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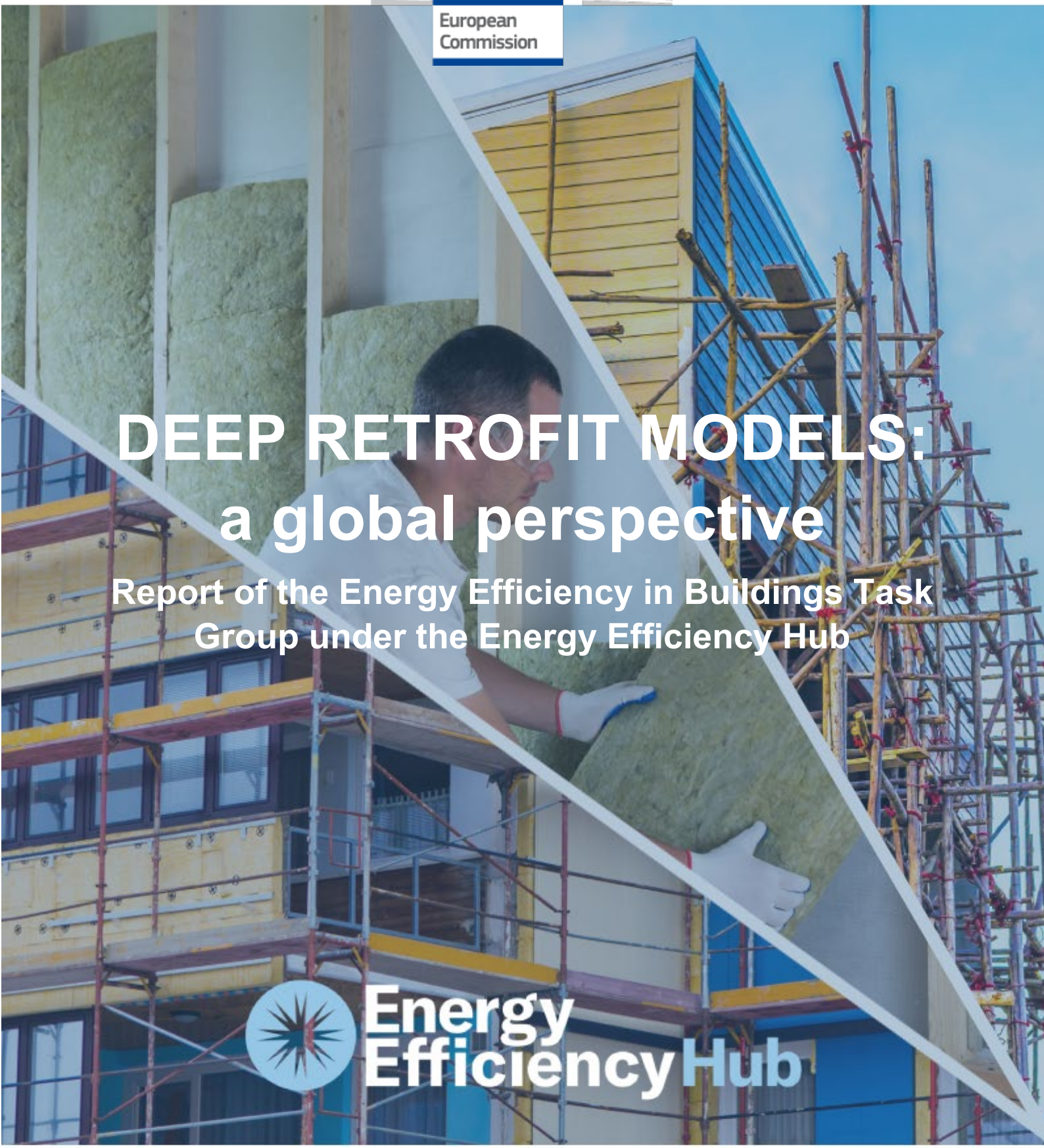

DEEP RETROFIT MODELS: a global perspective

Report of the Energy Efficiency in Buildings Task Group under the Energy Efficiency Hub

Energy Efficiency Hub

dena German Energy Agency

Trinomics

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Report of the Energy Efficiency in Buildings Task Group under the Energy Efficiency Hub

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September 2024

Directorate-General for Energy
Support to Energy Efficiency Hub´s Energy Efficiency in Buildings (EEB) Task Group on the focus area Deep Retrofit Models

2024 Ref. No.: ENER/B3/2023-436

In-person participants from the EEB Workshop on deep retrofit models
6 March 2024

Pictured above (from left): Viktoria Nagy and Kristina Klimovich (Hub Secretariat), Xiao Wang, Hongtao Ding, Xuefei Li, and Shanchuan Yu (MoHURD), Jonathan Sinton (Hub Secretariat), Julien Tami (European Commission), Zhe Li (MoHURD), Tudor Constantinescu (European Commission), Heide Godron (BMWK), Ang Ye and Ludwig Labuzinski (dena), Shanshan Wang (MoHURD), Paul Cronjaeger (BMWK), Assen Gasharov (EIB ELENA), Roland Gladushenko (IEA), Yanhua Yang (NCTI-GB), HaiYang Hu (CSCEC), Jessica Glicker (Trinomics).

The workshop, organised as part of the first Buildings and Climate Global Forum (Paris, 7-8 March 2024), focused on the implementation barriers and solutions for deep energy retrofit models and fostered collaboration among experts, practitioners, and policymakers. Officials and experts identified barriers, explored solutions, and shared best practices during plenary discussions, breakouts, and networking opportunities.

The Hub is a voluntary collaboration among 16 governments seeking to strengthen their effectiveness in deploying energy efficiency. Its Secretariat is hosted at the International Energy Agency (IEA) to foster coordination with the Agency and with other international organisations, the private sector, and other stakeholders.

The Energy Efficiency in Buildings (EEB) is a Task Group of the Hub, established in 2022 is a platform to exchange policy information about improving energy efficiency in buildings. It was established to scale up best practices on energy efficiency in buildings and to foster even closer cooperation with international partners. To learn more about the EEB, please visit: https://energyefficiencyhub.org/task-groups/eeb/.

EEB Task Group Membership: The Task Group is co-led by Germany and the European Commission. Task Group Members include Argentina, Brazil, China, Korea and Saudi Arabia.

The operating agent of the EEB Task Group is dena (Deutsche Energie-Agentur), the German Energy Agency.

Trinomics B.V. is a consultancy firm offering bespoke policy advice related to energy, environment and climate change issues. Trinomics was contracted by the European Commission to prepare this report.

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Contents

Glossary of terms

BASE	Basel Agency for Sustainable Energy
BBC	Low Consumption Building (*Bâtiment Basse Consommation)*
BEG	Federal funding for efficient buildings (*Bundesförderung für effiziente Gebäude*)
BMWK	Federal Ministry for Economic Affairs and Climate Action (*Bundesministerium für Wirtschaft und Klimaschutz*)
BMWSB	Federal Ministry for Housing, Urban Development and Building (*Bundesministerium für Wohnen, Stadtentwicklung und Bauwesen*)
BRP	Building renovation passport
dena	German Energy Agency (*Deutsche Energie-Agentur*)
DWG	Digitalisation Working Group
EaaS	Energy as a Service
EEB	Energy Efficiency in Buildings
EED	EU Energy Efficiency Directive
EIB	European Investment Bank
ELENA	European Local Energy Assistance
EMAK	Energy Management Action Network
EPBD	EU Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
ESI	Energy Savings Insurance
ESR	EU Effort Sharing Regulation
ETS2	EU Emissions Trade System 2
EU	European Union
G20	The Group of Twenty
GEG	Building Energy Act (*Gebäudeenergiegesetz*)
HVAC	Heating, Ventilation, Air Conditioning
KfW	Kreditanstalt für Wiederaufbau
kWh	Kilowatt hours
LED	Light-emitting diode
LTRS	Long-term renovation strategy
MEPS	Minimum energy performance standards
MS	Member State
NECP	National energy and climate plans
nZEB	Nearly-zero energy building
OSS	One-stop shop
PEE	Energy Efficiency Program (*Programa de Eficiência Energética*)
PRONEV	National Labelling Programme (*Programa Nacional de Etiquetado de Viviendas*)
PROUREE	Program for Rational and Efficient Use of Energy in Public Buildings (*Programa de Uso Racional y Eficiente de la Energía*)
RED	EU Renewable Energy Directive
RES	Renewable energy sources
SEAD	Super-Efficient Equipment and Appliance Deployment
SiCarb	Decree for the Information System for the Low Carbon Building Construction
SMEs	Small and medium-size enterprises
TOP TENs	Top Ten Energy Efficiency Best Available Technologies and Best Practices
ZEB	Zero energy building

Executive summary

Decarbonising the building sector is critical to reducing global emissions, as the operation of buildings accounts for 30% of final energy consumption and 26% of emissions worldwide.[1] There is an urgent need to transform the existing building stock to achieve high levels of energy efficiency as well as integrate renewable energy sources to reach the net zero targets as set out in the Paris Agreement. Policies stimulating the integration of energy efficiency and clean energy technologies into building retrofits are key to achieving climate and energy goals in terms of affordability, security and sustainability.

