally valid. The increased use of databases for EPCs could help address this issue by providing an updated and corrected value of the EPC. Alternatively, Member States could also create conversion tools and send an update to building owners. In any case, this type of update would not extend the validity of the EPC.

Changes in the calculation methodology will affect the work of independent experts and many professionals working in the building industry (e.g. designers or facility managers) and product manufacturers (from technical building systems to software developers). The Commission therefore strongly recommends that Member States carefully consider communicating these changes to all relevant professionals, preferably with a tailored approach according to the needs. This can include interservice consultations (during the process itself), guides, training (e.g. online courses), workshops, presentations, interactive tools, FAQs or a combination of all of them.

4. GUIDANCE ON TRANSPARENT BUILDING ELEMENTS

The energy performance of transparent building elements – primarily windows and glazing systems – greatly influences both heating and cooling demands and indoor environmental quality in buildings in Europe. According to the energy studies of the European Council for an Energy Efficient Economy, windows alone account for approximately 23 % of heating energy consumption in residential buildings ([11]) as such transparent building elements are a cause of heat loss. However, the effect on cooling energy needs is difficult to evaluate due to the combined influence of climate, orientation, shading, architectural aspects, ventilation, the use of the building and internal heat gains, among other elements. In summer, excess solar gains from windows may be a deciding factor in the requirement to install active cooling, which would also have a substantial impact on energy consumption. Transparent building elements are the main source of access to daylight in buildings, which plays a key role in adequate indoor environmental quality.

The EPBD requires Member States to take the necessary steps to set minimum energy performance requirements for building elements that have a significant impact on the energy performance of the building. Following on from the paragraph above, transparent building elements should fall under this category and Member States should set requirements accordingly by adopting a cost-optimal methodology for setting minimum energy performance requirements for building elements, including transparent components. In line with the cost-optimal methodology, the requirements should allow for differentiated requirements tailored to local climate zones and building categories. This will ensure that energy efficiency measures are both ambitious and economic over the lifetime of the product. Most Member States have set up requirements on transparent building elements, but there is still room for improvement.

EU Member States currently employ different metrics and indicators primarily based on the U-value (thermal transmittance) and, to a lesser extent, the g-value (solar factor) to assess and regulate the effect of transparent elements on the energy performance of buildings. The U-value measures a window’s insulation efficiency by quantifying the rate of heat transfer, whereas the g-value accounts for solar heat gain. While heat gains are particularly relevant in warmer climates as they impact cooling demands, their impact during winter is also quite significant and should not be ignored.

For instance, France has set a U-value requirement of 1.9 W/m^2K to limit heat loss. Other examples include Germany and Italy, with U-values around 1.3 W/m^2K and 1.1-3 W/m^2K, respectively. Countries with more stringent U-values like Hungary and Slovakia (both 1 W/m^2K or lower) place a stronger emphasis on reducing thermal losses in colder climates. In contrast, Cyprus requires a U-value of 2.25 W/m^2K, which reflects the milder climate.

([11]) European Council for an Energy Efficient Economy.

While U-values are widely adopted across Member States, only a few include the g-value as part of their performance metrics, potentially overlooking the role of solar heat gain in energy consumption for cooling and heating. However, countries like Denmark, Estonia and Germany emphasise an ‘energy balance’ approach. This accounts for both heat retention and solar gain, acknowledging the dual impact of windows on both heating and cooling needs.

There are also differences in how Member States measure the effects of orientation, shading or architectural features.

Furthermore, Member States also apply differences in the treatment of transparent building elements across building categories or depending on the purpose of calculations. In general, residential buildings use simpler methods with limited data, while larger and more complex buildings require more detailed calculations. Similarly, calculations for the issuance of an EPC in an existing building may be different from the calculations required for a new building.

4.1. **Summary of obligations under the EPBD**

The following Articles refer to obligations that EU Member States have in relation to the energy performance of the transparent building elements. These obligations mainly deal with windows and doors and their contribution to energy efficiency improvements. They also cover facades with a high proportion of transparent elements (e.g. high-rise buildings).

Article 4

Article 4 of the EPBD mandates that Member States develop and implement a methodology for calculating the energy performance of buildings. This methodology must be aligned with the calculation framework outlined in Annex I.

Article 5

Article 5 requires that minimum energy performance requirements are set for buildings and or building units. Furthermore, it requires Member States to ensure that specific minimum energy performance requirements are set for building elements that have a significant impact on the energy performance of the building envelope when these are replaced or retrofitted. Given the weight of transparent building elements in the overall building performance, virtually all Member States have set specific requirements for windows for new construction, major renovation or replacement.

Under Article 5, these minimum energy performance requirements must be set at cost-optimal levels, balancing the initial investment with long-term energy savings.

Article 7

Article 7 of the EPBD mandates that all new buildings meet energy performance requirements laid down in accordance with Article 5 until the application of the requirements that all new buildings are zero-emission as from 1 January 2028 for new buildings owned by public bodies and as from 1 January 2030 for all new buildings. This requirement extends to transparent building elements – such as windows and doors – which must comply with high insulation and thermal standards, incorporating factors to reduce heat loss and optimise energy efficiency.

Article 8

Article 8 of the EPBD mandates that EU Member States take necessary measures to upgrade the energy performance of existing buildings when they undergo major renovations. This includes ensuring that the energy performance of renovated parts meets minimum performance requirements, as established under Article 5, provided that these upgrades are technically, functionally and economically feasible. This obligation extends to individual building elements such as windows and doors that form part of the building envelope and significantly impact its energy performance. If such elements are retrofitted or replaced, they must also meet minimum energy performance standards, aligned with the Directive’s goals.

At the same time, Member States are encouraged to consider high-efficiency alternative systems for buildings undergoing major renovations. These measures aim to improve energy performance while also improving indoor environmental quality, adapting buildings to climate change, and addressing safety and accessibility concerns in alignment with national building regulations.

Article 11

Article 7 of the EPBD stipulates the requirements for zero-emission buildings (ZEB), notably asking for a ZEB maximum energy demand threshold to be setup 'with a view to achieving at least the cost-optimal levels' and 'at least 10 % lower than the threshold for total primary energy use' in place in the MS for nearly-zero energy buildings. Member States must also set operational greenhouse gas emission thresholds for ZEBs.

Annex I

Annex I(4(a)), requires that Member States' methodologies for calculating the energy performance of buildings take into account multiple factors that are related to transparent building elements:

— thermal capacity;

— insulation;

— thermal bridges;

— natural ventilation;

— orientation and climate;

— passive solar systems and solar protection.

Member States are also required to take into consideration the positive influence of local exposure conditions, active solar systems and natural lighting.

Through this approach, Annex I encourages a more holistic approach that integrates both thermal and solar performance. At the same time, the calculation framework provides flexibility to adapt to their various needs and conditions, including climate, building categories and the purpose of the calculations.

Energy calculations can be complex given the multiple data inputs and the need to consider the performance of the building at overall levels and at specific moments/periods. However, the advent of computer-aided tools in the latter part of the 20th century, the widespread use of 3D models, including Building Information Modelling, has made the task of all professionals in the field much easier. It is now easier than ever to gather the necessary input data and apply it to any number of available calculation engines. These will in turn produce valuable information for evaluating the performance of the building. This information is of high value when making decisions about the design of new or renovated buildings or the replacement of existing building elements.

4.2. **Implementation of obligations under the EPBD**

The obligations to apply a methodology for calculating the energy performance of buildings has been in place since the EPBD was first adopted in 2002 and was modified in 2010 and 2018. Member States must implement the laws, regulations and administrative provisions necessary to comply with the new or modified elements of the recast EPBD by the transposition deadline of 29 May 2026.

