



# ROADMAP TO CLIMATE-PROOF BUILDINGS AND CONSTRUCTION

## HOW TO EMBED WHOLE-LIFE CARBON IN THE EPBD



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# INTRODUCTION

The European Union aims to cut its net greenhouse gas emissions by at least 55% by 2030 (compared to 1990 levels) and to become climate neutral by 2050. Greenhouse gas emissions must be radically cut across all sectors to achieve these objectives. Mitigation in the construction and building sector plays a key role, though this requires current policies to do more to drive the required structural transformation of the sector.

There is potential to reduce carbon emissions further by broadening the scope of the Energy Performance of Buildings Directive (EPBD) to address and reduce the lifecycle carbon associated with buildings. In addition to considering operational emissions, this requires consideration of the embodied carbon associated with the manufacture, transport, maintenance and disposal of building materials and components, and the potential to increase the amount of sequestered or stored carbon in buildings.

There is no overarching consensus over exactly what proportion of total emissions arising from the European building stock is attributable to embodied emissions. Most estimates suggest that embodied carbon contributes to around 10-20% of buildings' total CO<sub>2</sub> footprint,<sup>1</sup> though the relative importance is expected to grow as more buildings are constructed and renovated to higher efficiency standards.<sup>2</sup> In addition, the short-term time horizon over which these emissions occur means they have a disproportionate impact on the remaining carbon budget for keeping global temperature rise below 1.5°C.

<sup>1</sup> International Energy Agency (2020) *Energy Technology Perspectives* and International Energy Agency (2019) *Material Efficiency in Clean Energy Transitions*

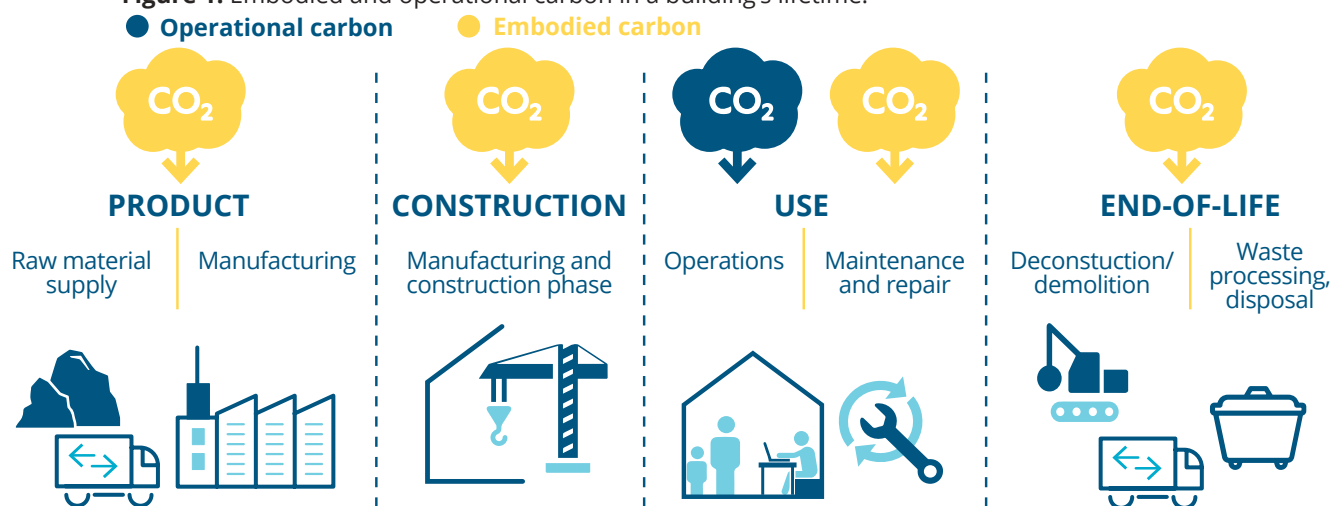
<sup>2</sup> Kjær Zimmermann, R. et al (2020) *Klimapåvirkning fra 60 Bygninger* (in English: Climate impact of 60 buildings). Aalborg University.



Currently, the measurement and mitigation of embodied carbon at the building level is typically voluntary, with no existing regulatory or statutory mechanisms in place across Europe to provide a consistent framework and trajectory. Many leading real estate developers now measure and optimise the embodied carbon footprint of new projects, and technical standards and guidance are available to do this, but it is far from being mainstream practice across the industry.

Despite an array of national initiatives and voluntary schemes, the whole-life carbon impact of buildings is still a blind spot of the current EU policy framework. Reductions of embodied carbon emissions can be achieved by developing and implementing policies that tackle the lifecycle emissions of buildings, including those resulting from the production, installation, maintenance and disposal of building materials. This is a significant expansion of existing policies, as most of the focus on reducing carbon emissions from the built environment has been on managing and reducing the energy consumption in the buildings' use phase, not addressing the important mitigation potential of embodied emissions.

**Figure 1:** Embodied and operational carbon in a building's lifetime.



Adding whole-life carbon objectives to the existing policy framework would not replace ongoing climate efforts focusing on operational energy efficiency, but rather ensure that efficiency measures are fully brought in line with carbon-neutrality goals and that greenhouse gas emissions are not being simply shifted between lifecycle phases. Energy efficiency remains an important metric to avoid energy being wasted. Minimum energy performance requirements will still have an important role to make sure the quality of buildings is improved and that easy substitutions, such as carbon offsetting, are avoided.

The ongoing review of key policy and legislative files provides a significant opportunity for the EU to begin consistently integrating whole-life carbon in the policy framework. This document primarily focuses on the pending recast of the EPBD but also references the Energy Efficiency Directive (EED) and the Construction Products Regulation (CPR). The cornerstones of how to fully decarbonise the European Union's building stock along its entire lifecycle must be laid now. Member States but also private actors need guidance and security to direct investments and set the framework to steer the required actions and trigger innovation.



**Despite an array of national initiatives and voluntary schemes, the whole-life carbon impact of buildings is still a blind spot of the current EU policy framework.**



## ABOUT THIS ROADMAP

The European Commission presented its proposal to recast the EPBD on 15 December 2021. The proposal puts forward a definition of 'zero-emissions building' for new buildings and renovation, as well as the requirement to disclose life-cycle Global Warming Potential for large new building as of 2030. Undoubtedly, these are important first steps which will need to be strengthened and followed up by further measures of capping embodied emissions and extending the definition of zero-emission buildings to include lifecycle carbon. **Considering the next revision is only planned by end of 2027, the time to get this right is now.**

This document sets out the necessary steps to introduce whole-life carbon considerations and align the provisions of the EPBD with climate-neutrality goals. It puts forward an overview of the most relevant and urgent actions up to 2050. The roadmap sends a long-term market signal by setting out a clear vision that provides the rationale and sets the level of ambition for further measures.

### THIS VISION IS GUIDED BY THE NEED TO:

- Align the EU building stock with climate-neutrality goals and **remaining carbon budget**
- Focus on **all carbon emissions** from the building stock
- Point out the **urgency of action** and provide a compelling timeline

- 1.** The first step in the implementation of the roadmap is to improve the consistency of carbon data sources and approaches for calculating embodied carbon at the product and building levels.
- 2.** The next step is to set voluntary requirements based on common standards and agreed methodologies. New construction should be required to assess and disclose information on embodied carbon emissions. Making whole-life carbon reporting mandatory will facilitate data collection and benchmarking, as well as allow the construction sector to develop the necessary skills and capacity.
- 3.** Ultimately, mandatory minimum whole-life carbon standards will have to be introduced and strengthened over time.

Appropriate milestones should be guided by both climate necessity and transparent carbon-intensity and benchmark data. Given the current lack of clear baselines, target values and carbon trajectories – both at individual building and stock levels – the milestones in the roadmap are only indicative, although definitely more ambitious than the requirements outlined in the Commission's proposal. This highlights once again the urgent need to fill data gaps and develop an EU-wide whole-life carbon trajectory that would make a robust and compelling case to mitigate all emissions related to buildings by 2050.