Building retrofit is a complex and capital-intensive process requiring collaboration between the public and private sectors and often necessitating a life cycle approach to minimise environmental and social burdens. Retrofits range from single-measure improvements, such as insulation or heating system upgrades, to more comprehensive building overhauls involving the envelope and system upgrades. This report focuses on a particular type of building retrofit—the deep energy retrofit—which significantly reduces energy consumption and emissions while enhancing building energy performance.

Deep energy retrofits are vital for achieving decarbonisation goals in the buildings sector. Deep energy retrofits involve comprehensive measures to significantly enhance energy performance, including insulation upgrades, advanced HVAC systems, and renewable energy installations. The implementation varies by country due to political, economic, climatic and historical factors. Legal and technical definitions of deep energy retrofit also differ widely among the surveyed countries, yet policies to decarbonise buildings share common elements such as addressing the entire building envelope and achieving a certain amount of energy savings. The following table outlines specific targets, such as a percentage reduction in energy use or achieving certain energy performance ratings.

[1] IEA (2023), Tracking Buildings.

Figure 0-1 Scope of deep retrofit in legislation of selected countries

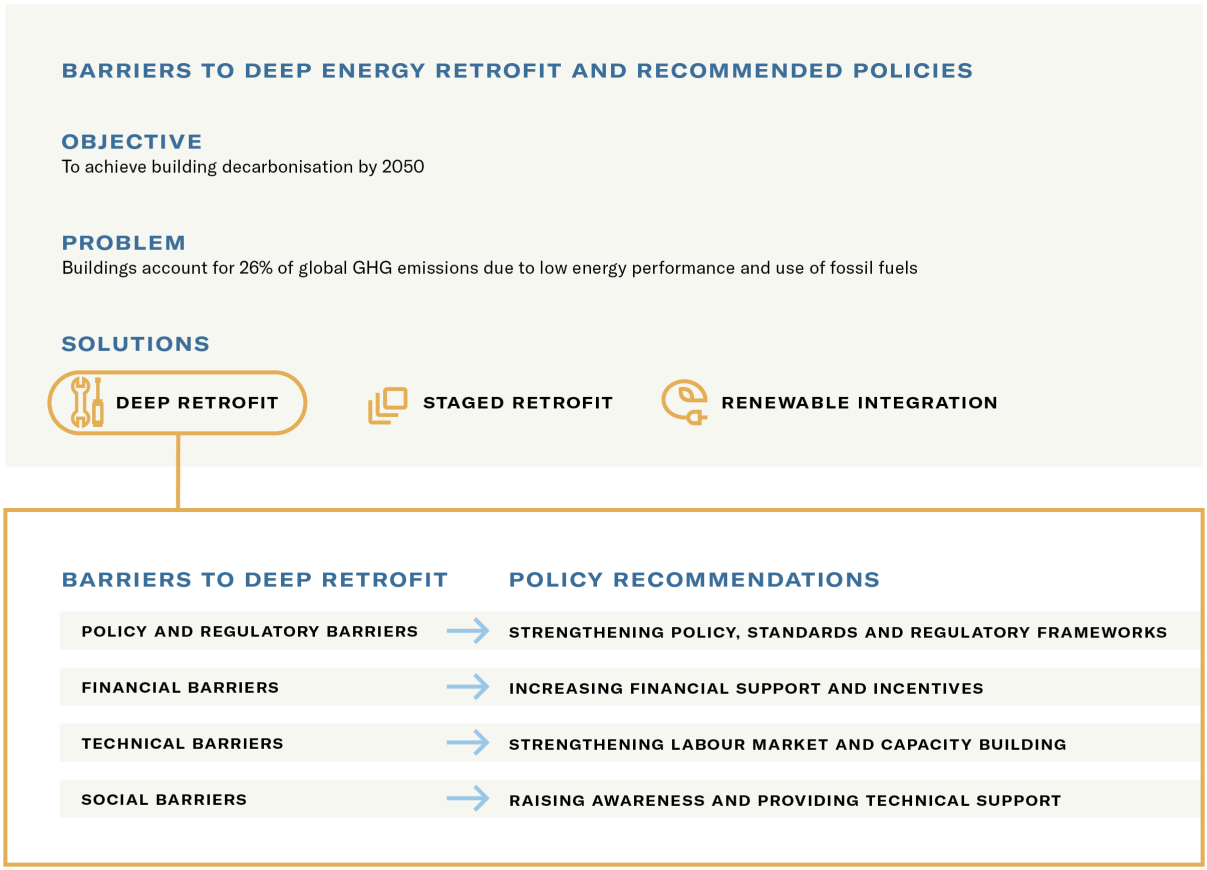
Source: Energy Efficiency in Buildings Task Group, 2024.

This report, developed by the Energy Efficiency Hub's Energy Efficiency in Buildings (EEB) Task Group, focused on the experiences of Argentina, Brazil, People's Republic of China, the European Commission, Germany, Korea and Saudi Arabia. Insights from Belgium, Canada, France, Ireland and the United States are also included to ensure diversity of best practices. The findings of report are based on the surveys conducted with the Task Group Members and several other countries as well as a literature review of existing policies, practices and definitions.

While deep retrofit is one of the key solutions needed to reach building decarbonisation by 2050, but barriers to achieving deep retrofit are not fully addressed by current

policies. Based on surveys and desk research, these barriers were categorised as: policy and regulatory, technical, financial and social. The recommendations of this report focus on solving these barriers to enable effective building decarbonisation through deep retrofits.

Figure 0-2 Barriers to deep energy retrofit and recommended policies



Source: Energy Efficiency in Buildings Task Group, 2024.

This framework aims to inform policy makers, industry stakeholders and practitioners to implement deep energy retrofits more effectively, ultimately contributing to global decarbonisation goals.

Task Group members have expressed their commitment to expand and deepen their analysis of deep energy retrofits and to continue developing enabling frameworks.

1. Introduction

Decarbonising the building sector is critical to reducing global emissions, as the operation of buildings account for 30% of final energy consumption and 26% of global emissions[2]. Rapid change of the building stock is needed, not only to integrate renewable energy, but also to be energy efficient and meet net zero emissions by 2050. Deep energy retrofit is a solution to achieve significant energy savings and reduce building emissions while achieving high energy performance. However, those performing deep retrofit implementation, particularly on a large scale, face several barriers, such as high upfront costs, lack of awareness of the benefits, labour shortages, no fully guaranteed results etc. To tackle these challenges, policy action is crucial to rapidly advance deep retrofit interventions on a large scale. In this context, enhanced intergovernmental cooperation on energy efficiency can facilitate the exchange of best practices and innovations, advancing sustainable building practices worldwide.

Textbox 1 Defining renovation, retrofit and refurbishment[3,4]

Renovation, **retrofit**, and **refurbishment** are related but distinct terms that describe different approaches to improving or updating a building or building components. In this study, we loosely define these terms based on existing literature as follows, given there are no international standard definitions.

Renovation refers to more extensive, comprehensive changes to a building. This can include updating heating and cooling systems, insulation installation or modernising the aesthetic. Not all renovations are energy-related.

Retrofitting is a more specific type of renovation involving adding or upgrading components or features to a building. Retrofits may involve installing new windows, upgrading lighting or improving the efficiency of larger appliances. Retrofit often refers to a comprehensive building remodelling and upgrade.