Transparent building elements such as windows, glazed exterior walls, skylights and rooflights play a dual role in building energy performance, influencing both heat losses and gains. Their energy performance is quantified primarily based on heat transfer due to temperature difference (conduction and convection) and through radiation (e.g. solar gains). The most commonly used indicators to express heat transfer are the U-value (thermal transmittance) and g-value (solar gains).

However, using these parameters in isolation does not provide a complete picture, as factors such as geographical location or architectural design among other aspects ([12]) also play a key role. Annex I of the EPBD highlights the importance of an energy balance approach, combining all elements to calculate the overall energy performance of the building. This approach is critical for optimising building envelopes throughout the whole year.

As this guidance focuses on transparent building elements, thermal transmittance can be assessed at different levels. The Ug-value refers specifically to the glazing's insulation performance, while the U-value accounts for the entire window unit, including the frame and spacer effects.

4.3. **Background**

4.3.1. *Energy balance*

The energy performance of transparent building elements depends on a combination of heat conduction (U-value multiplied by temperature difference) and heat radiance (g-value multiplied by solar irradiance (B)), which must be assessed across different seasons. Both heat conduction and heat radiance depend on the physical characteristics of the transparent building element. However, there are also other elements that may affect them, such as the presence of shading, the design of the building, orientation and local climate. Transparent elements' orientation plays a key role in the solar irradiance (B) rather than simply taking into account the location of the building. When oriented south, the B-value will be three to four times higher than for those oriented towards the north. This will in turn be affected by the presence of shading elements, which help control solar irradiance.

The design of the transparent building element must take into account these different elements. This is usually done through an energy balance approach.

Other elements, such as ventilation and infiltration losses, as well as internal gains, play significant roles in the overall energy balance of buildings. Ventilation heat transfer (H) accounts for air exchanges through windows or mechanical ventilation systems and should be explicitly included in energy assessments. Internal heat gains from occupants, lighting and appliances also contribute to the energy balance, reducing heating demand in winter, but increasing cooling loads in summer.

The energy balance method provides a holistic assessment of a transparent element's energy contribution. For instance, windows with low U-values may perform well in colder climates. However, if g-values, shading or the overall architectural design are not optimised, they may cause excessive cooling demands in warmer days. Similarly, the optimisation of the window and building design also allows for the use of solar gains in winter, offsetting the need for active heating. For modern buildings, which have high levels of insulation, solar gains may even need to be controlled in winter. Although solar radiance in northern climates is not as intense as in southern regions, the very low angle of incidence enables a high proportion of solar gains to reach the interior of the building, which has a significant effect. It is therefore recommended to consider the overall window and building design even in colder climatic conditions.

As a result, transparent elements must perform to a level where they adapt to the seasonal and external conditions: a low U-value and high g-value in winter to optimise insulation and maximise free solar gain, and a low U-value and low g-value in summer to optimise insulation and limit solar gain for thermal comfort. This reduces the need for active cooling.

4.3.2. *U-value, g-value and key concepts*

The U-value (W/m^{2}K) represents the thermal transmittance of a transparent element, indicating its ability to conduct heat to/from the building (i.e. retain or release heat). Given the weight of the building envelope in energy performance, the improvement in windows in particular has become an overriding factor in many situations. This is particularly the case in colder climates, where low U-values are a key to minimising heat losses.

Conversely, the g-value quantifies the amount of solar radiation that passes through the window, contributing to heat gains. The management of g-values allows us to influence heat gains through transparent elements during the heating season and minimise solar gains in hotter regions.

([12]) Other aspects include solar shading, orientation, etc.

Other key concepts:

— **Heating degree** (A): a numerical value that reflects the accumulated need for heating, typically expressed in kKd (Kilo Kelvin days), due to the difference between the indoor and outdoor temperature across the heating season. This value is heavily dependent on the local climatic conditions of the building analysed and the building itself. It is commonly calculated using heating degree days, degree hours or with the aid of thermal models.

— **Cooling degree** (X): a value that quantifies the accumulated need for cooling to maintain indoor thermal comfort over a given period. It is commonly calculated using degree days, degree hours or with the aid of thermal models.

— **Solar irradiance** (B): solar energy that enters a building through transparent elements. Solar irradiance may also consider the influence of orientation or shading.

— **Solar irradiance leading to overheating** (Y): refers to the portion of solar energy that enters a building through transparent elements and contributes to indoor temperatures that exceed comfortable thresholds. It depends on different aspects: climatic condition, orientation, insulation level of the building envelope, etc.

— **Transmittance cause by air infiltration** (H): heat transfer that occurs due to uncontrolled air leakage through gaps, joints or seals in a building's transparent elements.

4.3.3. *Heating vs cooling seasons*

In the heating season, U-values play a major role in mitigating heat losses, while g-values (or shading) control solar gains. During the cooling season, g-values (or shading) dominate as they significantly affect the internal heat load, especially in south-facing orientations. Energy balance calculations must therefore distinguish between these seasonal dynamics to tailor requirements effectively.

Quantitatively, the heating energy demand is therefore expressed as:

$$A \bullet (U + H) - B \bullet g = \textit{Heating energy needs}$$

whereas the cooling energy demand is expressed as follows:

$$-X \bullet (U + H) + Y \bullet g = \textit{Cooling energy needs}$$

It is important to highlight that air infiltration (H) must also be considered, as shown in the previous equations, and depends on the transparent elements' air permeability class and local wind levels.

4.3.4. *Calculation intervals*

Heating degrees or cooling degrees were, until very recently, calculated mostly on the basis of monthly or daily climate data. In some cases, annual data is still used. This allowed for a calculation of the influence of the heat losses and heat gains that was sufficiently representative, where heat losses were the main driver.

Modern calculation tools allow for much more detailed calculations, with calculation intervals that go to the level of hourly or even sub-hourly. Detailed calculations are particularly useful for transparent building elements given their importance for peak conditions. This is even more so the case in modern buildings, where the heat gains and heat losses are much closer to one another.

Given the improvement of the building envelope, proper consideration of the balance between heat gains and heat losses has become particularly important throughout all operational hours.

It is recommended that the calculation interval is also considered when setting the minimum energy performance requirements or when calculating the energy performance of buildings and building elements.

The Commission recommends at least an hourly calculation interval for both the setting of minimum energy performance requirements and the calculation of the energy performance of buildings.

Means of controlling solar gains

In addition to the U-value and g-value, there are other elements to also consider when taking into account both heat loss and solar gains: orientation, building design and solar shading.

ISO 52022-1 (solar & daylight characteristics – simple) and ISO 52022-3 (solar & daylight characteristics – detailed) provide multiple options for the calculation and consideration of the different elements.

The example below, based on the Spanish building code, provides a summary table with the different elements, including examples of values provided for simplified calculations.

Table 3

Elements that account for solar contributions

Element identified	Description	Quantified?	Value?	Where?
Different types of glazing	— Simple — Double …	Yes	g_{wi} (1) for: Single glazing: 0.77 Double glazing: 0.68 Double glazing with low emissivity: 0.60 Triple glazing with low emissivity: 0.45 Double window: 0.68 Figure 2 illustrates other g-values depending on the glass type	Table 11
Blinds (exterior mobile shade)	Solar transmission with movable shading devices (both automated or manual), affects solar energy transmission in openings. It depends on the type of glass and its g-value.	Yes	Summary of the values (see details in Tables 12 and 14): — 0 (for blinds) — 0.2 (for awnings) — 0.4 (for curtains)	Tables 12 and 14 (mobile blinds)
Curtains (interior mobile shade)	Used as internal shading, affects the total solar transmission through openings.	Yes	Summary of the values (see details in Table 12): — 0.4	Table 12
Trees/vegetation	Shadow factor can be adjusted based on vegetation density and type (perennial or deciduous).	No (the shadow factor corresponding to vegetation may be included at the discretion of the designer)	-	Sec. 2.2.4
Sunshades (e.g. awnings, shades with slats)	Various shading elements that adjust the solar factor and reduce solar transmission.	Yes	Summary of the values (see details in Tables 12 and 18): — 0.2	Tables 12 and 18

Element identified	Description	Quantified?	Value?	Where?
Overhangs	Fixed external shading devices with shadow factors based on orientation and size.	Yes	Details in Table 16	Table 16
Skylights		Yes	Details in Table 19	Table 19
Architectural setbacks	Setbacks can influence the amount of direct sunlight that enters a building.	Yes	Details in Table 17	Table 17
Orientation of openings	U-value limits set by orientation (north, south, east, west) and climate zone, affecting solar gains.	Yes	-	Depends on the location
Frame material	Frame types (wood, aluminium, aluminium with thermal break) and air permeability considerations.	Yes	-	Depends on the supplier
Night ventilation		No	-	-
Use of daylight	The energy use for artificial lighting should be considered.	No	-	-

(1) g_{wi} is the total solar energy transmittance value of the glazing (without an active shading device).