## 2021 - 2023 EPBD REVISION

## >2025 EPBD IMPLEMENTATION

### STRATEGY AND ENFORCEMENT

**EPBD RECAST:**  
Next National Building Renovation Plan (NBRP) include milestones to ensure a zero-emission building stock by 2050

EPBD is in line with EU 2050 whole-life carbon roadmap, the Sustainable Products Initiative and Green Public Procurement

Mandate common EU product category rules

**2030**  
NBPR MILESTONE

**2040**  
NBPR MILESTONE

**ENTIRE BUILDING STOCK IS NET ZERO CARBON ACROSS ENTIRE LIFE-CYCLE**

Legislative proposal for a framework directive for Sustainable Buildings

Making EPDs mandatory under CPR for all construction products

### DATA AND REPORTING

**EPBD RECAST:**  
Overhaul of EPC systems and databases

Prepare and establish a single EU carbon and LCA impact database

By 2025 EPCs report on whole-life carbon for new, public and larger non-residential buildings

By 2025 EPCs report on operational emissions

**2050**

2021

2023

2025

2030

2040



### NEW CONSTRUCTIONS

**EPBD RECAST:**  
Introduce Building Renovation Passport (BRP) to facilitate low-carbon renovations

**EPBD RECAST:**  
Introduce progressive tightening thresholds to net zero whole-life carbon

By 2025 all new buildings are zero-operational emission buildings

By 2036 all new buildings are whole-life zero emission buildings

By 2025 new buildings to measure and disclose whole-life carbon data

Deep renovations are whole-life zero emission

### EXISTING BUILDINGS

**EPBD RECAST:**  
Introduce Minimum Energy Performance Standards (MEPS) to improve worst-performing buildings

All public buildings carry out a LCA linked to a BRP

**2028**  
1<sup>ST</sup> MEPS THRESHOLD

**2035**  
2<sup>ND</sup> MEPS THRESHOLD

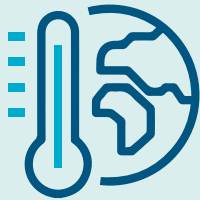
**2040**  
3<sup>RD</sup> MEPS THRESHOLD

**2045**  
4<sup>TH</sup> MEPS THRESHOLD

## THE VISION OF AN EPBD DELIVERING A CLIMATE-NEUTRAL BUILDING STOCK



The Energy Performance of Buildings Directive (EPBD) is the single most important legislation targeting the building sector at EU level. It requires Member States to set energy performance levels for their buildings, strategically plan the decarbonisation of the building stock through long-term renovation strategies and implement additional measures – both financing and advisory tools. Ever since it was adopted in 2002, the scope of the directive has been expanded beyond regulating operational energy performance to:



Mitigate the climate impact of the sector



Improve comfort and indoor air quality



Link buildings to other infrastructure such as e-mobility



Support Member States to make their building stock smart-ready



**THE EPBD IS THUS THE OBVIOUS POLICY TOOL TO SET OUT REQUIREMENTS AND CLEAR TRIGGERS FOR REDUCING WHOLE-LIFE CARBON EMISSIONS OF THE BUILDING STOCK**

Effective regulation of the whole-life carbon footprint of buildings will require coherent and well-aligned policy measures targeting both products and buildings. The EPBD may not be the only piece of legislation to expedite whole-life greenhouse gas emission reductions in the future, let alone a comprehensive framework addressing wider environmental impacts. **However, the ongoing revision can provide the opportunity to rethink goals for reducing emissions from the built environment and lay the foundation for a more comprehensive vision of a carbon-neutral building stock.**



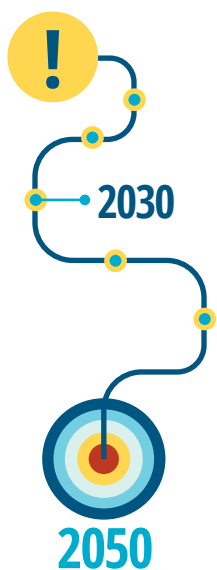
Taking into account the long-term aim of eliminating emissions from the building stock, the **preamble of the EPBD should reinforce the importance and urgency of this objective.** Embedding the end goal and timeline will provide certainty and consistency, as well as a clear pathway for further revisions, policies and market actions that can help deliver the ambition.

### OBJECTIVE: SET THE WHOLE SECTOR ON CONVERGENCE TOWARDS NET ZERO CARBON TARGETS BY 2050



The reference to a highly energy efficient and decarbonised building stock is insufficient and needs to be complemented by the necessity to reduce carbon across the entire lifecycle of the building stock. Aligning the EU building stock with 2050 carbon-neutrality objectives means buildings must achieve net zero carbon throughout their lifecycle, including development, renovation and operation. The construction of new buildings and renovation of existing assets will need to happen without further depleting the remaining carbon budget, i.e. the maximum cumulative amount of greenhouse gases associated with the 1.5°C warming threshold. Climate proofing of building investments requires proper measurement, tracking and targeting of positive climate outcomes that will take into account not only today's emissions, but the sum of all future emissions. Targets should be aligned with decarbonisation trajectories and what the latest climate science deems necessary to meet the goals of the Paris Agreement.

The carbon budget specifies the maximum amount of CO<sub>2</sub> that may be emitted to stabilise warming at a particular level – such as the Paris Agreement's 1.5°C threshold. It is seen as a key tool to inform climate policy goals and track progress towards net zero emissions targets. The remaining share of the EU building sector is estimated to be between 12 and 15 Gt CO<sub>2</sub>. **This will be used up by sometime in the 2030s unless drastic action is taken now.**



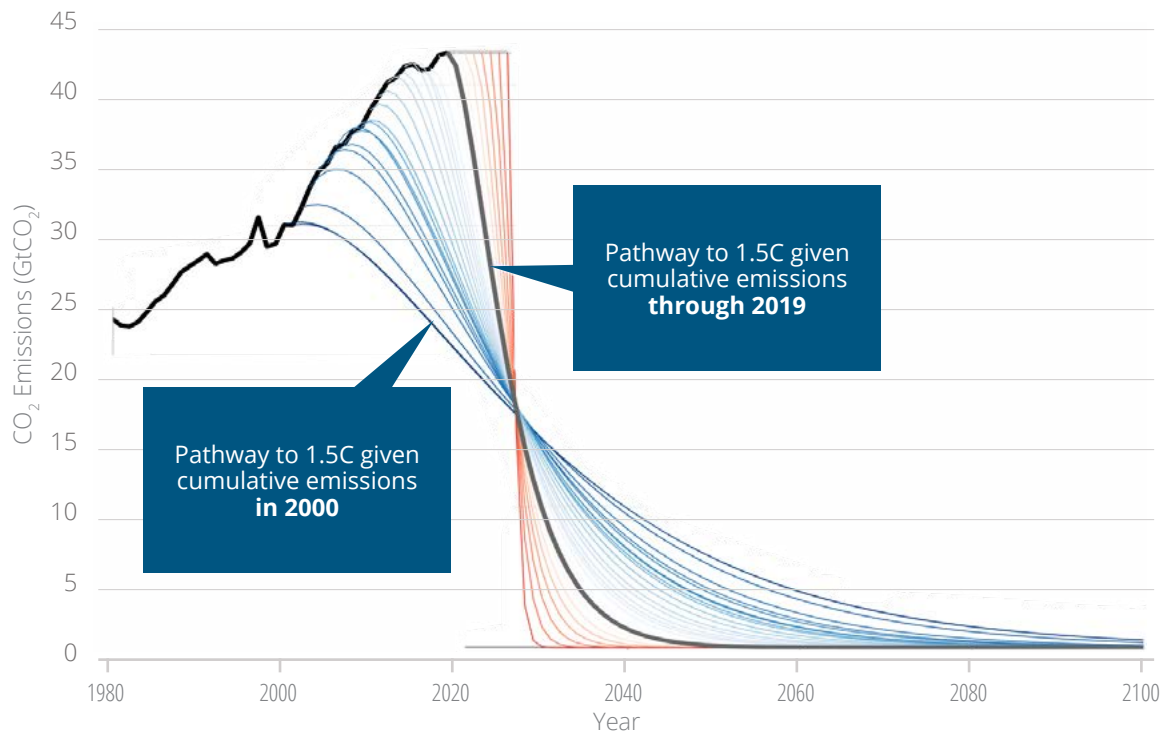
### TIMELINE AND URGENCY

The sooner new and existing buildings meet net zero carbon performance, the less difficult it will be to meet the 2050 target of climate-neutrality.<sup>3</sup> Regulating embodied emissions is particularly urgent as they are released in the near-term horizon, and are both immediate and irrecoverable. Unlike operational carbon, they cannot be mitigated during the working life of the building. The emissions released between now and 2050 are critical to keeping global temperatures at tolerable levels. Early emissions savings are needed long before the actual construction or operation phase. This would necessitate changes in building design and materials selection, including designing with less material and waste, selecting materials with a lower carbon impact and designing buildings for a longer lifespan or to be deconstructed. Embodied emissions are the first emissions a building generates, so neglecting these may trigger a tipping point for climate change beyond which energy savings realised in 20-30 years from now will no longer be enough.

<sup>3</sup> CICERO Center for International Climate Research (2020) It's getting harder and harder to limit ourselves to 2°C

Decarbonisation pathways are policy packages designed to reach net zero carbon buildings and building stock. They usually consist of a mix of measures targeting energy efficiency, renewable energy generation, embodied carbon and the use of carbon offsets. Decarbonisation pathways are informed by the size of the carbon budget, the allocation of this budget to different sectors, and the anticipated cumulative carbon emissions or ‘carbon lock-in’ of assets.

**Figure 2:** Emission reduction trajectories associated with limiting warming below 1.5°C by starting year. Solid black line shows historical emissions, while dashed black line shows emissions constant at 2018 levels. Source: [Carbon Brief](#).



The preamble of the EPBD should therefore indicate the timeline for the introduction of requirements to reduce carbon emissions along the entire lifecycle of buildings going beyond the 2030 cut-off date of most provisions in the current draft legislation. By doing so, the next recast of the EPBD can prevent regulatory lock-ins (e.g. new energy performance certificates (EPCs) that disregard reporting on whole-life carbon emissions). Future revisions can then gradually evolve the EPBD from an energy-efficiency legislation into a framework that will support Member States to fully decarbonise their building stocks.