Refurbishment, in contrast, typically involves a lighter touch compared to renovation, focusing on cosmetic updates and repairs to improve the appearance and functionality of a space, without major structural changes.

It is important to note that definitions and distinctions between these terms vary across contexts and translations, so they should not be treated as rigid or concrete throughout the text. The overall goal is to discuss ways to enhance the performance of existing buildings, whether through comprehensive renovations, targeted retrofits or a combination of approaches.

Regarding the establishment of a more robust definition for deep retrofit, there are two potential tracks to consider: the first is looking at a substantial decrease of energy consumption (around 50-60%), similar to the EU definition in the Energy Performance of Buildings Directive; the second is working to reach (near) zero energy/emission buildings.

[2] IEA (n.d.), Buildings
[3] T. Konstantinou (2023), Understanding Refurbishment, Renovation and Retrofit: Join the discussion
[4] IHBC (2022), Renovation v refurbishment v retrofit

While pursuing deep energy retrofits is one concrete way to reduce building emissions and save energy, it is not fully implemented in most countries. One primary barrier to widespread adoption is the significant cost and time required for comprehensive retrofits. As a result, many property owners and policy makers opt for more manageable alternatives, such as staged or one-step approaches.

In a staged approach, the retrofit process is broken down into smaller, sequential steps that are implemented over an extended period. This allows for incremental improvements in energy efficiency, making it easier to manage costs and disruptions. For example, an initial stage might focus on upgrading insulation and windows, followed by subsequent phases addressing HVAC systems, renewable energy installations and advanced control systems.

A one-step approach, on the other hand, involves implementing a single, significant upgrade that provides substantial energy savings without the need for a full-scale retrofit. This could include measures like installing a high-efficiency boiler or adding solar panels. While not as comprehensive as a full deep energy retrofit, these targeted interventions can still deliver meaningful reductions in energy use and emissions.

Both staged and one-step approaches offer practical alternatives to deep energy retrofits, making energy efficiency improvements more accessible and feasible for a broader range of stakeholders. However, to maximise potential benefits, these strategies should be part of a long-term plan that ultimately aims for the highest possible energy performance and sustainability.

Below is an overview of the structure and scope of the report.

- **Section 1** provides an overview of the **overall objective and scope of the report**, including the background, country contexts and methodology used for this study.
- **Section 2** identifies the **main barriers to deep energy retrofit** faced by the members, highlighting any similarities.
- **Section 3** describes the **policy context of deep energy retrofit** for each of the EEB members, including definitions and key enabling policies. Other countries with potential good practices are also included.
- **Section 4** outlines **recommendations** for EEB members to create a framework to enable deep energy retrofit based on the main barriers, existing policies and good practices identified.
- **Section 5** concludes with a **summary and next steps**.

1.1. Background

The **Energy Efficiency Hub** offers a platform for global government-to-government cooperation on energy efficiency in all sectors, supporting knowledge-sharing on best practices and policies among its 16 Members[5]. The Hub Secretariat is hosted by the International Energy Agency based in Paris. The substantive work of the Hub is concentrated in its five Task Groups: the Energy Management Action Network (EMAK); Top Ten Energy Efficiency Best Available Technologies and Best Practices (TOP TENs); Super-Efficient Equipment and Appliance Deployment (SEAD); the Digitalisation Working Group (DWG); and the Energy Efficiency in Buildings (EEB) Task Group. Different participating governments co-chair, coordinate and contribute to the Task Groups.

The EEB Task Group[6], led by the European Commission and Germany, focuses on improving the energy performance of buildings. Participating members include: Argentina, Brazil, China, Korea and Saudi Arabia, as well as the co-chairs, the European Commission and Germany. Additionally, Canada, France, Ireland and the United States have observed Task Group meetings, participated in discussions and provided informal inputs to the group.

The Task Group has identified three initial focus areas: energy savings in response to the 2022 energy crisis; life cycle assessment and costing of buildings; and deep retrofit models (the focus area of this study).

Based on EEB's goal, the report aims to tackle challenges in building renovation and energy efficiency globally, promoting a dialogue on common priorities. Its objective is to showcase insights from past successes to shape future policy and implementation. There are three components to the study being conducted in relation to the deep energy retrofit topic of the Task Group:

1. Analyse deep retrofit model's concept & enabling policies, via literature review and surveys with EEB members,
2. Design and facilitate three workshops, and
3. Develop a final report summarising the work conducted throughout the study.

This summary report provides an overview of the analysis, literature review and surveys that were conducted as part of this work. The report introduces the topic of deep energy retrofit and provides a summary of how the topic is treated by each EEB member and several additional countries.

[5] Argentina, Australia, Brazil, Canada, China, Denmark, European Commission, France, Germany, Japan, Korea, Luxembourg, Russia, Saudi Arabia, United States, United Kingdom
[6] EEH (n.d.), Energy Efficiency in Buildings Task Group

1.2. Methodology

The scope of this report is the EEB Task Group members: Argentina, Brazil, China, the European Commission, Germany, Korea and Saudi Arabia. The work includes several other countries as well, in particular for the inclusion of best practices.

For this high-level study, the team carried out a survey of the Task Group members, as well as a few others. The surveys were complemented by a literature review of policies and definitions. The survey questions are included in the Annex 1 of the report.

The survey included questions on definitions, policies and legal frameworks that are related to deep energy retrofits.

The survey questions were disseminated to participants via email, and a Country Fiche was created for each country based on their responses. Additional best practices were elaborated during Workshop 2 on 6 March 2024 (summarised in Annex 2), and Workshop 3 on 30 May 2024[7].

1.3. Context and scope

The definition of deep retrofit is shaped by the context, where interpretations vary regionally due to differences in needs and goals. For instance, the concept of deep retrofit is relatively well established in European countries, as buildings have become more of a focal sector for decarbonising the EU economy in the past 20 years. Not only does the European Union have a relatively old building stock requiring retrofit, but the region is also driven by long-standing EU retrofit policies to which each Member State (MS) must comply, such as the Energy Efficiency Directive (EED) and the Energy Performance of Buildings Directive (EPBD)[8]. In recent years, the social and economic impact of the recent energy crisis has made accelerating and deepening energy renovation a high priority in the region. For other countries, the concept of deep retrofit (or lack thereof) as a specific set of measures in policy making is shaped by other factors such as:

- **Climate:** The climate of a region can determine renovation measures best suited to improve building energy performance. For instance, energy renovations prioritise insulation, windows, and doors and heat systems, thus minimising heat loss. In warmer climates, an emphasis may be put on ventilation and enhancing efficiency of air conditioning systems. Furthermore, in regions which are more prone to extreme weather conditions, there may be more emphasis on structural preparedness and climate adaptation measures, such as hurricane hardening. Structural preparedness is also to be considered

[7] Workshop 1 was a general overview and introduction to the project and work, and therefore did not contain a detailed presentation of best practices.
[8] 3keel (2022), Global Retrofit Index