Figure 2

Range of g-values with associated glass types (source: Glass for Europe)

g-value range	Type of glass
0.05-0	Occultation (theoretical)
0.20-0.05	Dynamic solar control in colored state
0.20-0.35	Solar control for commercial sector (WWR* > 30%)
0.35-0.50	Solar control for residential sector (Warm Climate and/or WWR < 30%)
0.50-0.60	Low emissivity
0.60-0.80	Low-emissivity extra clear
0.80-1	Full transmittance

**WWR= Window-to-wall ratio. The size of the glazed surface will affect the calculation of the energy performance and the type of glazing to be installed.*

4.4. Impact of solar contributions on various building types

Solar contributions, including the g-value and the various values in Table 1, play a major role in determining the energy performance of transparent building elements. The impact of these contributions varies depending on the building type, usage patterns and climatic conditions. For instance, residential buildings often prioritise maximising daylight while mitigating overheating risks, whereas non-residential buildings might focus on managing solar gains for comfort and reducing cooling loads in large glazed areas. Differentiating these effects is critical in order to optimise transparent elements for new constructions, deep renovations and replacements.

Nevertheless, it is recommended to adopt an overall approach that prioritises optimising the building performance as a whole, and the building envelope in particular. This includes integrating shading elements, overhangs and other architectural features to manage solar heat gains and improve the overall energy efficiency of the building. By prioritising a comprehensive strategy for the entire envelope, including insulation and airtightness, the energy performance of the building can be significantly improved. While the optimisation of glazing remains important, it should be viewed as part of a broader design strategy rather than a standalone priority.

Furthermore, in Member States where mechanical air cooling is necessary, effective passive heat protection should be prioritised to minimise the energy required for cooling as far as possible.

Furthermore, the Commission recommends that Member States base the methodology for planning summer thermal insulation on climate projections that account for expected conditions in the short to medium term (e.g. over the next 20 years). This approach ensures that the design considers at least half of the service life of building components and aligns with anticipated climate trends. Reliable and comprehensive future climate data across Europe should be used to make building designs more resilient.

4.4.1. *Non-residential buildings: new or existing undergoing major renovation*

Non-residential buildings, such as offices or commercial spaces, typically feature larger glazed areas, which increases the relevance of solar contributions. These buildings often have higher internal heat loads due to equipment (e.g. computers, printers, different lighting systems, machinery, etc.) and occupants, making it critical to balance all requirements effectively.

According to the provisions in the recast EPBD (Article 9(2)), new buildings from 2020 and buildings undergoing major renovations must comply with zero-emission building requirements, which will be at least 10 % stricter than current nearly-zero energy building levels. While this approach ensures that these buildings are energy efficient, it also means that the balance between heat losses and heat gains will become more relevant. If not adequately managed, this may result in overheating, which would then require a cooling system to compensate. This would in turn increase the energy consumption of the building. Given the improved thermal insulation and airtightness, the energy demand for cooling could rise, particularly in buildings with large glazed areas. It is therefore essential to integrate effective strategies for controlling solar heat gains, such as the use of architectural design, solar shading and/or low-g-value glazing to maintain a comfortable and energy-efficient indoor environment.

For different building categories, Member States should ensure that a comprehensive calculation methodology, as outlined in this guidance document and in compliance with Article 4 of the EPBD, is rigorously applied. This methodology must account for all factors affecting solar contributions, as detailed in Table 1. The energy balance should reflect these contributions, considering variables such as glazing properties, orientation, shading and climate conditions to ensure accurate energy performance assessments. Member States should determine a requirement level according to specific local conditions and features. The same calculation methodology should be used when producing an EPC assessment. This will ensure an accurate evaluation of a building's energy performance, taking into account both solar gains and heat losses.

Member States are encouraged to set minimum requirements in terms of the U-value or g-value. However, given the need to balance different elements, the Commission recommends that Member States allow for exceptions to the minimum requirements (for individual building elements) if designers and developers can use an energy balance approach to demonstrate that the building would have a better energy performance. For example, if there are minimum requirements on the g-value, but the developer demonstrates that through the use of architectural design or fixed shading the g-value is no longer needed, then the Member State could allow for the installation of elements that do not comply with the g-value requirements.

In order to allow for this flexibility, it is important that the calculation methodologies in Member States are precise enough and account for as many elements as possible that influence the performance of transparent building elements.

4.4.2. *Residential buildings: new or existing undergoing major renovation*

New and renovated residential buildings share several requirements on the integration of transparent building elements that optimise energy performance with their non-residential counterparts. However, there are key distinctions in the design, occupancy patterns and energy usage of residential buildings that call for tailored considerations for both new constructions and renovations. The following section presents different considerations for residential buildings:

— These buildings typically feature smaller glazed areas compared to non-residential buildings. This reduces overall solar contributions but makes it more important to carefully optimise each transparent element to balance heat retention and solar gain.

— They prioritise natural daylight and indoor comfort. Transparent components must be selected to maximise visible light transmittance while minimising glare and energy losses.

— They often experience lower internal heat loads than non-residential buildings, making the management of heating and cooling needs heavily reliant on external factors like solar irradiance, natural shading (trees, neighbourhood buildings, etc.) and insulation quality.

The methodology used for assessing the energy performance of transparent elements in non-residential buildings can also be effectively applied to residential buildings. This ensures consistency across building types, while keeping in mind the differences in certain aspects such as heat loads.

As in the case of new and renovated non-residential buildings, the same best practices can be drawn upon for new and renovated residential buildings.

4.4.3. *Existing residential or small non-residential buildings*

The recast EPBD requires that Member States ensure that minimum performance requirements are in place for building elements when they are replaced or retrofitted.

As indicated in this document, upgrading transparent building elements plays a crucial role in reducing energy needs. Retrofitting measures should address factors such as replacing outdated glazing with high-performance alternatives that optimise the performance of the element (e.g. U-values and g-values), incorporating external shading devices and improving the building's overall airtightness to mitigate heat losses.

For new buildings and major renovations, a design team is generally in charge of the process due to the inherent complexity of such projects. Because the building is addressed as a whole, the design team has the tools and capacity to ensure that the windows are integrated with the rest of the elements. However, this is not always the case when the renovation works affect only the transparent building elements. This is typically the case when replacing windows. This does not cover isolated glass replacements due to breakage or damage but rather the systematic upgrade of windows as part of an energy performance improvement strategy.

Given the constraints of existing buildings and the capacity constraints that small businesses experience, there is a need to support the replacement of transparent window elements.

To facilitate this process, the Commission recommends that Member States provide support mechanisms, particularly for small businesses, to ensure effective decision-making and compliance with energy performance requirements.

The preferred option would be for installers to make calculations to determine the most fitting window replacement for the existing conditions. Member States should consider developing practical tools to allow installers to assess the impact of replacing windows on a building's energy balance using predefined factors.