# ALL TARGETS POINT TO 2050-MAINSTREAMING LIFECYCLE EMISSIONS IN THE POLICY FRAMEWORK



All provisions enshrined in the 2022 EPBD recast need to support the objective of a net zero emissions building stock by 2050. The objective needs to be reflected in the definitions, the long-term renovation strategies and in the minimum performance requirements for new constructions and existing buildings.

Policymakers at EU level must set requirements for Member States to define whole-life carbon metrics and requirements, in addition to existing energy performance ones. While there is an overlap between energy and carbon, they are not fully interchangeable metrics. Not all carbon emissions are related to energy, and as a result, making a building more energy efficient and replacing its heating system will not necessarily mean it is a 'zero-emissions building' over its entire lifecycle. Embodied emissions from the manufacturing, transport, construction, renovation and maintenance processes will also have to be accounted for at building level alongside operational carbon. It would be a missed opportunity to not address all building-related emissions through an integrated approach.

**Figure 3:** The difference in scope of the different building standards. Note the shift from energy (marked in yellow) to carbon (green) between the existing 'nearly zero energy' and the proposed net zero carbon standards.



## Article 2 Definitions and Article 7 on new buildings

Set robust definitions of 'net zero whole-life carbon building' and 'net zero operational carbon building'. The definitions must respect the principle of 'energy efficiency first' and the progressive enforcement should be aligned with the estimated carbon budget. By 2050, at the very latest, all new constructions must be net zero carbon over the whole lifecycle and all existing buildings must be net zero operational carbon.

- 'Net zero operational carbon' means net-zero emissions related to the ongoing operation and actual use of the building
- 'Net zero whole-life carbon' means net-zero emissions over the whole lifecycle of the building

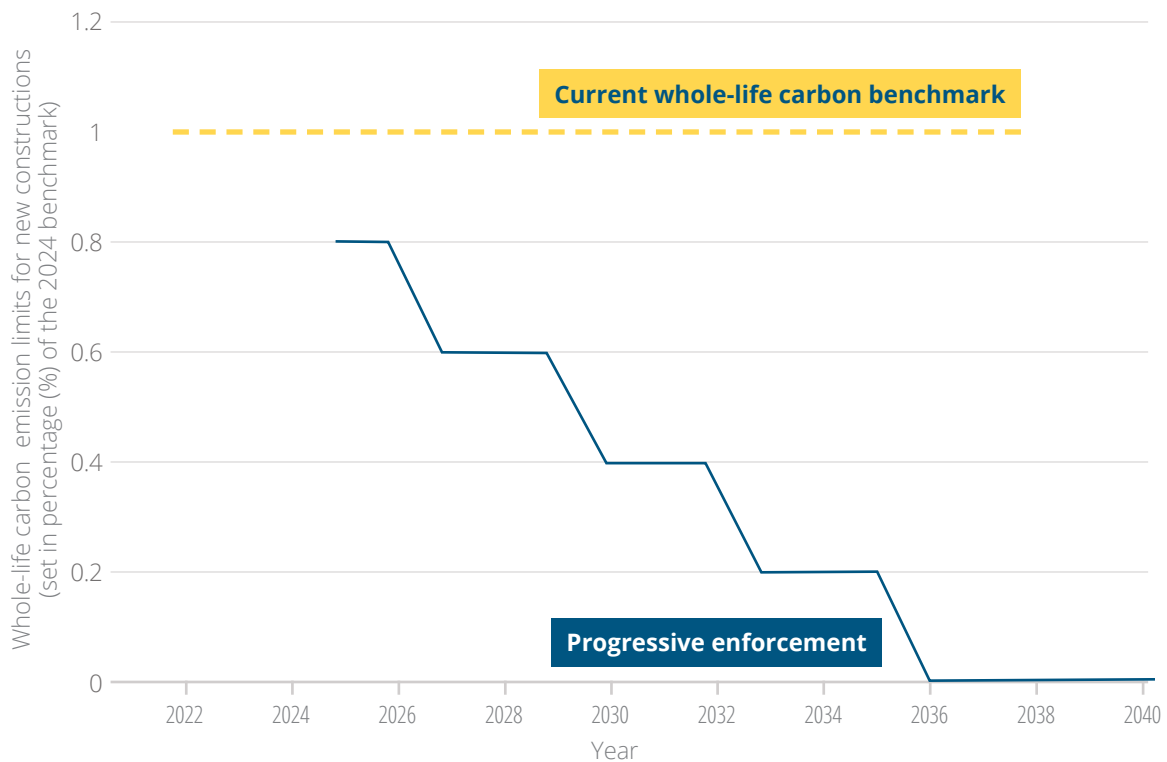
The path towards a net zero whole-life carbon implementation should follow a progressive tightening of the whole-life carbon threshold<sup>4</sup>, until it reaches net zero carbon over the whole lifecycle.

The new building standards must evolve from the current 'nearly zero energy' to become 'net zero operational carbon' and by 2030 also 'net zero whole-life carbon', covering the emissions over the whole lifecycle.

The standard must be achieved as early as possible to avoid the need to retrofit these buildings before 2050.

The existing building stock must be transformed to net zero operational carbon by reducing the energy need through renovations and decarbonisation of the heating and cooling system. Whereas embodied emissions from major renovations of existing buildings are typically less than half of the embodied emissions of new construction,<sup>5</sup> they nonetheless have an impact on the remaining carbon budget. The Renovation Wave objective to at least double the annual renovation rate makes it clear that we also need to consider the embodied emissions in the materials and components used during renovations.

**Figure 4:** Example of what progressive enforcement of whole-life carbon limits for new buildings could look like. Similar plans have already been introduced in Denmark and France, albeit not yet targeting net zero carbon.



<sup>4</sup> Progressive whole-life carbon limits for new buildings have recently been introduced in Denmark and France. See [https://www.bpie.eu/wp-content/uploads/2021/05/BPIE\\_WLC\\_Summary-report\\_final.pdf](https://www.bpie.eu/wp-content/uploads/2021/05/BPIE_WLC_Summary-report_final.pdf).

<sup>5</sup> EASAC (2021) Decarbonisation of buildings for climate, health and jobs.

The definition of net zero whole-life carbon buildings should clarify the boundaries and scope of emissions, including embodied carbon, carbon offsetting and sequestration. It should also consider potential trade-offs between operational and embodied emissions.

## NET ZERO CARBON BUILDINGS



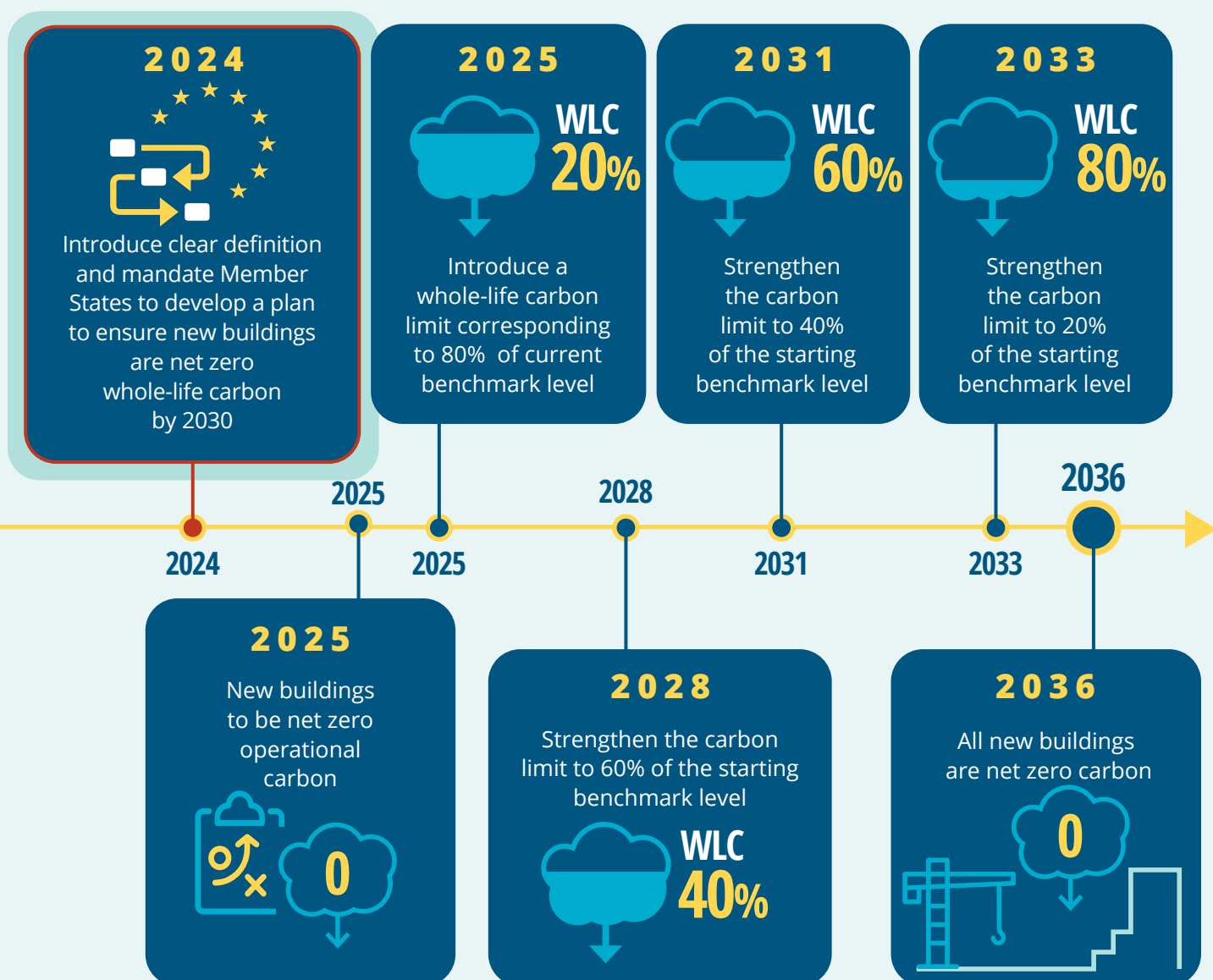
NET ZERO CARBON MEANS NOT ADDING TO THE AMOUNT OF GREENHOUSE GASES IN THE ATMOSPHERE. ACHIEVING IT MEANS REDUCING EMISSIONS AS MUCH AS POSSIBLE, AS WELL AS BALANCING OUT ANY THAT REMAIN BY REMOVING AN EQUIVALENT AMOUNT. THE FIRST AND MOST IMPORTANT STEP IS TO REDUCE OPERATIONAL CARBON EMISSIONS. **WHILE OPERATIONAL CARBON CAN BE REDUCED THROUGH IMPROVEMENTS IN ENERGY USAGE AND EFFICIENCY OVER TIME, EMBODIED CARBON IS LOCKED IN AT THE CONSTRUCTION, RENOVATION AND MAINTENANCE STAGES.** THIS MEANS EMBODIED CARBON EMISSIONS NEED TO BE CONSIDERED AT THE OUTSET TO AVOID SIGNIFICANT DETRIMENTAL EFFECTS IN THE LONG RUN.