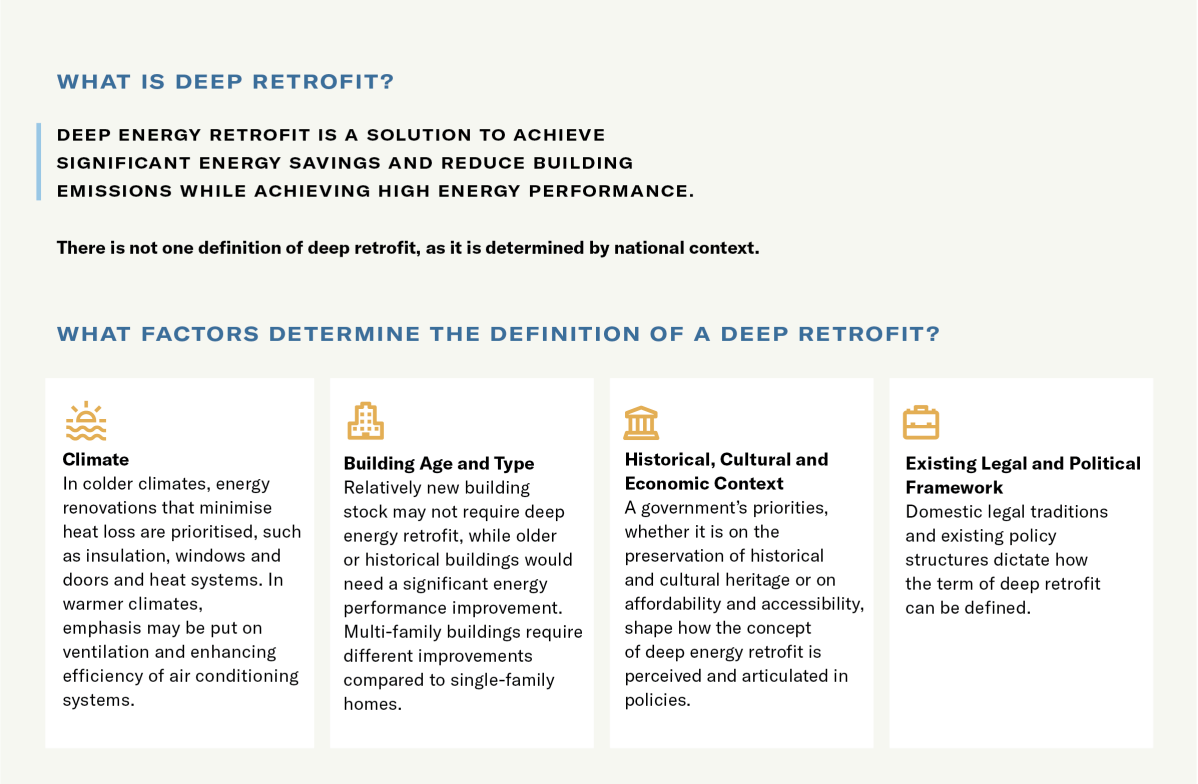
in regions with higher seismic activity when energy related renovations are envisaged.

- **A building stock's age and type:** The age and type of building stock is also a factor that determines the need for deep renovation. For instance, the building stock in countries such as **China** and **Korea** are relatively new compared to European building stock[9], meaning that the discussion of deep renovation is at an earlier stage in this region (given that renovations are not often considered early in a building's life). There are also no common definitions[10]. For example, although **Germany** does not have a clear definition of deep renovation (while they are still bound by the EU definition[11]), there are several policies and practices in place to promote building renovation. Germany has developed similar concepts such as the 'best possible principle' for renovation advice (used as part of the building renovation passport initiative[12]), the Passive House[13] and Efficiency House Standards.
- **Historical, cultural and economic contexts:** These contexts often dictate how countries prioritise and perceive deep renovation. For instance, these factors can influence the understanding of deep renovation and potentially put emphasis on certain elements, such as preservation (of historical/cultural heritage) and affordability/cost-effectiveness (depending on economic conditions). For example, **Brazil** is focusing on decarbonising the construction sector, which is experiencing rapid growth. Brazil is firstly addressing the embodied carbon and circularity of building materials and achieving zero energy buildings (ZEBs) for new buildings, with a secondary focus on decarbonising existing building stock.
- **The existing legal / political framework** and **language:** The previous contextual components feed into and inform the legal / political framework and language, which in general, can also shape the concept of deep renovation, especially when legal traditions / structures dictate how the term can be defined. The political and social climate (e.g. social resistance to rapid change), as well as existing renovation regulation/standards are included in this context. For instance, in **China**, the decarbonisation of buildings is identified as an important factor under its policy to achieving carbon neutrality by 2060. There are specific targets set to improve the energy efficiency of both new and existing building stocks.

[9] 45.5% of the European Union's building stock was built before 1969. European Commission (2019). Overview - Decarbonising the non-residential building stock.
[10] GBPN (2013), What is a deep renovation definition?
[11] EU Member States must incorporate EU directives into their national laws, ensuring alignment with EU-level regulations. Therefore, definitions included in EU level directives must be used at the national level.
[12] A Building Renovation Passport is a strategic plan that outlines a step-by-step roadmap for improving a building's energy performance over time. It includes tailored recommendations and timelines to achieve energy efficiency goals.
[13] Passive House is a high standard for energy-efficient buildings that minimise energy use for heating and cooling. It employs high insulation, airtight construction, and advanced ventilation to create a comfortable, low-energy environment.

The table below provides an overview of the main contexts of each EEB member and shows how members compare in these different aspects. There are significant variations among the members analysed in the report, including differences in climate, building typology, building stock age and cultural and economic contexts. These variations result in diverse legal and political frameworks, which complicate the ability to draw common conclusions across the different regions. In summary, national contexts are wide-ranging, giving way to a multitude of interpretations of deep retrofit.

Table 1-1 Summary of national contexts[14]



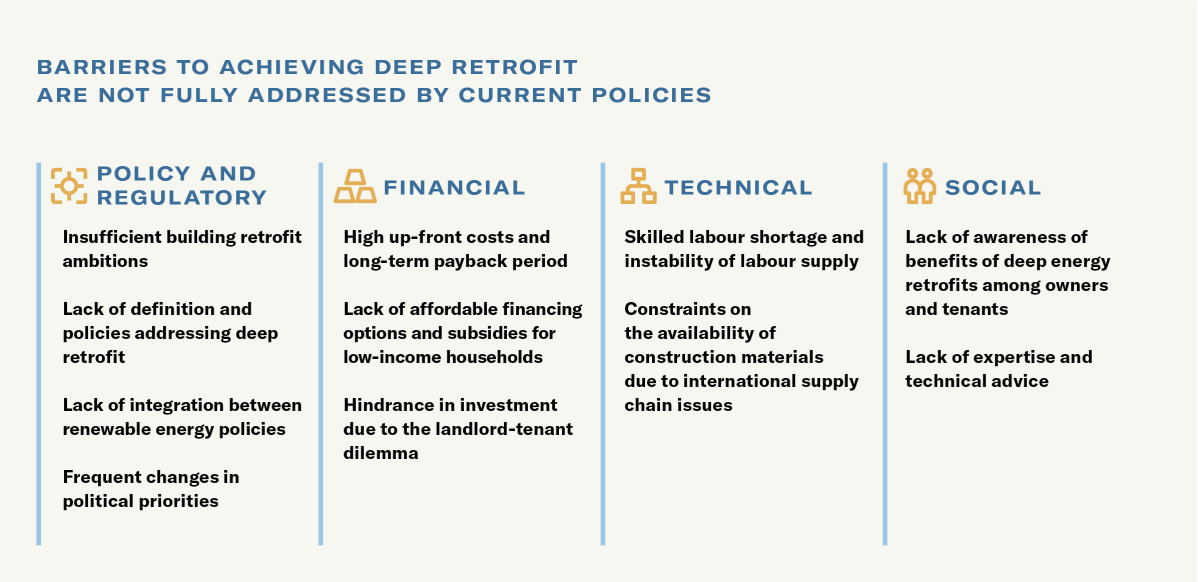
Source: Energy Efficiency in Buildings Task Group, 2024.

[14] This overview does not include China.

2. Barriers to deep energy retrofit

The barriers to deep energy retrofit gathered from the surveys and associated desk research are grouped into four categories: policy and regulatory, technical, financial and social. The table below provides an overview of these barriers, which encompass common issues faced by the EEB members, as shown below.

Figure 2-1 Barriers to achieving deep retrofit are not fully addressed by current policies



Source: Energy Efficiency in Buildings Task Group, 2024.

All EEB members encounter these challenges to various degrees; members particularly facing these barriers are highlighted in the table below.

Table 2-1 Overview of major barriers to deep energy retrofit

	Main challenges	Potential consequences	Member country examples
Policy and Regulatory	Current ambitions may be insufficient to reach national emissions targets	Strategies for energy retrofits are not sufficient to reach national emissions targets. This sends weak signals to owners/investors with potential to invest in energy retrofit.	The **European Union** and its Member States' current renovation ambitions are deemed inadequate to achieve emissions reduction targets, where a 2% deep renovation rate is considered necessary.
	Lack of policies addressing deep retrofit and/ or a definition of deep retrofit	Lack of policies addressing deep energy retrofits makes it difficult for local stakeholders to understand how policy (e.g. financial schemes) will shape the market or what requirements are necessary. This provides no	**Argentina**, **Brazil and Saudi Arabia** currently do not have comprehensive policies for energy retrofit of existing buildings[15].