If detailed calculations cannot be made, the Commission recommends that Member States prepare detailed guidance. This should include the following:

— required and recommended U-value and g-value for different orientations;

— guidance on how to account for the presence of solar shading elements (e.g. for windows with solar shading, the g-value requirement is waived).

When preparing the requirements and recommendations, Member States should rely on a methodology based on the energy balance. The cost-optimal report, which Member States must carry out every five years, is a good framework to include this assessment at national level.

Retrofit strategies, such as installing external shading, should also be prioritised to reduce cooling demands while maintaining comfort and energy efficiency.

4.4.4. *Summary of recommendations*

The following is a summary of the recommended requirements for different types of buildings and works.

Table 4

Summary of recommendations for the treatment of transparent building elements

Type of works	Type of building	Energy Balance calculation	U-value requirements	G-value requirements
New	Single residential	Yes	Yes	Based on EB results
	Multi-residential	Yes	Yes	Based on EB results
	Small non-residential	Yes	Yes	Based on EB results
	Non-residential (rest of buildings)	Yes	Yes	Based on EB results
Major renovation	Single residential	Yes	Yes	Based on EB results or Member State simplified guidance
	Multi-residential	Yes	Yes	Based on EB results
	Small non-residential	Yes	Yes	Based on EB results or Member State simplified guidance
	Non-residential (rest of buildings)	Yes	Yes	Based on EB results
Replacement	Single residential	Optional	Yes	Based on EB results or Member State simplified guidance
	Multi-residential	Yes	Yes	Based on EB results
	Small non-residential	Optional	Yes	Based on EB results or Member State simplified guidance
	Non-residential (rest of buildings)	Yes	Yes	Based on EB results

Uw-value requirements: Member States should introduce specific requirements based on U-values to limit heat losses through transparent building elements.

gw-value requirements: Member States should consider introducing simplified g-value requirements for residential buildings and small non-residential buildings. They should account for different uses and, in particular, orientation and climate in their requirements. Glazing with g-values ranging from 0.25 to 0.8 are already available in Europe, including low-emissivity glazing (designed to minimise heat transfer while allowing solar gain) and solar control glazing (which limits excessive solar heat gain to prevent overheating). If the building has adequate fixed solar shading, the requirements could be waived. For new buildings or larger non-residential buildings, it is recommended that the g-value is selected on the basis of the energy balance.

Energy balance: Member States should introduce both simplified and detailed methodologies for calculating the energy balance. Simplified and detailed calculations could be used by designers in new buildings or renovations. For simple replacement, where in many cases the selection is done directly by installers, it is recommended that Member States provide guidance for the application of a simplified energy balance.

4.5. **Best practices from different Member States:**

Denmark:

Denmark's approach to energy efficiency for transparent building elements is governed by its national building regulations, known as BR18. These regulations enforce stringent energy balance requirements for windows and other glazing elements, applicable to both new constructions, deep renovations and single window replacements.

Windows must achieve 'energy-neutral' status, meaning they must allow as much solar gain during the heating season as they lose through thermal transmittance. This is calculated using the following formula ([13]):

$$E_{ref} = I \bullet g_w - G \bullet U_w = 196.4 \bullet g_w - 90.36 \bullet U_w$$

Where I is the solar incidence corrected for the g-value's dependence on the angle of incidence; $g_w$is the total solar transmittance for the window; G is the heating degree based on an indoor temperature of 20 °C and $U_w$is the heat transmission coefficient of the window.

BR18 addresses the overall energy consumption and climate impact of buildings in Chapter 11. Specific requirements for the energy performance of windows are outlined in §258, with detailed explanations and implementation guidance provided in Section 1.6. These regulations ensure that transparent building elements contribute effectively to reducing energy demand while supporting Denmark's sustainability goals.

Germany:

The technical standard DIN/TS 18599-2 is used in Germany for calculating the energy performance of buildings as part of the DIN/TS 18599 ([14]) series. The series provides detailed methodologies for assessing the efficiency of energy systems and building components, including heating, cooling, ventilation, lighting and building envelopes.

DIN/TS 18599-2 focuses on building envelopes, including transparent components like windows and glazing, and provides calculation methodologies for their energy performance by introducing a new characteristic, BK_{tr}. This parameter represents the energy balance of transparent components and integrates factors like the U-value, g-value and S_f known as the radiation gain coefficient dependent on the orientation. It ensures an accurate energy assessment of transparent elements within the overall building envelope.

The DIN/TS 18599 series is used to ensure compliance with the German Building Energy Act ([15]).

([13]) Based on the calculation of a European standard size window (1.23 × 1.48 m, – cf. EN 14351-1).
([14]) DIN V 18599: DENA guidelines on achieving energy efficiency | BUILD UP.
([15]) BMWSB – Building Energy Act.

ANNEX 13

to the

Commission Notice providing guidance on new or substantially modified provisions of the recast Energy Performance of Buildings Directive (EU) 2024/1275

Life-cycle global warming potential of new buildings (Article 7(2) and (5))

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1. GENERAL CONSIDERATION

The recast Energy Performance of Buildings Directive (the 'recast EPBD') ([1]) supports the 2050 vision for a decarbonised building stock, which goes beyond the current focus on operational greenhouse gas emissions. It aims to reduce a building's overall contribution to greenhouse gas emissions through the whole life cycle ([2]), supported by measures including better design and more sustainable choice of materials. According to Article 7(2), Member States must ensure that the life-cycle GWP is calculated and disclosed in the energy performance certificate of new buildings (as of 2028 for large new buildings and as of 2030 for all new buildings). Article 7(5) requires Member States to draw up national roadmaps by 1 January 2027 on the introduction of limit values on the life-cycle GWP of all new buildings.

2. RELEVANT LEGAL PROVISIONS

As defined in Article 2(25), the life-cycle GWP of a building measures the GWP contributions of a building along during its full life cycle.

Calculating and disclosing the life-cycle GWP in an energy performance certificate of the building ([3]) is mandatory under Article 7(2) for all new buildings with a useful floor area larger than 1 000 m^2 from 1 January 2028, and for all new buildings from 1 January 2030. The categories of buildings which Member States exclude from the obligation to have an energy performance certificate (as permitted by Article 20(6)) may also be exempt from the obligation to calculate the life-cycle GWP.

As provided for in Article 7(3), a delegated act will be adopted by the Commission by 31 December 2025 to amend Annex III to set out an EU framework for the national calculation of life-cycle GWP with a view to achieving climate neutrality.

According to the first paragraph of Article 7(5), by 1 January 2027 Member States must publish and submit to the Commission a roadmap for introducing limit values for the life-cycle GWP of new buildings. Member States have to set targets for new buildings from 2030, that feature a progressive downward trend, i.e. the targets must be understood as a series of limit values from 2030 with a lower limit value each time (i.e. in 2033, in 2036, etc.). If relevant, the Member States adapt these limit values to different climatic zones and building typologies. When setting the limit values, Member States can take into account the readiness of the market while encouraging the decarbonisation of the construction sector as soon as possible. As mentioned in the second paragraph of Article 7(5), Member States must set these limit values in line with the EU's objective of achieving climate neutrality. No limit values are required for new buildings exempted from the GWP calculation obligation.

As provided for in Article 7(5), Member State must publish and submit a roadmap to the Commission by 1 January 2027. It may be very technically challenging for some Member States to directly set the actual numerical value of the limit values in this national roadmap by that date. However, they must detail how the limit values will be introduced and what the ambition levels are. The actual numerical limit values can be set later in the national legislation at the earliest possible date, but they must be in force by 1 January 2030 at the latest.

Timeline	Details
1 January 2027	Article 7(5) requires Member States to submit a roadmap to the Commission by 1 January 2027. The roadmap should describe at least the process and how Member States want to apply limit values. This does not mean that the actual numerical values have to be set by 1 January 2027, but Member States must as a minimum set a clear ambition level and timeline and set out in detail how the limit values will be set and then applied.