Aligning the EU building sector with climate-neutrality goals means that the sector reduces its entire emissions at a rate commensurate with achieving net zero emissions by mid-century. The sector's pathway to net zero is not, however, a fixed one, but changes based on how much of the carbon budget is left. In this sense, **the EU Commission and the Member States should gather and analyse existing data in order to establish robust benchmarks for whole-life carbon in both new constructions and renovations which will guide the requirements and level of ambition.** These benchmarks should be based on a wide and consistent set of lifecycle assessment data, suitable for benchmarking best practices across different building uses and typologies (houses, flats, offices, etc.).

The benchmark will inform the thresholds and target values, alongside a clear timeline for how to introduce embodied carbon limits for common building types. The progressive implementation will provide the market with sufficient lead time to prepare. The incremental enforcement and tightening will provide investment security, unleash the necessary innovation and capacity in the supply chain, and fill data gaps. Public procurement and voluntary targets could lead the market. Finally, mandatory minimum whole-life carbon standards which strengthen over time should be extended to comprise the entire stock.



**Figure 5:** Indicative timeline of introducing net zero whole-life carbon requirements.



**THE COMMISSION SHOULD ADOPT DELEGATED ACTS SUPPLEMENTING THE EPBD TO PROVIDE GUIDANCE FOR ALIGNING WHOLE-LIFE CARBON THRESHOLDS FOR BUILDING TYPES WITH SCIENCE-BASED DECARBONISATION PATHWAYS.**

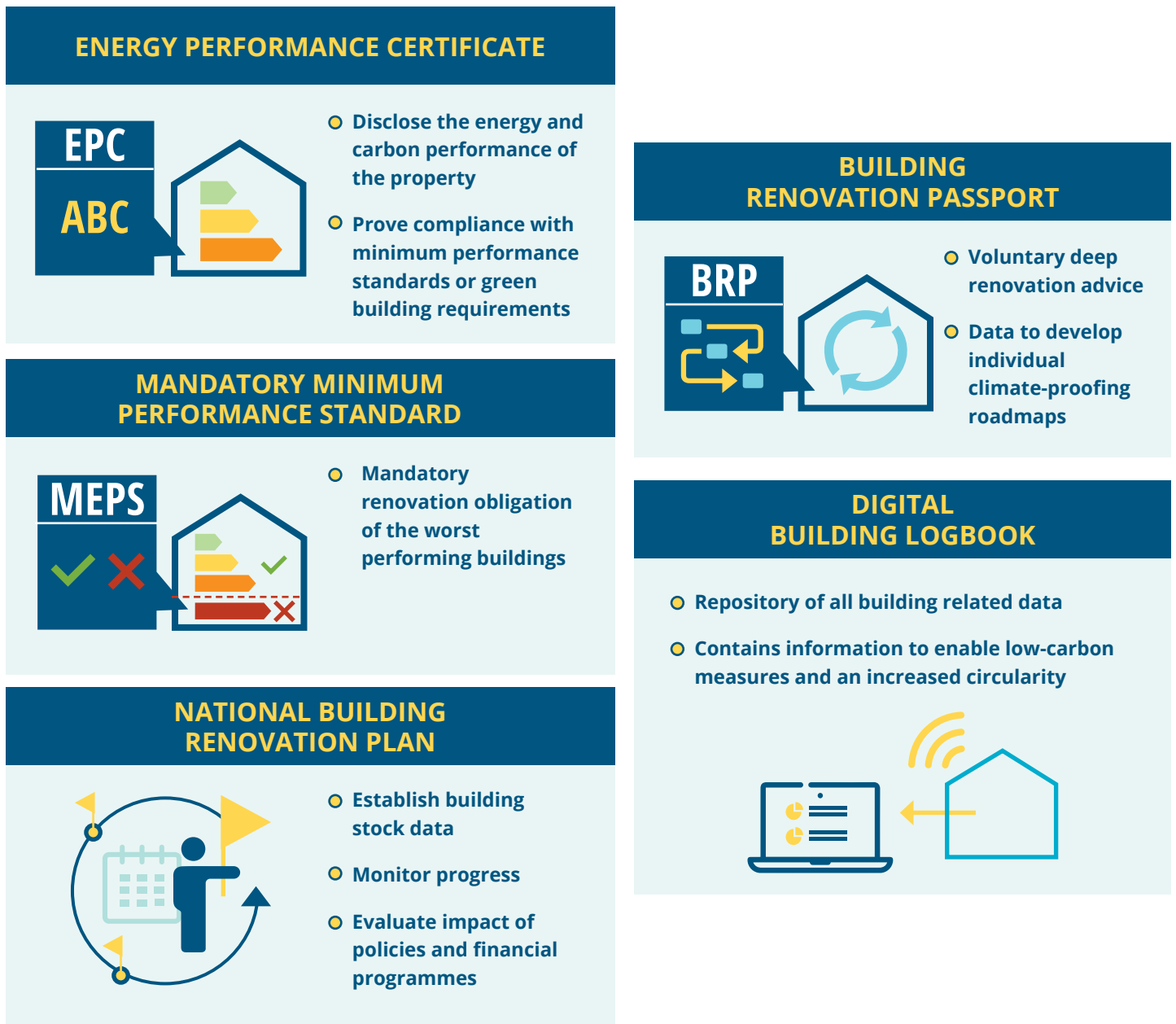
The recast EPBD will need to include a mandate that enables the EU Commission to develop benchmarks and set targets against 2050 via delegated acts. The mandate will empower the Commission to develop guidance for aligning whole-life carbon thresholds with science-based decarbonisation pathways and periodically revise the trajectory for these limit values up to 2050.

# TOOLS TO FACILITATE THE INTRODUCTION OF WHOLE-LIFE CARBON CONSIDERATIONS



Over the years, the EPBD has employed a diverse set of policy tools such as energy performance certificates (EPC) and long-term renovation strategies to drive down energy use and operational carbon emissions. New measures are currently in the pipeline including minimum performance standards, building renovation roadmaps and digital building logbooks. If amended accordingly, all these tools can be instrumental in preparing the groundwork and enabling the introduction of whole-life carbon considerations in existing regulations. The section below describes how these individual policy measures taken collectively can build market demand, create trust, contribute to robust data tracking and reporting, which in turn will help expand datasets and enable further refinement of targets.

**Figure 6:** Other key EPBD provisions that can facilitate the integration of whole-life carbon in renovation decisions.