[15] In most of these country contexts, the priority is not on (deep) retrofit measures. For example, in Argentina, emissions of the building stock are relatively low as compared to the transport sector. In Brazil, the focus is on decarbonising the construction sector and therefore, the emphasis is on new construction rather than retrofit measures. A lack of policies/definition is only a critical issue where deep retrofits are considered essential to reach national climate targets. See Section 1.2.

	Main challenges	Potential consequences	Member country examples
		signal to pursue deep retrofits to a sufficient energy savings level, if at all. Having a common national definition of deep energy retrofit sets clear standards for policy makers and local stakeholders (building owners, construction sector, etc.) of what level of improvement deep retrofit entails.	**Argentina**, **Brazil, Korea** and **Saudi Arabia** do not yet have a clear definition of deep renovation.
	Lack of integration of strategies	Renewable energy and energy efficiency improvements are inherently interconnected. A lack of integration between the two can lead to suboptimal decision-making. Similarly, there can be an imbalance in the strategies and policies targeting new building construction versus building renovation.	**EU** legislation tackles different parts of building decarbonisation within separate directives: RED, EED and EPBD. This makes synergies between energy efficiency and renewables integration difficult. **Korea** has a strong regulatory framework for developing sustainable new buildings; however, such a framework is lacking for existing buildings. In **Brazil**, there is no policy focus on integration of renewables in buildings given the high level of renewable electricity produced. **Germany** has no specific renewable energy targets for the building sector, although it will set an indicative target as required by Article 15a of the revised Renewable Energy Directive.
	Changes of political priorities	Uncertainty around regulations and long-term policy strategies, such as cuts to public funding or rapid changes in policy, sends mixed signals to building owners, investors and renovation professionals. This can create instability and disruptions throughout the value chain.	
Financial	Lack of economic attractiveness	Given the high upfront costs and long payback time for deep renovation, investors/owners do not find it attractive to invest in deep energy retrofits.	Given the high demand for housing in **Korea**, demolition of older buildings to be replaced with new buildings with greater gross floor area on the same property tends to be more economically attractive than renovation of existing buildings.
	Difficulty for low-income households to access financial resources	The high upfront costs and long payback periods associated with building retrofits also act as a significant deterrent for	Economic conditions and inflation in **Argentina** exacerbate the difficulty for low-income households to afford retrofitting.

	Main challenges	Potential consequences	Member country examples
		households that lack the financial resources to finance such retrofit measures.	Low income/vulnerable consumers face such difficulties also in other regions,. Therefore in Europe were developed special financing instruments for vulnerable groups. Budgetary constraints of public programmes hinder the effectiveness of implementation of financial support.
	Split incentive problem	The incentives of landlords and tenants are conflicting, where tenants may feel that only the landlord benefits from renovations (increased rent prices), and landlords may feel that only the tenant benefits from lower energy bills. In this case, neither party is willing to invest in (deep) energy retrofit.	This issue is specific for the rental sector, where tenancy is high, such as in **Germany**, where over 50% of residents live in rental units.[16]
Technical	Skills gap	(Skilled) labour shortage can delay renovation efforts, not only making it difficult for owners to find the right professionals but also increasing the cost of renovation.	There is a significant labour shortage in the **EU** construction sector, where up to 1.5 million additional workers in this field are needed from 2023 to 2030.[17] Given the high rate of self-employment and small businesses in the construction sector in **Argentina**[18], this sector is highly vulnerable to economic crises, leading to instability in labour supply.
	Constraints on construction material availability	With the COVID-19 pandemic, energy crisis and ongoing global conflicts, the international supply chain has been under pressure with a lack of resource availability and decreased material production capacity, leading to delays in material delivery and increase in material prices.	The energy crisis and ongoing global conflicts have led to several obstacles in the global value chain, which has particularly struck the **European Union** (including **Germany**), leading to higher material price and delays in delivery.
Social	Lack of awareness among owners/residents and technical assistance	Lack of awareness of the benefits of deep energy retrofits makes retrofitting less attractive for owners/end users. Renovation is a complex, multi-stakeholder process that requires a challenging decision-making process. Homeowners often lack the expertise and the time to compare options, where technical assistance can alleviate this issue.	In **Germany**, although financial solutions are available, there is a lack of awareness among households of the other benefits (e.g., health, energy savings). In **Brazil**, there is a lack of interest in energy efficiency, where RES is considered more attractive, as owners/residents are not aware of the benefits of energy efficiency.

[16]Eurostat (2024), Distribution of population by tenure status, type of household and income group
[17] ITUC CSI IBG (2023), More than two million workers will be needed in the construction sector in Europe by 2030
[18] ILO (2020), COVID-19 and the labour market in Argentina

Based on consultation with EEB Task Group members and barriers identified in literature[19]

To some extent, these barriers are addressed by the existing enabling policies in place in EEB members (see Chapter 3). However, as described in the table above, these challenges still remain. We identify recommendations and best practices to further address these barriers in Chapter 4.

[19] Trinomics (2021), The Road to Energy Efficiency

3. National definitions and enabling policies for deep energy retrofits

This section examines the policy context of deep energy retrofit for each EEB member, including definitions and key enabling policies. Other countries with potential best practices are included. By comparing the concept of deep energy retrofit across countries, this overview provides a snapshot of current global policy trends.

Figure 3-1 Scope of deep retrofit in legislation of selected countries

Source: Energy Efficiency in Buildings Task Group, 2024.

3.1. Argentina

Argentina does not yet have a clear definition of deep energy retrofit, although it has enacted several policies enabling energy retrofits. There is a recognised need to develop such a definition as retrofit incentives are being explored. Namely, the Argentinian National Atomic Energy Commission described deep renovation in a study of energy improvements carried out holistically, taking into account environmental factors, resident behavioural patterns and comfort levels while reducing existing energy consumption by 60% or more[20].

Emissions trends indicate that building energy efficiency may not be considered a high priority for decarbonising Argentina's economy. Energy-related emissions from the building sector are relatively low in Argentina (accounting for 12% of direct emissions) compared to the G20 average. Although Argentina has been able to reduce their buildings emissions per capita by over 24% from 2016 to 2021 (much faster than the G20 average of 0.7%), the reduction may also be attributed to the period of economic recession experienced over the same period. The relatively low emissions and declining trend in building emissions indicate that national policy strategy for decarbonisation may be more focused on other 'problematic' sectors, such as transport, where emissions have continued to increase.

Argentina has national targets for improving energy efficiency of buildings, but there are no existing policies which set energy efficiency requirements or provide public funding for existing buildings[21]. The national Plan for Climate Adaptation and Mitigation sets a target to improve the thermal envelope of 6 million houses[22] by 2030 and reduce the heating consumption of buildings, although the type of retrofits required is not specified. This is to be achieved under the newly established energy efficiency labelling programme, the National Labelling Programme (PRONEV)[23]. There are also several policies which set mandatory energy efficiency standards for new social housing projects[21]. The Programme for Rational and Efficient Use of Energy in Public Buildings (PROUREE) also aims to implement energy efficiency measures in public buildings. Table 3-1 provides an overview of Argentina's key enabling policies. In addition to the identified policies, it is also important to recognise that policies and measures at the provincial and municipal level could be implemented to improve energy efficiency of buildings.

[20] Comisión de Energia Atómica (2020). Una mirada a la rehabilitación energética profunda de edificios

[21] Climate Transparency (2022), Argentina Climate Transparency report: Comparing G20 climate action

[22] Based on the latest census carried out in 2022 (República Argentina (2022), Censo 2022), there are about 18 million households, so the 6 million target represents about a third of the total households. It is also worth noting that this target is almost equivalent to the total number of households in the province of Buenos Aires, the most populated province in the country, with about 6.7 million households.

[23] Although PRONEV is a voluntary programme, the objective is for provinces to adopt the labelling programme and use it as a vehicle to establish obligations within their own jurisdictions. For example, they could require minimum energy labels to be achieved during real estate transactions or negotiate with local governments to incentivise building retrofits by mandating the attainment of a minimum energy label as a condition for granting construction permits. This programme has potential to activate private funding to achieve the energy efficiency targets for buildings.