([1]) Directive (EU) 2024/1275.

([2]) See definition of 'whole-life-cycle greenhouse gas emissions' in Article 2(24).

([3]) See definition of 'building' in Article 2(1).

Timeline	Details
1 January 2030	The first limit values must be in place by 2030 at the latest for all new buildings, meaning they need to be set beforehand, taking into account the preparations needed for inclusion in national regulation and by people involved in construction, such as project designers.

3. DRAFTING THE NATIONAL ROADMAP

As defined in Article 2(25), the life-cycle GWP of a building measures the GWP contributions of a building during its full life cycle.

Figure 1 sets out the recommended steps to be taken by the Member States to write their national roadmap. These steps are based on experience and inputs from experts and some Member States that have already adopted national regulation in this area. These Member States have developed and implemented aspects such as official national methodologies, product environmental data and limit values. If their current measures fully meet the requirements laid down by the Directive, they could simply report their actions using the templates provided in this document, see Section 4. If they only partially meet the requirements of the recast EPBD, the national measures must be brought into alignment. Checking the recommended process will identify whether national regulations need any adjustments.

Each step will be discussed in more detail below. As some of the steps could take a lot of time, fast-track routes are proposed in some cases to help all Member States comply with the Directive's objective by 2030, especially those who otherwise are unsure of being able to follow the full process. However, the fast-track route is an initial short-cut and Member State will eventually need to move to a full national process at the earliest opportunity. Any Member States using the initial fast-track must detail in their roadmap the timeline they will follow for any such later adjustments.

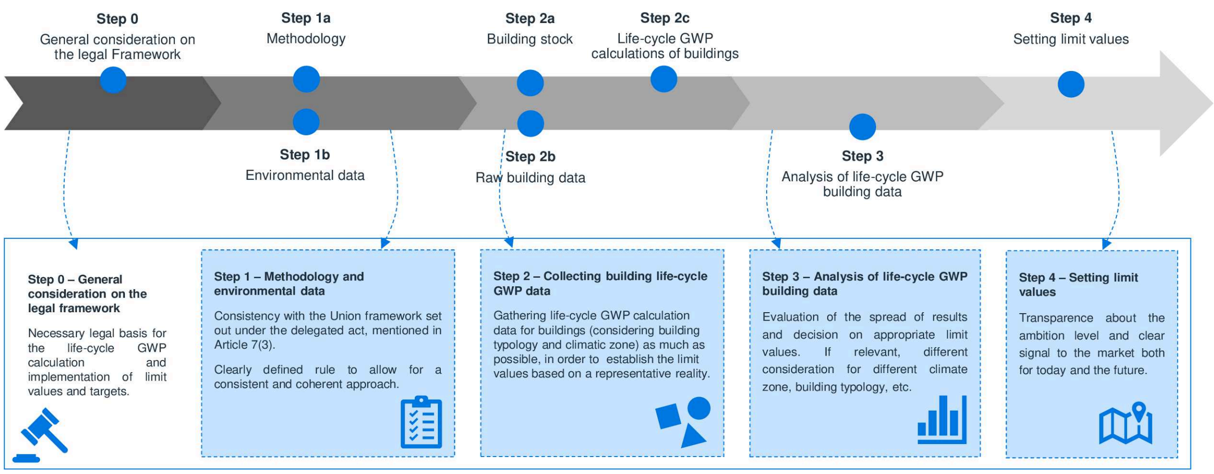

Figure 1. Steps for setting limit values for the life-cycle GWP of buildings at national level.

3.1. Step 0 – General considerations on the legal framework

The whole process (steps 1-4) is underpinned by the general national legal framework for the calculation of GWP in line with Article 7(2) (step 0), which is the basis for setting limit values at Member State level. The legal framework for GWP calculation must be in place by May 2026 to comply with the transposition deadline of the recast EPBD. Other legal frameworks may be developed and evolve in parallel with the other steps in the process. A clear legal framework is essential for outlining procedures, defining roles and responsibilities, and for giving a consistent interpretation of the terms and meaning of the EPBD legal text.

When preparing their roadmap for publication by 1 January 2027, Member States should consider at least the elements described below and may report them as step 0 in their national roadmap.

When establishing and implementing the national roadmap, Member States are highly encouraged to consider coordination and cooperation among different countries to reduce the fragmentation of the market. Besides this document, Member States should also consider other relevant documents addressing the life-cycle greenhouse gas emissions associated with the buildings and construction sector, including the European Commission Staff Working Document on the decarbonisation of buildings when available.

3.1.1. *Timeline for setting the limit values*

Article 7(5) requires Member States to publish a national roadmap and submit it to the Commission by 1 January 2027 at the latest. The national roadmap does not necessarily need to set any fixed limit values. Limit values can be defined later in national regulation. However, the first limit values must be in force no later than 1 January 2030.

3.1.2. *Compliance with limit values*

The aim of the recast EPBD is to consider the whole-life-cycle emissions of buildings, starting with new buildings, to encourage better design and better choices of material. Once a product or a material has been used for the construction of a building, its emissions have already occurred, so the life-cycle GWP has to be estimated before the start of the construction work.

The compliance with the limit values must be confirmed at least at the 'as-built' stage. Member States should also clearly define the responsibility of the economic actors involved to comply with limit values to give the visibility to the sector.

3.1.3. *Defining roles and responsibilities*

Implementing the GWP calculations and limit values could involve different actors, depending on the legislative context in each Member State. Member States should define the different roles and responsibilities as soon as possible so that those involved can be prepared. For example, it is quite typical for the regional or local authorities to handle practical implementation such as issuing building permits and controlling building quality. Member States could therefore decide that the control and verification of the calculation and documentation will happen at this same level. Member States could also decide that the requirements for life-cycle GWP and compliance with limit values should have a different control system than other building requirements.

Member States should clearly define the role of the private sector. This should be done as soon as possible, so that it is clear who is responsible for: calculating the value; submitting the calculated value from 2028; and complying with the limit values as of 2030. Member States might at some point need support from research and science centres, for issues such as tool development, databases management, and data gathering and analysis. Member States should have a long-term perspective over who handles the databases on construction-product environmental data and building data.

3.2. **Step 1 – Methodology and environmental data**

Step 1 is the fundamental step for setting limit values, consisting of two sub-steps, step 1a setting out the calculation methodology, and step 1b defining the environmental data for the calculation (see Figure 1). It is important to have these steps in place, to ensure the right understanding and ambition of the limit values. Both sub-steps need to be initiated as soon as possible and can be worked on in parallel. Step 2 cannot be finalised before step 1 is finished, but step 2a and 2b can run in parallel with step 1.

3.2.1. *Step 1a – Methodology*

The definition of the calculation methodology (step 1a) must be consistent with the provision in Article 7(2). In accordance with Article 7(3), by 31 December 2025, the Commission will adopt a delegated act to set out an EU framework for national calculations of life-cycle GWP.

The scope of life-cycle stage or building components covered by the limit values can be more selective than the scope required for the calculation. For example, a building's life-cycle can be split into stages (A, B, C, D) and sub-stages or modules (A1, A2, etc.). The scope of the life-cycle stages required for the calculation according to Article 7(2) needs to follow the minimum requirements set out in the delegated act. This information is particularly useful in giving the designer and project owner a clear understanding of emission sources. However, the Member States can adjust the scope of life-cycles stages or modules covered by the limit values for their national regulation. See section 'Step 4 – Setting limit values' for more discussion on the scope of life-cycle stages or building components covered by the limit values.

3.2.2. *Step 1b – Environmental data*

The life-cycle GWP calculation at the building level requires data inventories for products and other relevant environmental data. Where available, the construction-product data issued under the Construction Products Regulation must be used.