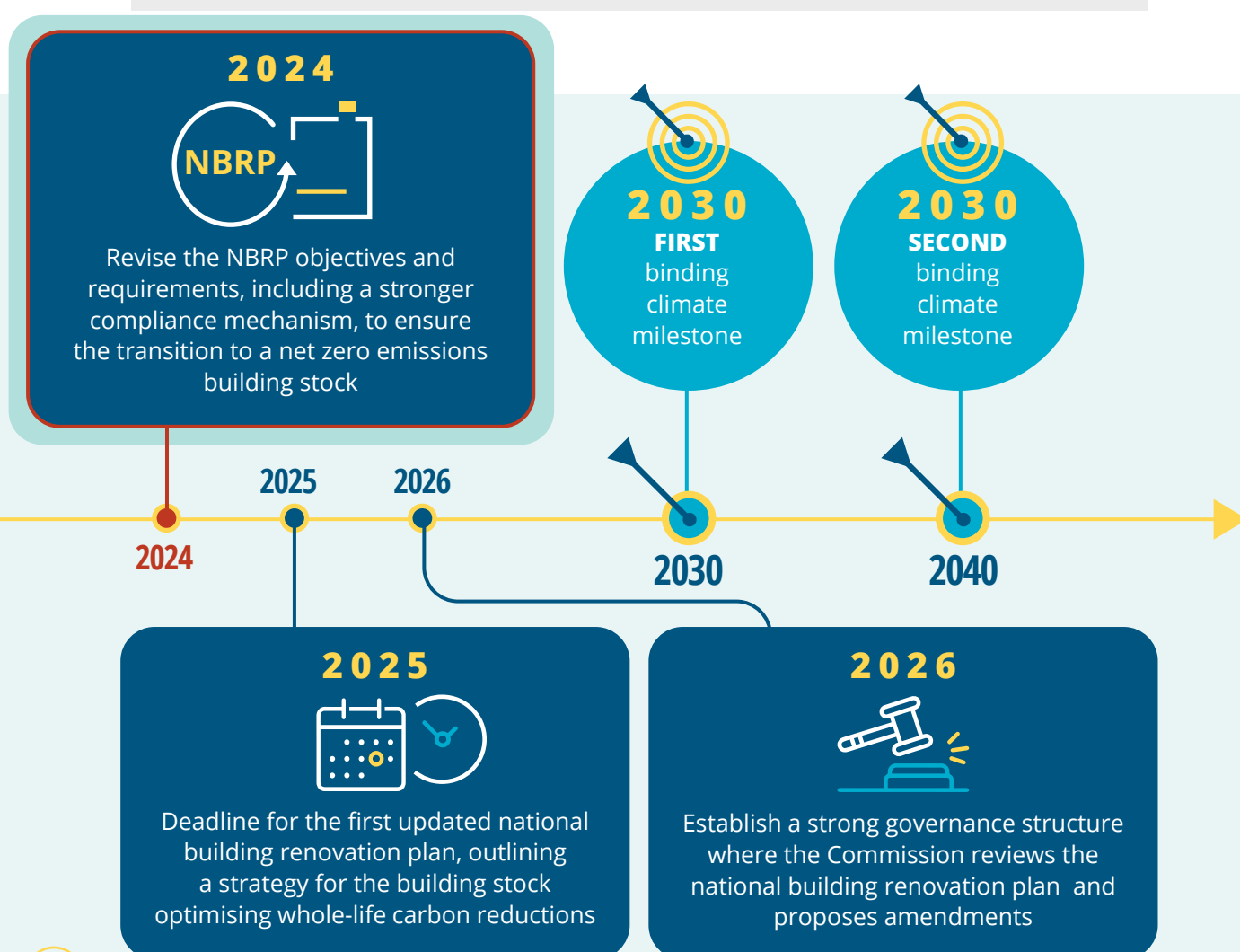


# NATIONAL BUILDING RENOVATION PLANS



## Article 3 National building renovation plan

- Every national building renovation plan (NBRP) needs to be compatible with the EU's goal of climate-neutrality and needs to achieve a net zero emissions building stock by 2050.
- National building renovation plans ought to spell out binding intermediate climate milestones for 2030 and 2040 covering lifecycle emissions.
- Member States should report on a harmonised set of indicators to allow for a more consistent and comparable assessment of national building renovation plans.
- Each national building renovation plan should encompass:
  - Policies and measures to reduce both operational and embodied carbon emissions.
  - A methodology to break down available carbon budgets across regions and sectors, which reflects future energy demands and renewable energy generation capacities, sector growth expectations and carbon reduction opportunities.
  - Transparent monitoring, verification and compliance mechanisms at national level to ensure targets are met.
  - Incentives and guidance for the regional and local levels as well as complementary national building renovation plan at local governance levels.



National renovation plans and strategies need to be strengthened by the ongoing recast of the EPBD to become fit for the new strengthened purpose. Member States will have to turn the plan into their guiding instrument to achieve the 2050 targets and set the pathways to achieve them. This can be ensured by extending the mandate of the Commission to evaluate, give recommendations on and approve the long-term renovation strategy by:



**Expanding the scope of the national building renovation plan towards tackling the entire lifecycle of the building and clearly articulating the role of the building stock to meet European climate goals**



**Requiring better monitoring of the impacts of the plans in each Member State**



**Establishing stricter sanctioning mechanisms in case of non-compliance**

According to the Commission's proposal, the objective of the national building renovation plan is to transform the building stock 'with a view to the 2050 climate-neutrality goal'. This goal can only be achieved in a 'carbon-effective' way, meaning the renovation measures optimise the whole-life carbon savings. In driving more ambitious building regulations, attention should be paid to the right balance and break-even points between embodied carbon and operational carbon. Member States should also be required to develop renovation plans which are aligned with the sector's carbon budget.

# MANDATORY MINIMUM PERFORMANCE STANDARDS



## Article 9 Mandatory minimum performance standards

*The EPBD recast introduces a requirement for Member States to enact mandatory minimum energy performance standards, designed to phase out the worst-performing buildings and to systematically improve the whole building stock performance. Research shows that the standard needs to address broader aspects than energy to best contribute to the climate targets (therefore it is referred to as 'mandatory minimum performance standard' in this roadmap)<sup>6</sup>.*

- *The ambition level of the standard should be derived from the analysis conducted in the national building renovation plan, including the remaining carbon budget for the sector.*
- *The threshold must be based on both energy efficiency and carbon footprint, while the triggered renovations should be optimised for the lowest lifecycle carbon impact<sup>7</sup>.*

The mandatory minimum performance standard should be tailored to trigger improvements of the buildings with the highest impact on the climate, i.e. highly inefficient buildings heated by fossil fuels. In addition, the schemes ought to ensure the embodied emissions of the renovations are minimised, which partly can be achieved through reused/reuseable and recycled/recyclable materials. The policy design also needs to ensure the policy primarily triggers renovation and doesn't incentivise demolition of buildings before their lifetime has come to a definite end.

The mandatory minimum performance standard thresholds ought to be raised over time, aligned with the national building renovation plan milestones, and communicated well in advance so that building owners and buyers know the required performance level for the building in 2030, 2040 and 2050, i.e. beyond 2030 and 2033 which are the only milestones of the current proposal. The analysis of the building stock and performance level required for existing buildings by 2050 presented in the national building renovation plan should influence the stringency of the thresholds to avoid lock-ins triggered by low ambition levels. Moving up one or two EPC bands only (from G to E) is counterproductive for both achieving the climate objective and addressing energy poverty considering that buildings renovated between now and 2033 will not be renovated again before 2050. The final target should be set so that it enables a low carbon building stock, in line with the long-term targets specified in the national building renovation plans.

<sup>6</sup> See discussion (starting from page 370) in European Commission, Directorate-General for Energy, Steuerer, S., Volt, J., Dorizas, V., et al., (2020) Annexes to the study 'Lessons learned to inform integrated approaches for the renovation and modernisation of the built environment', Publications Office, Available: <https://data.europa.eu/doi/10.2833/177071>

<sup>7</sup> Ibid



2024



Mandate Member States to announce mandatory minimum performance standards for the whole building stock

2026



Require worst performing buildings to get a building renovation passport

2025

2026

2024

2025



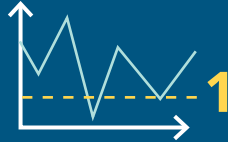
Require Member States to outline a long-term trajectory of a progressively strengthening mandatory minimum performance standards in the revised national building renovation plan

2028



Integrate whole-life carbon considerations in mandatory minimum performance standard design through building renovation passports

2028



FIRST mandatory minimum performance threshold comes into effect

2040



THIRD mandatory minimum performance threshold comes into effect

2035



SECOND mandatory minimum performance threshold comes into effect

2045



LAST mandatory minimum performance threshold comes into effect

2028

2035

2040

2045

“

**The mandatory minimum performance standard should be tailored to trigger improvements of the buildings with the highest impact on the climate, i.e. highly inefficient buildings heated by fossil fuels. In addition, the schemes ought to ensure that embodied emissions of the renovations are minimised, which can be partly achieved through reused/ reuseable and recycled/recyclable materials.**

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## Article 16 to 19 Energy Performance Certificates

*The ongoing recast of the EPBD should provide for a clear procedure for updating EPCs, including defining additional indicators and setting out a timetable for their introduction. It should facilitate harmonisation and performance validation to increase reliability and comparability, enabling asset rating calculations to be reconciled with measured performance of both energy and carbon emissions.*