Table 3-1 Overview of Argentina's key enabling policies

Policy	Building type	Policy type	Description
Plan for Climate Adaptation and Mitigation	Residential	Strategy	Includes targets for improving the energy efficiency of 6 million houses by 2030
Programa Nacional de Etiquetado de Viviendas (PRONEV)	Residential	Enabling - Awareness	National energy efficiency labelling system for residential buildings
Programa de Uso Racional y Eficiente de la Energia (PROUREE)	Public	Enabling- Fiscal/ awareness	Programme to support the improvement of energy efficiency in public buildings and increase staff awareness of rational use of resources
Weatherization without borders (Buenos Aires)	Residential	Enabling - Fiscal/ skills	Pilot projects starting in Buenos Aires which target low-income households with energy efficiency improvements. The programme trains new workers to carry out energy audits and retrofits. (Based on the US policy, Weatherization Assistance Program)

Building decarbonisation and renewable integration in Argentina

Decarbonising buildings is a part of the *Energy Transition* strategy in Argentina's National Plan for Climate Change Adaptation and Mitigation. In addition to upgrading the insulation of 6 million homes to better retain heat by 2030, country goals also include replacing outdated food preservation appliances in homes, commercial settings and social organisations. Additionally, the Secretariat of Energy is focused on advancing the efficient generation of domestic hot water, expanding the deployment of LED lighting solutions, promoting devices that reduce water consumption and supporting the adoption of Energy Management Systems to optimise energy use[24].

[24] Ministerio de Ambiente y Desarrollo Sostenible de la República Argentina. (2022). Plan Nacional de Adaptación y Mitigación al Combio Climático, page 420

3.2. Brazil

Brazil does not yet have a clear definition of nor targets for deep energy retrofit, although it has enacted several policies targeting energy retrofits. This includes setting up a "Technical Group for Energy Efficiency in Buildings" (since 2001) with the aim to advise the Energy Efficiency Indicators Management Committee in the implementation of energy efficiency law in the buildings sector[25]. Since 1984, Brazil has advanced its energy labelling programme, implementing measures to improve energy efficiency of their building stock[26].

Emissions trends in Brazil indicate that energy efficiency for existing buildings may not be considered a high priority for decarbonising its economy, similar to Argentina**.** The building sector in Brazil only accounts for less than 4% of the country's energy-related CO_2 emissions (9% when including indirect emissions from electricity use)[27]. This is very low compared to the European Union, where 35% of energy-related CO_2 emissions are attributable to buildings[28]. The building sector emissions per capita in Brazil is 0.2 tCO_2/capita, compared to the G20 average of 1.5 tCO_2/capita[24]. Consequently, the building sector is not a main focus for decarbonisation for Brazil as compared to agriculture, transport and industry. Furthermore, the Global Retrofit Index assessment noted that the need for building retrofit in Brazil is lower than in other G20 countries[8]. Nonetheless, opportunities to decarbonise existing building stocks are still available, e.g., improving shading and air seal for conditioned spaces (since Brazil's primary bioclimatic zone is hot) and developing an energy efficiency label for existing buildings[29].

Expected growth of the construction sector in Brazil has led to a growing priority to address embodied carbon and circularity of building materials and to achieve zero emissions for new buildings[30]. The new Growth Acceleration Programme (Novo PAC), launched in August 2023, is expected to deliver more than 2 million new homes by 2026[31]. The construction sector, including embodied carbon emissions of materials, account for a significant share of global CO_2 emissions[32]. Brazil has also continued developing technical energy efficiency regulations (especially for new buildings), including the Minimum Energy Performance Standards (MEPS) due to be published in early 2025. At the time of writing this report, Brazil is also preparing to publish a new Decree for the Information System for the Low Carbon Building

[25] Ministério de Minas e Energia (n.d.), GT Edificações
[26] Ministério de Minas e Energia (2021), National Policy of Conservation and Rational use of energy, slide 7; Ministério de Minas e Energia (n.d.), Energy Efficiency in Brazil
[27] Climate Transparency (2022), Brazil Climate Transparency report: Comparing G20 climate action
[28] EEA (2023), Greenhouse gas emissions from energy use in buildings in Europe
[29] A new methodology is under development. See CBCS (n.d.), Plataforma de Cálculos - Benchmarking de Consume de Energia
[30] OECD (2024), Country Profile on Decarbonising Buildings - Brazil
[31] Secretaria de Comunicação Social (2024), Brazil's Minha Casa, Minha Vida program is back, delivering over 2,700 homes across six Brazilian states
[32] UNEP (2022), CO2 emissions from buildings and construction hit new high, leaving sector off track to decarbonize by 2050: UN

Construction (SiCarb) to ensure that the carbon emissions throughout the entire construction life cycle will be considered[33].

Brazil will still need to improve the energy performance of buildings to align with the Paris Climate agreement[8]. Although building emissions have declined in recent years, this is mainly due to decarbonisation of the power sector, where buildings efficiency has not yet played a significant role[8]. Brazil's does have some existing policies targeting energy retrofits, listed below in Table 3-2 Overview of Brazil's key enabling policies. Brazil's main enabling policies are currently the energy performance certificate scheme (PBE Edifica) and minimum energy performance standards[34], where standards are expected to be expanded from public buildings to include residential and commercial buildings (see Table 2-1 Overview of major barriers to deep energy retrofit).

Table 3-2 Overview of Brazil's key enabling policies

Policy	Building type	Policy type	Description
Minimum requirements for federal buildings (Normative Instruction N.02, 2014)	Public	Regulation	New and existing federal buildings are required to have an energy labels and must meet Class A.
Energy Efficiency Programme (PEE)	Residential	Regulation	Energy companies are required to launch public calls every year for at least the two largest energy consumers (e.g. residential, industrial sector) to finance the development of the approved proposals.
PBE Edifica	All	Enabling - Awareness	Labelling programme to determine the energy efficiency level of buildings. There are plans to expand this label, which is currently applicable to federal buildings only, to be nationally mandatory (see https://www.gov.br/mme/pt-br/assuntos/ee/cgiee-1/agenda-regulatoria). Database of certified buildings can be found here.

[33] The main tool to support this Decree is the Sidac tool, which supports the calculation of environmental performance indicators for construction products based on Brazilian data and Life Cycle Assessment (LCA) concepts. The first version of Sidac includes indicators of primary energy demand and CO_2 emissions , from the cradle to the factory gate. See Sedac (n.d.), Sidac

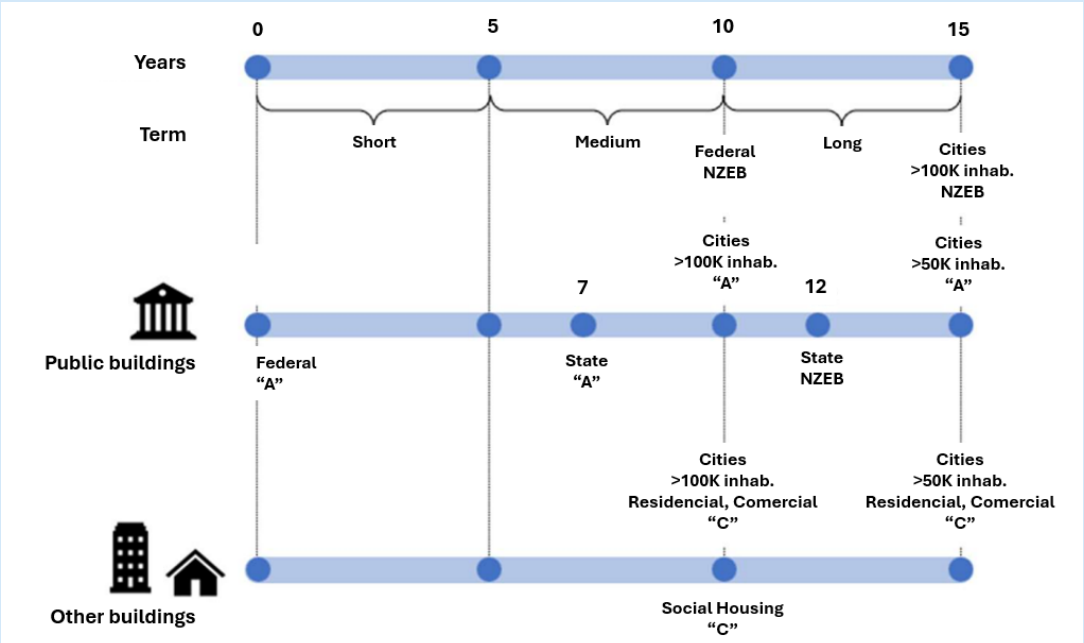
[34] Portal de Compras do Governo Federal (2014), Normative Instruction N.02, 2014

Policy	Building type	Policy type	Description
National Electric Energy Conservation Programme (Procel Edifica)	All	Enabling - Awareness	The programme focuses on overall energy efficiency and conservation across the country, encompassing buildings, industry, public lighting, smart cities and equipment. New and renovated buildings classified in level A under PBE Edifica (as well as meeting additional Seal technical criteria) receive Procel Seal[35]. The Seal's aim is to highlight the most efficient buildings in the country. The Procel Seal also promotes energy efficiency in the building sector by sponsoring and supporting the training of professionals and students and promoting new technologies, such as sponsoring initiatives like Standardization Platform for Buildings.