In addition, Member States should adopt environmental generic data ([4]) and default values ([5]) for products and processes so that GWP calculation is possible when project-specific data or product-specific data is not available or to simplify the calculation. Generic data and default values are also needed especially to fill the data gap when specific production information is unknown. Beside the data related to products, other types of input data will be necessary to carry out the building assessment, such as environmental data for energy carriers and processes like activities on the construction site.

Before creating a new national framework for environmental data, Member States may consider existing frameworks including databases, generic data, default value data, etc., for inspiration or collaboration if relevant. If a national system is in place, the environmental database for products and processes will require continuous maintenance and updates due to sector development. In that case, as mentioned previously, Member States should think strategically about the role and responsibility of any actors involved.

When available, the data calculated in accordance with Regulation (EU) 2024/3110 ([6]) (previously Regulation (EU) No 305/2011 ([7])) has to be used for specific construction products. If compatible, data on specific products calculated in accordance with product regulation derived from Directive 2009/125/EC, Regulation (EU) 2024/1781 ([8]) and/or from Regulation (EU) /2017/1369 ([9]) should also be used when available. Any platform or tool for GWP calculation should be developed with these requirements taken into account and designed to be readily adaptable to the availability of such data.

When combining data from different sources, Member States may consider include in their national roadmaps the measures they deem necessary to achieve consistency for the life-cycle GWP calculation at building level.

Fast-track for step 1

Member States that currently have no data and methodology in place, can work together with neighbouring countries or other partners. For example, before starting to develop national generic data, Denmark used the data available in the German product database (Ökobaudat). This fast-track option helped Denmark to get started quickly with the calculations, but it will take more time later on, since changing the generic database will impact building-level assessments. Its effects need to be considered in the limit values.

Another case study to be considered is the collaboration on database development between Sweden and Finland.

([4]) Data that is not for a specific product or project and calculated in accordance with EN 15804 or compatible standards for a group of products for a country or region.
([5]) Environmental data calculated in accordance with EN 15804 or compatible standards, used to fill data gaps, where no other data sources are available or to simplify the calculation.
([6]) OJ L, 2024/3110, 18.12.2024.
([7]) OJ L 88, 4.4.2011.
([8]) OJ L, 2024/1781, 28.6.2024.
([9]) OJ L 198, 28.7.2017.

3.3. Step 2 – Collecting building life-cycle GWP data

Step 2 may well be the most time-consuming step, consisting of three sub-steps. The aim of this step is to gather data from actual building projects to set limit values. The sub-steps are:

— Step 2a: gather information on the building stock;

— Step 2b: gather raw building data, like bill of materials etc., for representative building typologies;

— Step 2c: conduct actual life-cycle GWP calculations of the building cases according to the methodology of the national legislation (step 1).

Steps 2a and 2b can be started straight away (and run in parallel to step 1). However, step 2c can only be finalised when step 1, step 2a and step 2b have been finalised. The detail and quality of these steps will affect the execution and the quality of step 2c.

Besides the steps presented below, Member States may also consider the continuous collection of life-cycle GWP data for new buildings, as set out in Article 7(2), for the purpose of adjusting the limit values. Indeed, as of January 2028, life-cycle GWP calculations will be required for new buildings with a useful floor area larger than 1 000 m^2. The calculation will be mandatory for all new buildings from 2030 onwards. The calculated GWP values contained in the energy performance certificates will be gathered in a national database for energy performance of buildings in accordance with Article 22. In addition, for the purpose of setting and adjusting limit values, Member States are encouraged to consider using a standard building document for more comprehensive building data collection at national level. For example, the standard building document could contain the information below:

Reporting information	Description	Example
A short description of the building in free text	The potential to highlight any unique features of the building project that might be relevant when assessing the life-cycle GWP result. This should also be associated with a unique identifier to help identify specific assessments from national databases when needed. This requires a clear description of the technical and functional requirements and characteristics of the building. Member States may consider including any relevant information, including criteria set out in the Level(s) common EU framework.	— Building/project ID — Heat pump — Major materials used, e.g. load bearing structure is concrete — Flat roof — Information on on-site energy consumption — Energy consumption
Building typology	So that the national database can be filtered by building typology, preferable also the type and pattern of use and the number of users.	Single-family house, for 3-4 users.
Type of assessment	A design stage assessment or an as-built type assessment.	As-built assessment/assessment here
Year of assessment	To assess trends over time.	2030
Useful floor area, for the life-cycle GWP calculation	To have transparency of the life-cycle GWP results. The area should be based on a national definition.	The area used for this calculation is 152 m^2, where the calculation for the area is followed as described in the national methodology.

Reporting information	Description	Example
Other relevant floor area information	So that the national database can be used for analysis across Member States; to see if there are any trends related to this (e.g. larger buildings possibly having lower per m^2 life-cycle GWP)	Reference floor area: 130 m^2 Gross floor area: 160 m^2 Heated floor area: 110 m^2
Number of floors	To be able to analyse data to see if there is any carbon premium on higher buildings, for example, related to foundations or the larger relative share of space that might be occupied by structural elements and vertical circulation areas.	A single-family house with a ground floor, and a first floor.
Country	To allow for analysis of data at European level.	Country: […]
Region	To allow for analysis of data on a regional basis.	Region: […]
Latitude, longitude	Approximate latitude and longitude to see if there are any significant impact	Latitude: […] Longitude: […]
Altitude	Approximate altitude to see if there is any notable trend caused by this variable for similar building typologies.	Altitude: […]
Life-cycle GWP impacts	Reporting of life-cycle GWP results with maximum details	GWP impact (kg CO_2/m^2) for each sub life-cycle stages or modules, e.g. A1-A3, A4, A5, B1, B2, B4, B6, C1, C2, C3, C4, D1, D2, etc.
Carbon storage in or on buildings	Relevant indicator for carbon storage in or on buildings in accordance with Regulation (EU) 2024/3012 ([1])	Biogenic carbon content (kgC)
Relevant metric reflecting the data quality of the assessment	Metric reflecting the ratio between project-specific and product-specific data, as compared to average data, generic data, and default values.	
Data reference	To declare what emission data is used, both on product level (specifying if it is generic data, default values, EPDs, CPR etc.,) with a link to the operational emission data, and emission data for transport, materials etc.	Data as defined in the national methodology is used. Which data exactly is used, can be seen in the calculation file.
Special specification compared to the EU framework	Describe if any special specification is used for the calculation for the transparency of the results.	

Reporting information	Description	Example
Building system scenarios for operational energy	Describe which scenario is applied for building integrated photo voltaic and/or on-site generated and exported energy and refer to which Approach the national method describes (see delegated act on EU framework for national calculations of life-cycle GWP referred to in Article 7(3)).	Approach A is required in the national methodology, and also used in this calculation.
Climate zone	Optional: Only if Member State decides to define these in more detail than default climate zones.	Climate zone: […]
Soil class	Optional: Only if Member States have important differences in soil classes and want to be able to see how this affects results for total life-cycle GWP as well as for foundations.	Soil class: […]
Other relevant information		[…]

(1) OJ L, 2024/3012, 6.12.2024.

To simplify the process of data collection, Member States are encouraged to consider using a machine-readable format document.

3.3.1. *Step 2a – Building stock*

Member States should begin by analysing their respective building stocks, to identify the most common building types and to establish the sample size needed to statistically represent the national building stock. It is essential that the buildings chosen to set limit values accurately reflect the types of buildings commonly constructed within the Member State, ensuring that these limit values are realistic and appropriate to local conditions. The reliability of data depends on how closely the selected cases represent the actual building stock of newly constructed buildings in the Member State. Achieving good representativeness requires a thorough understanding of the building stock.