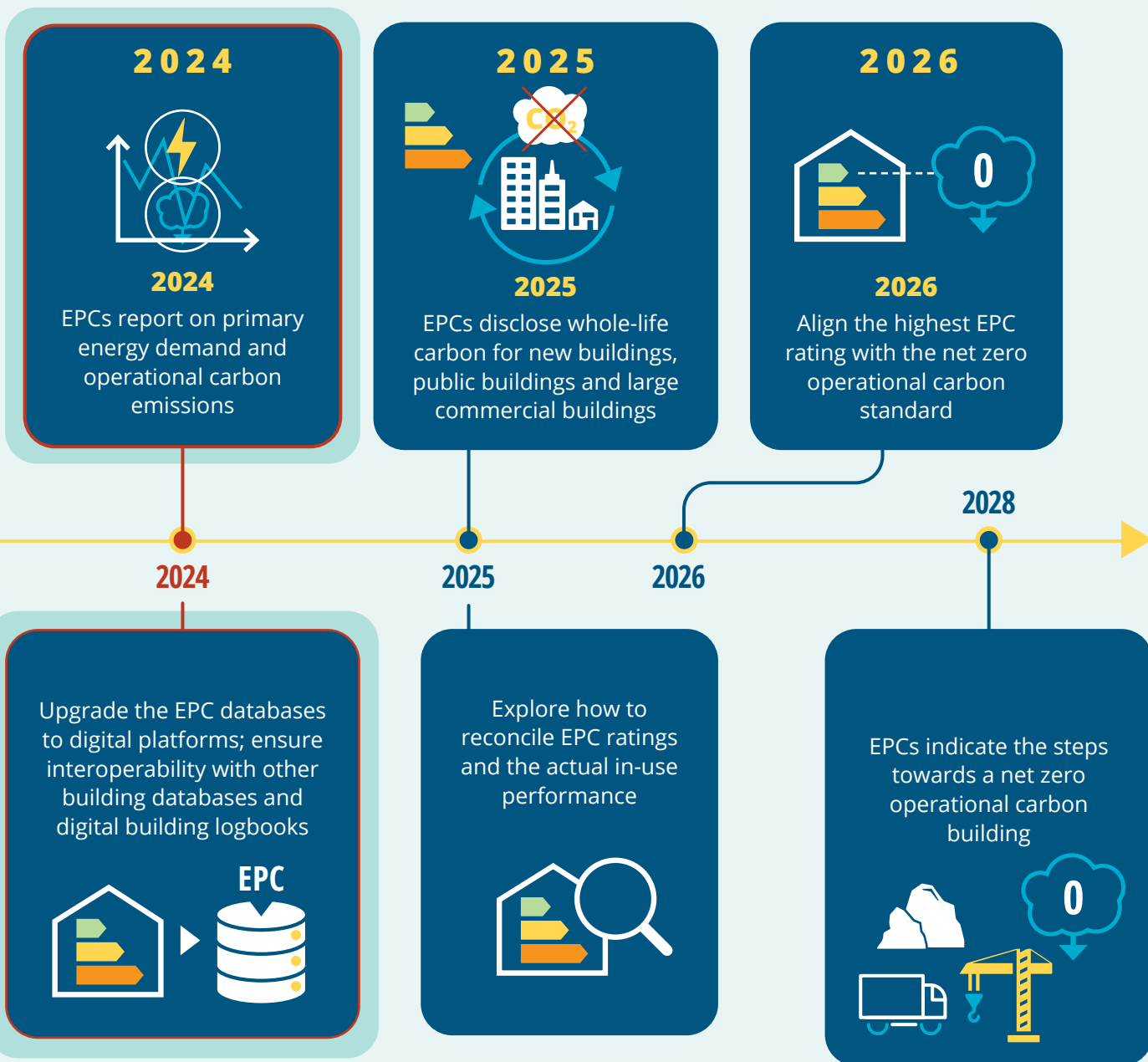
- *Require whole-life carbon data for new constructions to be disclosed in the EPC.*
- *Improve the reliability, user-friendliness and market penetration of the EPC.*
- *Member States should set up EPC databases which can be used to check compliance and that can feed the national building renovation plan with information on the building stock.*
- *Ensure the EPC recommendations are used to steer renovation investments towards deep renovations that ensure low embodied carbon emissions.*

EPCs were first introduced by the EU more than 20 years ago and have continuously improved and gained significance. The instrument had a challenging beginning and still needs to overcome multiple obstacles before Europe-wide implementation can be seen as successful. At the same time, EPC schemes, including trained assessors and databases, also represent a valuable resource to help deliver a fully decarbonised building stock.

Measuring and disclosing whole-life carbon is a first step to address embodied emissions of buildings. EPCs are the right information tool to communicate whole-life carbon emissions alongside energy performance. As a next step, EPC ratings can be adjusted to require even lower whole-life carbon emissions thresholds.

Article 19 of the recast proposal requires Member States to set up EPC databases. Databases should collect and make available building data, including whole-life carbon for new constructions, that can feed into the national building renovation plans and enable the Member States and the EU to track decarbonisation progress. The databases should follow a common template which also allows future interoperability with digital building logbooks<sup>8</sup> and building renovation passports.

<sup>8</sup> A digital building logbook is a new instrument initiated by the European Commission, which is intended to be a common repository for all relevant building data. See more: Toth, Z & Volt, J (2021) Definition of the Digital Building Logbook. European Commission. <https://op.europa.eu/de/publication-detail/-/publication/cacf9ee6-06ba-11eb-a511-01aa75ed71a1>.



**Measuring and disclosing whole-life carbon is a first step to address embodied emissions of buildings. EPCs are the right information tool to communicate whole-life carbon emissions alongside energy performance.**



# STEERING RENOVATIONS WITH BUILDING RENOVATION PASSPORTS



## Article 10 Renovation passport

*Require Member States to roll out national building renovation passport schemes according to a harmonised framework and link with the 2050 carbon-neutrality target.*

*The framework needs to:*

- *Align the final step of the building renovation passport with the net zero operational building standard.*
- *Take into consideration the carbon footprint of renovation measures.*
- *Support homeowners to comply with the mandatory minimum performance standards, and facilitate deep renovations where the embodied emissions are minimised and technical lock-ins are avoided.*

A building renovation passport outlines a renovation roadmap for an individual building, based on an on-site visit by an expert. The passport can ensure that deep renovations, carried out in one or several stages, are optimised in terms of energy savings, cost-optimality, indoor environmental quality and carbon emission reductions. Being a tool defining the necessary renovation interventions and their timeline, the end-goal of the roadmap should result in a net-zero emission building.

Figure 7 illustrates how the German building renovation passport breaks down the deep renovation measures, and indicates the order in which they should be implemented. While currently not the case in the German model, the 'renovation stages' can be used to maximise whole-life carbon savings. The 'renovation stages' are developed based on a detailed energy audit and comprise the optimal sequence of renovation measures for the homeowner to consider. The renovation stages are currently designed on the principle to optimise energy and cost savings. Integrating whole-life carbon considerations, in addition to the existing principles, would enable deep renovations that also ensure low embodied carbon options.

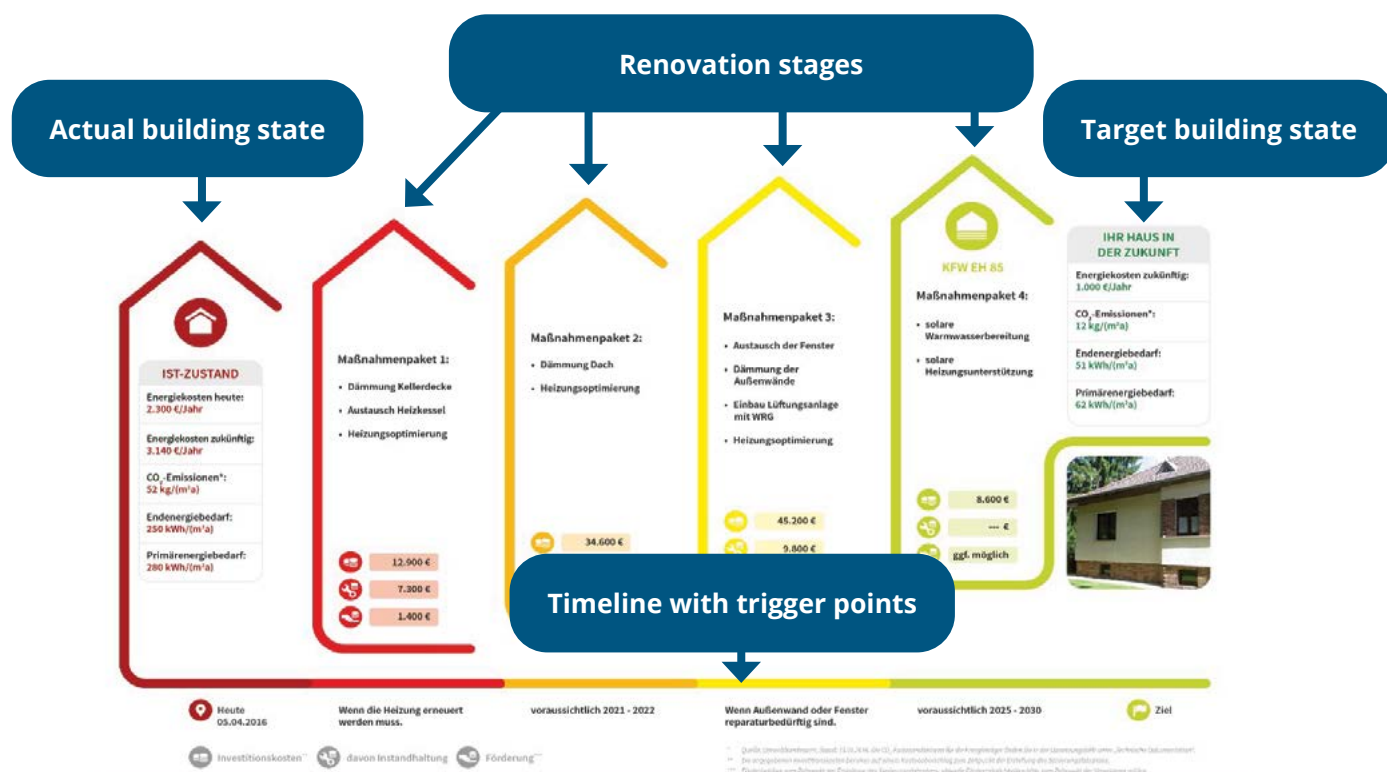
## WHAT IS A BUILDING RENOVATION PASSPORT?