Textbox 3-1 Implementation of minimum energy performance standards in Brazil

Brazil's minimum energy performance standards currently apply to only federal buildings (which must meet Class A)[8]. However, in 2022, a 15-year strategy has been proposed to implement MEPS in other buildings, with the aim to require residential and commercial buildings to meet Class C.[36] The figure below provides an overview of this plan, where there is a gradual implementation of requirements to federal buildings as well as municipal buildings with over 50 000 inhabitants. Furthermore, requirements would be introduced to residential, commercial and social housing, where a C-level label would be required.

Figure 3-1 Implementation of minimum energy performance standards to Brazilian buildings over 15-year period (2022)[36]



[35]IEA (2019). PROCEL Seal.
[36] Ministério de Minas e Energia (2024),Publicações e Estudos - Edificações

Building decarbonisation and renewable integration in Brazil

Policies for promoting renewables in the energy mix started in the 1970s in Brazil, where electricity is the main energy source for buildings, including for heating water. Given that more than 80% of Brazil's electricity comes from renewables[37], there is not a policy focus on the integration of renewables in buildings. However, targets were recently set for building material production in the New Industrial Policy, which aims to have building material production with at least 43% low carbon materials. Furthermore, the Sidac tool has an important role to support the identification of the embodied carbon on the building materials from primary data from the industry.

3.3. China

China has a clear definition of *energy-saving* retrofit of existing buildings. According to the 2008 Energy Conservation of Civil Buildings, energy-saving retrofits of existing buildings refers to the implementation of energy-saving retrofitting activities on the envelope, heating and cooling system, lighting equipment and hot-water-supply facilities of existing buildings that do not comply with the mandatory standards for energy conservation in civil buildings.

The Chinese government places great importance on energy conservation and carbon reduction in the building sector, as urban and rural construction is one of the major areas of carbon emissions in China. The Chinese Government systematically carries out building energy conservation and carbon reduction work with the Energy Conservation Law as the supreme law, the Regulations on Energy Conservation of Civil Buildings as the main governing legislation and local laws and regulations as complementary. The Chinese Government has introduced a number of measures to promote energy efficiency in existing buildings (refer to the summary of key policies in Table 3-3). In addition, the Chinese Government has also developed relevant standards and specifications to clarify the requirements for energy-saving renovation of existing buildings and established an energy-saving planning mechanism for civil buildings, which specifies energy-saving goals for each stage in their five-year plan.

China has established a well-rounded framework of building energy conservation policies and regulations. As explained above, at the legislation level, China has formed a building energy conservation legislation system with the Energy Conservation Law as the supreme law, the Regulations on Energy Conservation of Civil Buildings as the governing law, and local regulations and rules as complementary measures. Among them, the Regulations on Energy Conservation of Civil Buildings, issued and implemented in 2008, requires a planned and step-by-step retrofitting of existing buildings. At the same time, a series of policies have been issued to launch the energy efficiency retrofitting of existing residential and public buildings in planned

[37]MME & EPE (2023), Summary Report 2023

batches. Various regions across the country have achieved positive outcomes from implementing diverse energy-saving retrofit models for existing buildings according to local conditions.

China has specified energy-saving retrofit requirements for existing buildings in mandatory standard. According to the General Specification for Energy Conservation and Renewable Energy Utilisation in Buildings, implemented since April 2022, retrofitting work of existing buildings should follow energy-saving diagnosis. In addition, energy-saving retrofitting schemes should specify energy-saving indicators and methods of testing and acceptance.

China has set specific targets for energy-saving retrofits of existing residential and public buildings. China's current Five-Year Plan (the 14th Five-Year Plan) for building energy efficiency and green building development from 2021–2025, sets the target to retrofit 350 million m^2 of existing buildings. In terms of incentive policies, most public funds mainly support the energy-saving retrofits of existing residential buildings (old and under-functional residential communities and clean heating projects in northern China). Some public funds support work on existing public buildings.

Table 3-3 Overview of China's key enabling policies

Policy	Building type	Policy type	Description
The 14th Five-Year Plan for building energy efficiency and green building development from 2021–2025	Public and residential	Strategy	National strategy including targets for retrofitting public and residential buildings, not explicitly large-scale work.
Energy Conservation Law and regulations on Civil Building	All	Regulation	This policy aims to reduce energy consumption during the use of civil buildings (including new buildings and existing buildings) and to improve energy efficiency. The scope covers construction, remodelling and implementation process of civil buildings, with existing buildings as an important part of the building energy efficiency project.
General code for energy efficiency and renewable energy application in building (GB 55015-2021)	Residential, public	Compulsory standard	Suitable for energy-saving renovation of existing public and residential buildings.

Building decarbonisation and renewable energy integration in China

As promised in 2020, China plans to be carbon neutral by 2060. Buildings play an important role in realising this goal. China has set specific decarbonisation targets for existing buildings (in terms of emissions reduction) in the 2022 Implementation Plan for Carbon Peak Achievement in Urban and Rural Construction Sector. Targets require work on residential buildings with retrofitting potentials and suitable conditions as much as possible, to the extent that the energy efficiency of the retrofitted part should meet current standards. China continuously promotes energy efficiency enhancement of public buildings in key cities, and by 2030, all key cities above prefecture level will have completed the retrofit task, with an overall energy efficiency improvement of more than 20%.

In addition to building energy efficiency, the Chinese government is also actively promoting the use of renewable energies in buildings, such as solar energy (including thermal utilisation and photovoltaic power generation) and geothermal energy. The goal is to achieve a renewable energy substitution rate of 8% in urban buildings by 2025. From 2021 to 2025, China plans to add 50 million kW of newly installed photovoltaic capacity and 100 million m^2 of geothermal energy applications in buildings.

3.4. European Union

The European Union has an established definition for deep energy retrofits, although the term 'deep renovation' is used rather than 'retrofit'. Over the past years, this definition has evolved. Recently, deep renovation has been officially defined in the European Union's 2023 Energy Performance of Buildings Directive (EPBD) recast as:

A renovation in line with the energy efficiency first principle and efforts to reduce whole life-cycle greenhouse gas emissions generated during the renovation, which focuses on essential building items, such as wall insulation, roof insulation, low floor insulation, replacement of external joinery, ventilation and heating or heating systems and treatment of thermal bridges, to ensure the necessary comfort of the occupants in summer and winter or a renovation resulting in a reduction of at least 60% primary energy demand for worst-performing buildings for which it is technically and economically not feasible to achieve a zero-emission building standard, and which transforms a building or building unit:

a) before 1 January 2027, into a nearly zero-energy building[38]

b) as of 1 January 2027, into a zero-emission building[39]*.*

[38] "a building with a very high energy performance, as determined in accordance with [the EPBD] Annex I, which cannot be lower than the 2023 cost-optimal level reported by MSs in accordance with 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 nearby" European Parliament (2024), EPBD

[39] A building with a very high energy performance, as determined in accordance with [the EPBD] Annexes I and III, which contributes to the optimisation of the energy system through demand-side flexibility…"; European Parliament (2024), EPBD

The recast specifies that *staged* deep renovation is an important solution, as it is less disruptive and more cost-efficient than one-step deep renovation. In this context, renovation passports[40] play a guiding role by providing a clear roadmap for staged deep renovation, supporting owners and investors in planning the best timing and scope for interventions.