To understand their building stock, Member States can consider, for example, national database for the energy performance of buildings (10), EU Building Stock Observatory data, as well as other databases and research projects. Member States should consider the available information in their national building renovation plan, the national database for the energy performance of buildings as well as any analysis already undertaken for the purposes of Article 9 of recast EPBD. Additional information about representative building typologies could also be obtained through consultation with researchers, experts and stakeholders (11). The representativeness of the building stock should cover different factors, e.g. building typology, climatic zone, construction method, size of building, main building material, etc. Member States may exclude from this analysis buildings exempted from the GWP calculation obligation (as permitted by the regulation according to Article 20(6)). Member States may also decide to prioritise the analysis of the most recently built buildings. After a number of specific building types are identified and respective high-quality data is gathered, the number of studied cases can be multiplied by applying variations to each of those specific building type, see step 2b.

(10) See Article 22 for the databases for the energy performance of buildings.
(11) For example, the Commission study 'Analysis of GHG emissions and removals of EU buildings and construction' has modelled the whole life cycle emissions of the building stock at national level and EU level. See https://c.ramboll.com/life-cycle-emissions-of-eu-building-and-construction.

Member States are encouraged to consider factors such as location and temperature when collecting case data (step 2) and conducting analysis (step 3) to determine if there is a need to differentiate limit values based on climatic zones or their specific geography. In some areas, factors related to building location, such as differences in ground conditions, seismic activity, groundwater levels, proximity to the coast, and other environmental factors, could have a major impact on a building's life-cycle GWP.

3.3.2. *Step 2b – Raw building data*

This sub-step is about gathering information needed for the life-cycle GWP calculation in the step 2c from recently built buildings. Step 2b is a crucial part of the process and can be time consuming. To accelerate the process, Member States can begin to gather these raw input data on buildings even before progress has been made with step 1. It is recommended that data collected at building level include at least:

— Bill of materials (BOM) including both material type and amount, normally held by construction contractors and engineers and which can be extractable from building information models (BIM) if available;

— Floor area: available from public records, technical drawings and BIMs;

— Energy performance certificate (if available).

Preparing and curating BOM information may take a lot of effort to have consistent and comparable case studies. When available, the BOM information can be compared and organised into a hierarchy similar to that described in Level(s) to ensure its completeness and to have it 'prepared' as input for life-cycle GWP calculation as soon as the calculation method and databases are available.

There are different approaches to gathering robust data on buildings. Two approaches are presented below as examples, and Member States should indicate in the national roadmap the adopted approach at the national level.

Approach I: Case collection

The more buildings covered, the more robust and better informed any decisions on future limits and targets, as well as any adjustment for different building typologies or climate zones will be. Member States are advised to carefully select at least a limited number of highly representative buildings in different categories, e.g. single-family houses (detached, semi-detached, terraced, etc.), multi-family houses (i.e. apartment blocks), office buildings, retail units, etc. The selection of these buildings should be well documented and with sufficient numbers to represent the building stock in the context of each Member State. If available, Member States may decide to focus on the most recently built buildings or credible building projects. Member States should indicate in their national roadmaps the number of building cases they expect to collect in their respective countries.

Approach II: Variations in generic buildings

Another possibility is to create a set of generic buildings, representing typical construction methods, and covering different building typologies. The generic buildings could be adapted to different variations in materials for facades, form of roofs, etc. This can also help in getting a better understanding of the impact of different building parts on GWP.

Experience from Member States

Some Member States such as Denmark and France worked with voluntary systems before adding life-cycle GWP obligations to their national regulation. These voluntary systems have helped to gather data from participating projects including building information and life-cycle GWP assessment. These voluntary systems can be identical to or can be adjusted to the future obligation in the regulation. The Netherlands is currently implementing a voluntary system to extend the scope of modules. This approach allows them to gain experience on a voluntary basis before transitioning to mandatory requirements.

3.3.3. *Step 2c - Life-cycle GWP calculations of buildings*

This step focuses on the assessment of life-cycle GWP data of real buildings. These buildings should have been built as recently as possible, i.e. within the last two or three years. Data will be compiled to form the basis for the subsequent analyses in step 3 and decisions on limits and targets in step 4.

To perform the life-cycle GWP calculations, environmental data from step 1b are connected to real building data from step 2b, following the calculation methodology set out in step 1a. It is strongly recommended that the data obtained are collected in a digital case bank containing single unit record data for each building, so that further extensions and updates to the methodology, data or the assessment tools can be done effectively.

3.4. **Step 3 – Analysis of life-cycle GWP building data**

Step 3 consists of analysing the result of the life-cycle GWP calculations of the buildings. The execution and quality of the analysis depends on the amount of data gathered and its quality. During the analysis, Member States can divide the datasets by building typology (e.g. residential, offices, educational buildings, hospitals, etc.). If relevant, Member States should also group data into different climate zones. However, when the dataset is divided, the subsequent datasets for each category will become smaller in size, and it will be harder to draw clear conclusions. Hence, a balance needs to be found based on the available dataset. It is up to Member States to decide if and how they want to break down the datasets. They can also consider the development of the available dataset, e.g. adding more data in the future, with more building typologies or climate zones.

The results spread for life-cycle GWP for each building typology should be statistically analysed, and this will form the basis for decisions in step 4 about where to set the maximum limit values and the targets. Theoretically, if step 1 and step 2 are done well, step 3 can be rather rapidly executed. However, based on experience, the analysis in step 3 can identify certain issues, which in turn require that steps 1 and 2 need to be refined.

Example of limit values for different building typologies in Denmark

Denmark introduced one limit value for all new buildings over 1 000 m^2 in 2023, based on a limited amount of building cases collected in the previous years. In the years following the first data collection, Denmark collected more cases and ended up with separate limit values for different building typologies, which will be applied as from mid-2025. The advantage of having separate limit values is that each building typology is subject to the same ‘intensity’ of regulation, ensuring that no typology is disproportionately affected.

3.5. **Step 4 – Setting limit values**

Steps 1 to 3 put in place the life-cycle calculation method, life-cycle datasets, and a statistical analysis of real building life-cycle GWP data. This last step in the recommended process will depend on each Member State’s pathway to achieving climate neutrality, while also considering the readiness of their economic actors and their markets. As provided for in Article 7(5), limit values need to be in place by 2030.

As set forth in Article 7(5), Member States should consider setting different limit values for different climatic zones and building typologies depending on the national context. Member States may consider the specific features of a building typology that may affect its life-cycle GWP results, e.g. hospitals, care facilities for older people, technical buildings requiring specialised foundation, buildings equipped with additional photovoltaic capacity, etc. Depending on the geographical situation, Member States may also consider differentiating limit values by climatic zone. Buildings in different climatic zones may face different challenges, e.g. buildings in areas prone to earthquakes or high winds or heavy snowfall, etc. Possible approaches include setting limit values with a high level of granularity for different building typologies or adding an ‘add-on’ to the limit values to accommodate special needs based on building functionality. For any of these considerations, Member States should document their approach in the national roadmap.

The adopted limit values must not constitute barriers to Member States promoting renewable energy production (in particular through the solar energy installations) and tackling the issues of optimal indoor environmental quality, adaptation to climate change, fire safety, risks related to intense seismic activity, or accessibility for people with disabilities.

The targets are a series of limit values starting from 2030 with a downward trend, e.g. a limit value in 2030 followed by a lower value in 2033, an even lower in 2036, etc. A progressive downward trend would ideally represent a gradual, smooth reduction in limit values on a graph, starting from the anticipated values in 2030 and decreasing steadily towards 2050. This may not follow a perfectly linear path; instead, there could be periods of steeper decline and stabilisation as policies take effect and new technologies emerge. When setting the targets, Member States may consider taking into account progress in industry or other relevant sectors with regard to decarbonisation, as well as relevant policies towards the objective of climate neutrality. Member States are encouraged to anticipate also the benefits of the circular economy model when it is well established in the construction sector, as well as the potential of biobased materials. The interval is up to the Member State to decide. The advantage of applying shorter intervals is that quick changes in the sector are accounted for, but this comes at the cost of bigger administrative burdens. A reasonable interval should be between three and five years.