**THE BUILDING RENOVATION PASSPORT (BRP) IS AN INSTRUMENT OUTLINING A RENOVATION ROADMAP FOR AN INDIVIDUAL BUILDING, BASED ON AN ON-SITE VISIT BY AN EXPERT.**



**Figure 7:** The German building renovation passport (individueller Sanierungsfahrplan (iSFP))  
Source: M. Peht, ifeu and DENA.



Building renovation passports should be established as a tool to support the implementation of mandatory minimum performance standards, to phase out the worst performing buildings and facilitate low carbon refurbishment. Mandatory minimum performance standards are at the heart of the Renovation Wave, and the building renovation passport can ensure the implementation of low carbon renovation measures.

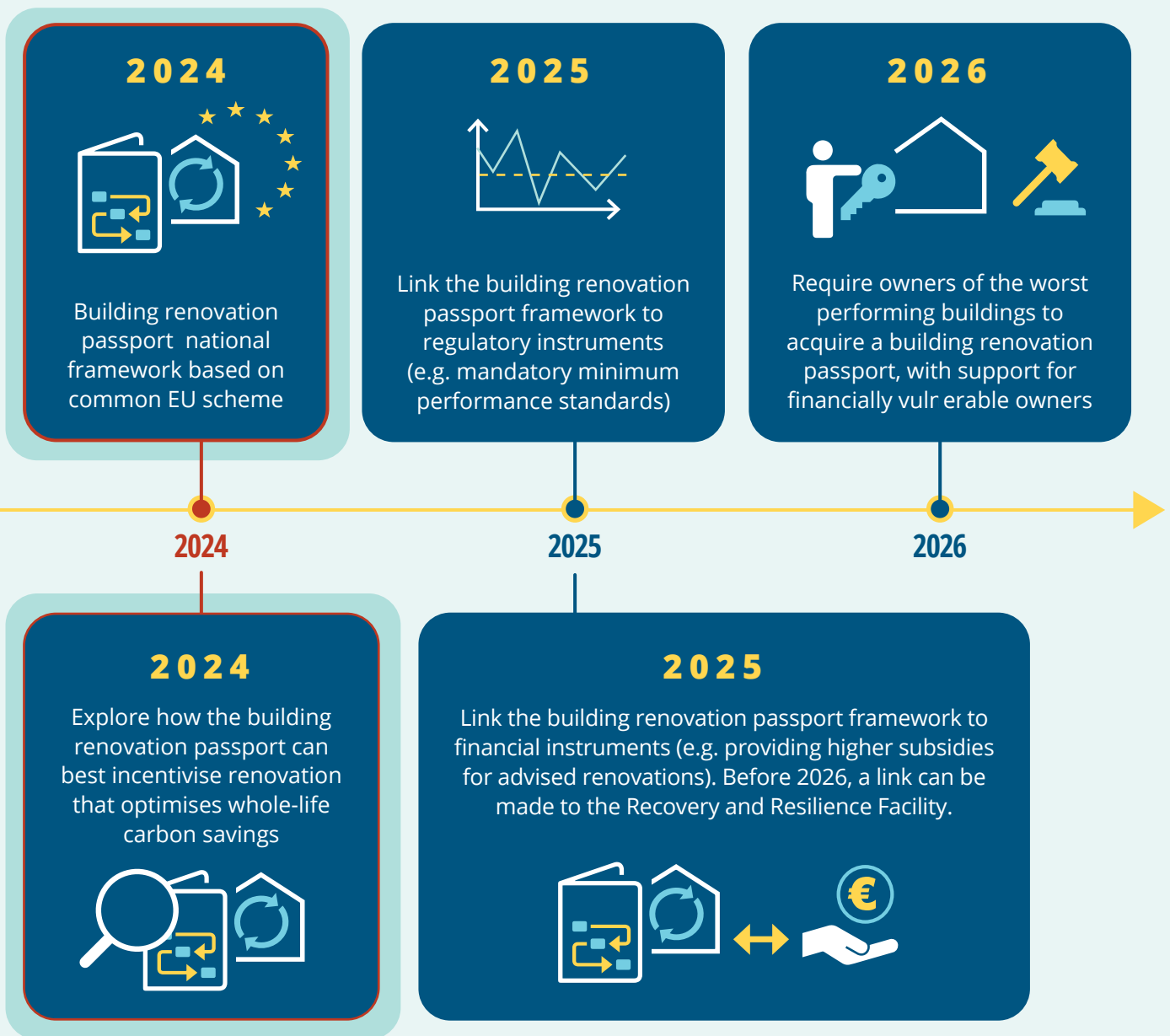
The EPBD should give clarity on how digital building logbooks can support the development of building renovation passports, and act as a common repository bringing together all relevant building data based on EPCs, Level(s),<sup>9</sup> bills of materials,<sup>10</sup> material passports<sup>11</sup> etc. The digital building logbook can include information about the quality, origin and location of materials and products, giving insights into the material, circular and financial (residual) value of the building. The building renovation passport can provide the digital building logbook with data, while the compiled data in the digital building logbook can facilitate a more effective and cost-efficient building renovation passport.

The roadmap below indicates how building renovation passports can support the introduction of whole-life carbon considerations in the EPBD. The first step would be to mandate Member States to introduce building renovation passport-frameworks to steer deep renovations towards low carbon solutions. The second step is to link the building renovation passport to various financial instruments, while the last step is to require, by 2026, owners of the worst performing building to acquire a building renovation passport and to implement renovation measures that would improve the building to meet the mandatory minimum performance standard threshold.

<sup>9</sup> Level(s) is a European Commission initiative, developed to provide a common language for assessing and reporting on the sustainability performance of buildings. Level(s) uses core sustainability indicators to measure carbon, materials, water, health, comfort and climate change impacts throughout a building's full lifecycle.

<sup>10</sup> A bill of materials is an inventory of the raw materials, components, tools and parts, as well as the quantities needed, to construct or renovate a building.

<sup>11</sup> A material passport is a document which describes the defined characteristics of materials in products and constructions, which give them value for recovery, recycling and re-use. See e.g. the Horizon 2020 project Buildings As Material Banks (BAMB) for more details.



**Building renovation passports should be established as a tool to support the implementation of mandatory minimum performance standards, to phase out the worst performing buildings and facilitate low carbon refurbishment. Mandatory minimum performance standards are at the heart of the Renovation Wave, and the building renovation passport can ensure the implementation of low carbon renovation measures.**



## MEASUREMENT AND REPORTING OF WHOLE-LIFE CARBON EMISSIONS



Whole-life carbon measurement typically involves compiling an inventory of all the materials and processes used in the construction and lifetime of the building and assessing their carbon footprint. Measurement and disclosure of whole-life carbon is not currently a statutory requirement at EU level for new constructions and renovations, but a number of countries with progressive requirements for operational energy are also looking into regulating embodied carbon emissions.<sup>12</sup> In addition, many local authorities and professional bodies encourage whole-life carbon measurement, as do voluntary building sustainability assessment and labelling systems with international applicability or influence.

A key aspect to the generation of reliable whole-life carbon measurement is to use standardised approaches. There is a lot of similarity in the way these national schemes and voluntary market initiatives currently address embodied, sequestered or lifecycle carbon, and also some notable differences. Standardised methodologies are already available and in use by the industry, in the form of the suite of standards created by CEN/TC 350, i.e. EN 15804 and EN 15978. A common concern around existing accounting standards is that they are considered too high level and lack a uniform interpretation by building professionals.

In the interest of practical implementation, countries such as Sweden, Finland, France and the Netherlands have developed their own (simplified) lifecycle assessment methodologies. A consistent Europe-wide framework is necessary to ensure greater transparency and comparability of measurements. The EPBD could already establish Level(s) as the main framework for measuring and reporting whole-life carbon. The Level(s) framework can also be used to enable benchmarking of whole-life carbon performance and, eventually, the introduction of regulations, as intended in Sweden<sup>13</sup> and Finland.<sup>14</sup>



**Carbon accounting and management should be made more accessible to building sector stakeholders. The EPBD could start requiring operational carbon metrics based both on high quality asset ratings and in-use verified energy consumption data, if available, or on realistic estimates of operational energy consumption of the building.**



Carbon accounting and management should be made more accessible to building sector stakeholders. The EPBD could start requiring operational carbon metrics based both on high quality asset ratings and in-use verified energy consumption data, if available, or on realistic estimates of operational energy consumption of the building. Embodied carbon metrics can be based on estimates of quantities of materials, products and processes in the building (bills of materials) as well as their respective environmental coefficient (preferably using harmonised and third-party verified data) for each lifecycle stage of the building.