Each Member State should decide on their downward trend ambition level at each interval in order to reach the objective of achieving climate neutrality. A target will in the future become a limit value. If relevant, Member States can consider adjusting these future limit values when the time comes based on the development of construction-product environmental data or any subsequent adjustment in the methodology.

While the scope of life-cycle stages or modules included in the calculation must cover the minimum requirements set out in the Union framework of the delegated act, the scope of life-cycle stages or modules covered by the limit values is for Member States to determine. Also, if relevant, Member States can decide to exclude certain parts of the scope of building components from the scope of the limit value. If Member States decide to neglect a certain scope of life-cycle stages or some parts of the scope of the building components from the scope of the limit value, they should include this decision in their national roadmap and provide an explanation for it. In any case, Member States are strongly recommended to adopt a long-term perspective, so that future limit values can always be compared to those in the past, confirming a progressive downward trend as required by Article 7(5). As will be specified in the delegated act issued under Article 7(3), most life-cycle stages will have to be included in the calculation and declaration referred to in Article 7(2). The delegated act will also specify the minimum requirements for the scope of building components for the calculation. Member States should therefore consider the benefits of the available information issued from the calculation when setting the scope of life-cycle stages or the scope of building components covered by the limit values. By using a fixed scope of life-cycle stages and building components covered by the limit values, Member States could encounter fewer difficulties in demonstrating a downward trend in their targets, as required by Article 7(5), and stakeholders, particularly project designers, would benefit from a more stable regulatory framework.

Being transparent about the ambition level for the limit values is recommended as this will help market uptake. When setting limit values and the scope of life-cycle stages and building components covered by the limit values, stakeholders must be properly consulted, and Member States should clearly communicate the technical solutions available for new buildings to comply with the proposed limit values. In addition, early communication of limit values is key for market readiness. For example, the first numerical limit values should ideally be communicated to stakeholders at least six months or a year before they enter into force in 2030.

Example of adjustment of limit values in France

In the beginning, Member States can consider adjusting the limit values to accommodate market uptake of relevant technologies or solutions. For example, France put in place a limit value for life-cycle GWP in 2022 covering all elements of the building. Two limit values have been applied for each typology of building: one limit value for operational carbon and one limit value for embodied carbon. Some components, such as solar panels, can have a very significant impact in terms of embodied carbon, although they are a local renewable source and greatly beneficial for operational carbon. In addition, the embodied carbon of solar panels is expected to be reduced progressively as more products will arrive on the market with better environmental declarations. To avoid slowing down the deployment of solar panels, the limit values are adjusted with an ‘add-on’ when the building project is equipped with solar panels.

3.6. Recommended timeline

Figure 2 suggests a timeline for recommended steps described above, with the following dates to be aware of:

— Member States must 'publish and notify' the roadmap to the Commission at the latest by 1 January 2027, describing the ongoing and planned steps for the implementation of limit values;

— Limit values need to be in force by 2030, hence they need to be set earlier, depending on the length of the legislative procedure in each Member State;

— There is no requirement in Article 7(5) to update the roadmap after 2027, but Member States should see it as their own individual strategic document;

— All the necessary legal framework for life-cycle GWP calculation for new buildings over 1 000 m^2 must be in place before 2028 and for all new buildings by 2030, see Article 7(2);

— Some real data on life-cycle GWP for new buildings over 1 000 m^2 should be obtained during 2028/2029.

Member States are highly encouraged to implement limit values as early as possible and ideally start a voluntary approach before 2030, as such a scheme can help actors across the whole value chain.

Step	2025	2025	2026	2026	2027	2027	2028	2028	2029	2029	2030
	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st Jan.
Step 0 – General considerations on the legal framework			Trans-position				Article 7(2).a				Article 7(2).b and 7(5)
Step 1a – Methodology		DA									
Step 1b – Environmental data											
Step 2a – Building stock											
Step 2b – Raw building data											
Step 2c – Life-cycle GWP calculations of buildings											
Step 3 – Analysis of life-cycle GWP building data											
Step 4 – Setting limit values								National scrutiny period			Article 7(5)
Drafting the roadmap				Article 7(5)							

Figure 2. Recommended timeline for Member States to draw up the national roadmap and implement the limit values. Light blue indicates when a work should have started, and dark blue areas indicate when a step should be finalised at the latest. Light green indicates when an initial work is finished but can be continued for the future target limit values.

4. COMMON ROADMAP TEMPLATE

A common template is proposed below to help Member States draw up their national roadmap. Following this template will help ensure that all the required elements are included and will help the Commission in reviewing and assessing the submitted documents.

Section	Content explained
Step 0 Legal framework	(1) Describe the relevant legislative framework (already in place, in preparation or planned) related to the **GWP calculation and the setting of limit values**. (2) Describe the relevant legislative framework (already in place, in preparation or planned) related to **control, verification and penalties for non-compliance** with limit values. (3) Describe the relevant legislative framework (already in place, in preparation or planned) related to **roles and responsibilities** for the different actors involved.

Section	Content explained
Step 1a Method	(1) Describe the **adopted calculation methodology and any special consideration compared to the EU framework**. (2) Describe the development of any **guidance documentation** (already in place, in preparation or planned) for the life-cycle **GWP calculation**, with reference and link if available. (3) Describe any framework or legal consideration regarding **calculation software/tools** (either obligatory or recommended), with reference and link if available. (4) If '**fast-track**' is chosen, describe when and how the subsequent adjustment will be done. (5) Describe any planned future development/evolution.
Step 1b Data	(1) Describe the accepted **environmental data for GWP calculation**: data sources, data management, accessibility, data availability, data update, etc. (2) Describe how product-specific **data issued according to Regulation (EU) 2024/3110 (CPR)** is used when available. (3) Describe how **compatible environmental data according to Regulation (EU) 2024/1781 (ESPR)** is used when available. (4) Describe how any **other product-specific or project-specific data** can be used when data from CRP or ESPR is not available. Describe if **average data for a product** group can be used. Describe how the data quality is controlled, how the transition to CPR data or compatible ESPR data is planned, etc. (5) Describe how **generic product data and default value data** is established: data management, data responsibility, any specific rules (e.g. safety factor), etc. (6) If '**fast-track**' is chosen, describe when and how adjustment will be done.
Step 2a Building stock	(1) Describe the existing **building stock** in your country. Member States may consider data reported in the National Building Renovation Plan. (2) Describe any **factor or criteria considered relevant** to the establishment of limit values: building typology, climatic zone, construction method, etc.
Step 2b Building data	(1) Describe how **data on building level** (raw bill of materials data) will be collected from recently built projects: building typologies, amount, etc. (2) Describe the **treatment of collected data**. (3) Describe how generic building is identified if used or will be used.
Step 2c Life-cycle GWP calculations	(1) Describe the work plan for how building data (step 2.b) is or will be used with environmental product data (step 1b) for the **life-cycle GWP calculation for buildings**.
Step 3 Analysis	(1) Describe the work plan: timeline, number of cases expected before proceeding to step 4: case study or the variations of generic building (2) Describe orientation regarding the analysis and aggregation of data from Step 2c.

Section	Content explained
Step 4 Setting limit values	(1) Describe how the limit values are/will be adopted, particularly the **scope of the life-cycle modules covered by the limit values**. **Explain the choice**, particularly if any module of the life-cycle is excluded from the scope of the limit value. (2) Describe how the national policy is in line with the EU's objective of achieving climate neutrality. (3) Describe how the national policy is translated to **the ambition** for each maximum limit value. (4) Describe the interval of limit values. (5) **For each limit value, indicate either actual limit value or corresponding ambition level, with progressive downward trend and in line with above-mentioned national policy and ambition**. (6) Describe if Member States decide to use top-down approach for the establishment of the limit values. (7) Present a timeline from 2027-2050 including any planned development/evolution: updates in methodology, data, case collection, updating of targets, setting limit values as milestones.