<sup>12</sup> For an overview of country initiatives, see BPIE (2021) *Whole-life Carbon: Challenges and solutions for highly efficient and climate-neutral buildings*.

<sup>13</sup> Boverket (2020) *Regulation on climate declarations for buildings*. Swedish National Board of Housing, Building and Planning.

<sup>14</sup> Kuitinen, M (2019) *Method for the whole life carbon assessment of buildings*. Publications of the Ministry of the Environment.



### Article 14: Building data

- *Member States should encourage the roll out of digital building logbooks capable of linking data silos and data scattered across the building value chain. This would enable whole-life carbon accounting and the development of individual climate-proofing roadmaps. Further upstream, it would inform long-term renovation strategies and benchmarking at the building stock level.*
- *Member States should establish open-source carbon databases using a common EU framework covering product embodied carbon, embodied carbon benchmarks and carbon factors, as well as information of the carbon intensity of the grid.*

Regulating whole-life carbon is a complex and data-intensive undertaking. Best practices exist, however, and can be useful for preparing the market for large-scale roll-out of carbon accounting and reporting as part of building regulations. The experience of frontrunning Member States suggests that trade-offs between simplicity and accuracy, as well as data quality and granularity, will need to be carefully weighed until more data becomes available through mandatory reporting. In the meantime, carbon accounting and management should be made more accessible to building sector stakeholders via open-source carbon databases.

The Renovation Wave strategy positively references the digital building logbook as a common repository for all relevant building data. The digital building logbook is a dynamic tool that allows a variety of data, information and documents to be recorded, accessed, enriched and organised, including information about the quality, origin and location of materials and products.<sup>15</sup> Most importantly, it also acts as a gateway connecting various data silos and data scattered across the building value chain and lifecycle. This makes the digital building logbook an extremely useful data source for whole-life carbon accounting and developing individual climate-proofing roadmaps, but also, further upstream, to inform long-term renovation strategies, decarbonisation pathways and targets at the building stock level.

In parallel, the EPBD should set up open-source carbon databases to facilitate the development of whole-life carbon measurement and reporting as well as benchmarking and target setting. The links between the existing data repositories and uses of data will also need to be further clarified.



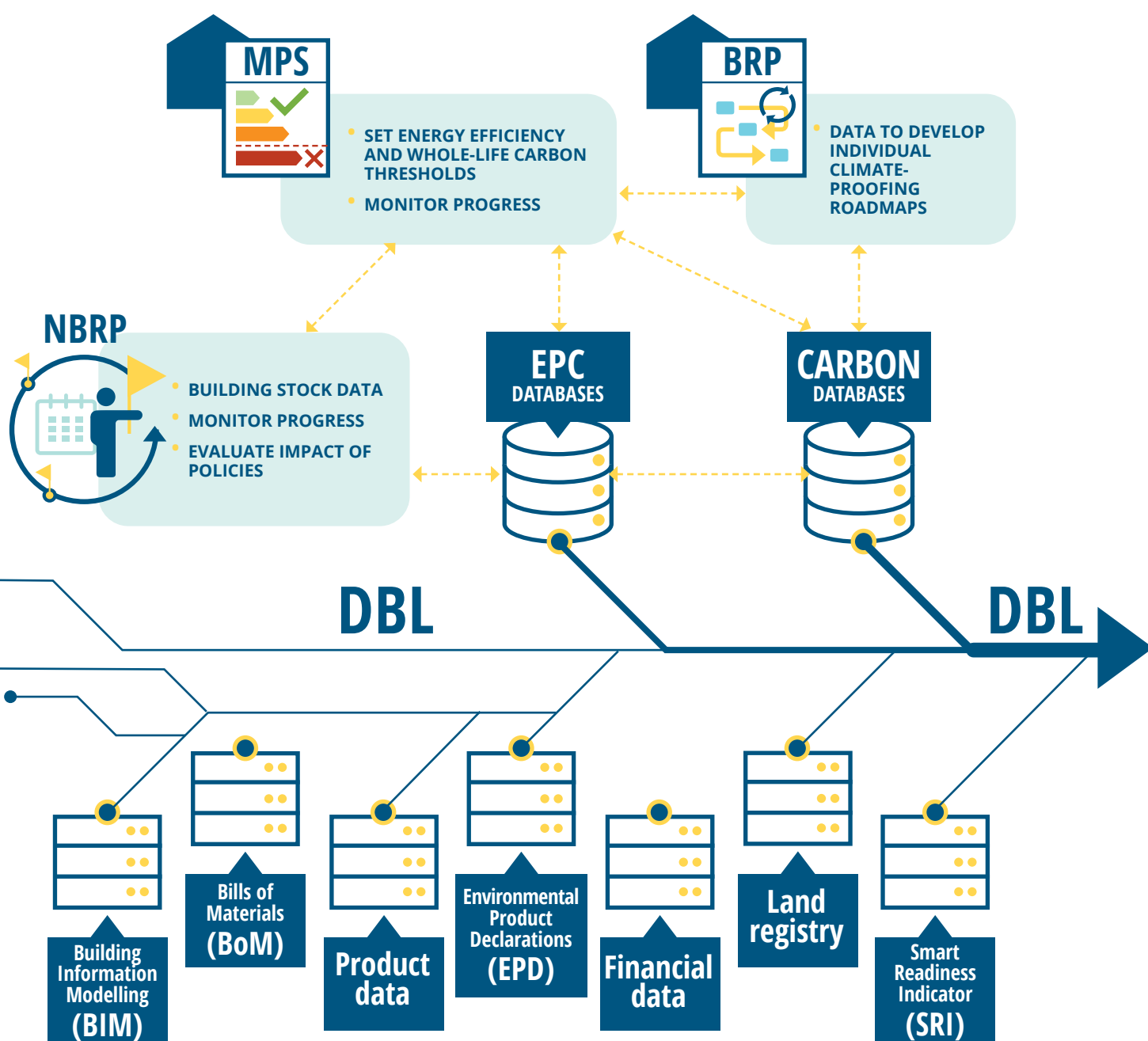
## WHAT IS A DIGITAL LOGBOOK

**THE DIGITAL BUILDING LOGBOOK (DBL) IS A DYNAMIC TOOL THAT ALLOWS A VARIETY OF DATA, INFORMATION AND DOCUMENTS TO BE RECORDED, ACCESSED, ENRICHED AND ORGANISED, INCLUDING INFORMATION ABOUT THE QUALITY, ORIGIN AND LOCATION OF MATERIALS AND PRODUCTS. MOST IMPORTANTLY, IT ALSO ACTS AS A GATEWAY CONNECTING VARIOUS DATA SILOS AND DATA SCATTERED ACROSS THE BUILDING VALUE CHAIN AND LIFECYCLE.**

<sup>15</sup> Volt, J., Toth, Z. et al. (2020) Definition of the digital building logbook. European Commission.

One of the relevant data sources for whole-life carbon measurement is environmental product declarations, which provide an overview of the lifecycle environmental impacts of construction products. They can be a reliable source of carbon data in whole-life carbon assessment, but a few concerns over their consistency have to be resolved first. The main limitation is that methodologies and reporting methods used to produce the data are not harmonised across environmental product declaration issuers, the Member States and products, making comparisons difficult. The use of different data sets and assumptions, generic data and proxies introduces significant uncertainties when whole-life carbon assessments need to yield coherent and comparable results.<sup>16</sup> The ongoing review of the Construction Products Regulation could make a more compelling case for streamlining the use of environmental product declarations, improving their consistency and digitising information according to a harmonised format to facilitate interoperability with building assessment tools.

**Figure 8:** Data sources and uses relevant for whole-life carbon regulation.



<sup>16</sup> BPIE (2021) Addressing the hidden emission in buildings: status quo, gaps and recommendations for a Environmental Product Declarations and whole-life carbon



# Conclusions

- **The current recast of the EPBD represents the first legislative milestone of the roadmap to reducing whole lifecycle carbon emissions in buildings. The recast takes place before carbon benchmarks and before an EU-wide whole-life carbon trajectory will be available to guide how all emissions related to buildings can and should be reduced in the long run.**
- **This lack of synchronisation runs the risk that not every recommended action from this roadmap will be taken up in the current recast or that policies addressing and affecting the different stages of the construction value chain will not be coordinated.**
- **Given the lack of a coherent policy framework, the preamble of the Directive must set a clear vision of the rationale and ambition which aligns with a trajectory for net zero whole-life carbon by 2050.**
- **A further revision of the EPBD is scheduled to be carried out by the end of 2027. The vision should ensure the consistency of the approach and continue with the sequence of recommended actions while not incurring further delays.**





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