The EPBD recast also stipulates that Member States shall incentivise (staged) deep renovation with greater financial, administrative and technical support based on this definition[41]. If retrofitting a building to zero-emissions standard is not possible for technical or economic reasons, a deep renovation should result in at least 60% reduction of primary energy consumption.

Deep renovation in the European Union has commonly been defined as achieving at least 60% energy savings, even prior to the EPBD. This definition is used in EU regulation and strategies. This definition was used in the EU Renovation Wave Strategy. In the REPOWEREU Action Plan, deep renovation is also mentioned in terms of the objective of increasing the annual renovation rate (in terms of medium and deep renovation). Deep renovation is also mentioned in the EED as a cost-effective energy efficiency solution in relation to meeting energy savings obligations. Furthermore, the European Commission has previously qualified the intensity of renovation in five main levels in a 2019 study[42], depending on the primary energy savings and the number of measures applied:

- **Below threshold:** the type of renovation where primary energy is reduced by less than 3% compared to the primary energy demand prior to the renovation.
- **Minor renovation:** includes the implementation of one to three low-cost measures (e.g. roof insulation); expected primary energy savings are up to 30%.
- **Moderate renovations:** includes three to five energy improvement measures resulting in 30-60% primary energy savings.
- **Deep renovation:** a package of measures is implemented, working simultaneously, aiming at 60-90% of primary energy savings.
- **Zero Energy Building (nZEB):** includes a wholesale implementation of measures aimed at energy-use reduction and installation of renewable energy technologies, all contributing to reaching almost zero energy consumption and carbon emission levels.

The study estimates that the average deep renovation[43] rate in the European Union is 0.2% based on data from 2012 to 2016 - which is too low to reach buildings' climate neutrality by 2050.

[40] Renovation passports are a tailored roadmap for deep renovation of a specific building in a maximum number of steps that will significantly improve energy performance
[41] European Parliament (2024), EPBD, Article 17
[42] Ipsos & Navigant (2019), Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU - Publications Office of the EU
[43] 60-90% PE savings

Several EU Member States have individually defined deep renovation in their long-term renovation strategies[44]. Definitions widely vary. The strategies have been replaced by Building Renovation Plans, as shown in the table below. While some MSs' definitions align with the previous EU definition of 60% energy savings, some MSs provide other definitions, such as relating to energy performance labels or other energy savings targets. Some strategies mention deep renovation but do not define it explicitly. Notably, some MSs use the term *major* renovation instead of deep renovation.

Table 3-4 EU Member State definitions of deep renovation in Long-term renovation strategies[45]

Member State	Type of renovation	Definition
Austria	Deep	Mentioned but not defined
Belgium – Flanders	Deep	EPC label A (100 kWh/m²/year)
Belgium – Wallonia	Deep	75-100% energy consumption reduction
Bulgaria	Major	EPC label B or higher and energy savings of more than 60% (refer to as major renovation)
Croatia	Deep	>50% energy consumption reduction
Cyprus	Deep	>60% energy savings
Czechia	Deep	EPC label A or B (<107 kWh/m²/year, expected to be reduced to 79 kWh/m²/year as of 2022)
Denmark	Deep	>60% primary energy savings
Estonia	Major	EPC label C (<150 kWh/m²/year)
Finland	Deep	Mentioned but not defined
France	Deep	Reference to *Bâtiment Basse Consommation* (BBC) Energy Renovation Label (80 kWh/m²/year) and to a scenario of *'rénovation performante*' being equal to BBC stepwise renovation
Germany	Major	Mentioned but not defined
Greece	Major	EPC label B to A+
Hungary	Deep	Nearly zero-energy building, as well as complying to requirements on comfort and building structure stability
Ireland	Major	>25% of the surface area of the building envelope undergoes renovation
Italy	Deep/ Major	Mention of deep renovation, but not defined. Major renovation defined as >25% of the total gross surface of the building renovated.
Latvia	Deep	Mentioned but not defined
Lithuania	Deep	>60% primary energy savings
Luxembourg	Deep	Reference to renovation quality with EPC A/A to B/B and average 72% energy savings
Malta	Deep	60-90% primary energy savings
Netherlands	Deep	Mentioned but not defined
Poland	Deep	Meets specific energy savings and thermal insulation requirements
Portugal	Deep	Mentioned but not defined
Romania	Deep	>60% energy savings
Slovakia	Deep/ Major	>25% of building surface area renovated, and retrofit of the building technical systems exceeds 50% of the investment costs

[44] As set out in the EPBD, EU Member States are required to adopt a Long-term renovation strategy (LTRS), with overview of policies and actions to reach indicative milestones for 2030, 2040 and 2050 for the Member States' contribution to the European Union's building energy efficiency targets.

[45] BPIE (2021), Deep renovation: shifting from exception to standard practice in EU policy

Member State	Type of renovation	Definition
		of acquisition of a new comparable technical building equipment (major renovation + substantial retrofit)
Slovenia	Deep	>60% primary energy savings
Spain	Deep	>60% primary energy savings
Sweden	Deep	Level 3 'total energy renovation' = 50% improvement of energy efficiency for residential buildings and 40% for offices

Legend :	Not defined	Definition aligned with pre-2023 EPBD recast EU definition (>60% PE savings)	Other definition

Key EU-level policies enabling deep retrofit are listed below in Table 3-5 Overview of the European Union's key enabling policies**.** The main EU policies are established through EU Directives, namely the Energy Performance of Buildings Directive and the Energy Efficiency Directive. These Directives provide specific targets for improving the performance of buildings, but also provide specific measures for MSs to implement. MSs must then in turn adopt national policies and measures compliant with the Directives (this is called "transposition").

Table 3-5 Overview of the European Union's key enabling policies

Policy	Building type	Policy type	Description
Renovation Wave Strategy	All	Strategy	The goal of this strategy is to at least double the annual energy renovation rate by 2030, with the focus on energy poverty and worst performing buildings, renovation of public buildings and decarbonisation of heating and cooling[46].
Energy Performance in Buildings Directive (EPBD)	All	Regulation	The EPBD is a legislative framework with the aim to fully decarbonise the EU building stock by 2050, which includes several obligatory and voluntary measures for MSs to implement to reach this target. A recast Directive was adopted in 2024.
Building Renovation Plans (Formerly Long-term renovation strategies)	All	Strategy	Under the EPBD, MSs are obliged to submit Building Renovation Plans (formerly Long-term renovation strategies) with a long-term strategy for the MSs to decarbonise their building stock.
Energy performance certificates (EPCs)	All	Enabling/ Regulation - Awareness	These certificates provide energy performance ratings and recommendations for improvements for a specific building. They are intended to be mandatory for buildings which are newly constructed, sold or in change of tenancy. They can also be used to enforce certain rules, e.g. in France dwellings of lower EPC classes can be banned from renting.
Minimum Energy Performance Standards (MEPS)	Non-residential	Regulation	The revised EPBD includes the provision for a phased introduction of MEPS for non-residential buildings.

[46] EC (n.d.), Renovation wave

Policy	Building type	Policy type	Description
Building Renovation Passports (BRPs)	All	Enabling - Awareness	An optional digital instrument that MSs can implement to support owners/investors with a tailored, long-term roadmap for the renovation of a specific building
Energy Efficiency Directive (EED)	All	Regulation	The EED is a legislative framework with the aim to reach the European Union's energy efficiency targets. The framework includes several obligatory and voluntary measures/ targets for MSs to implement to reach EU climate targets: - Article 6 requires each EU MS to ensure that at least 3% of the total floor area of heated/cooled buildings owned by public bodies is annually renovated to become nearly-zero-energy or zero-emission buildings, demonstrating the public sector's exemplary role in improving building energy performance. - The energy efficiency first principle, an important standalone enabler, guides MSs to consider cost-optimal energy efficiency measures before applying renewable energy measures.
Regulation on governance of the Energy Union and Climate Action	All	Regulation	This regulation sets common rules for reporting, planning and monitoring of energy and climate targets.
National energy and climate plans (NECPs)	All	Strategy	NECPs represent each MS's comprehensive strategy for meeting EU climate and energy targets for 2030, which include reducing greenhouse gas emissions, increasing renewable energy use and improving energy efficiency.
EU Emissions Trading System 2 (ETS2)	All	Regulation - Fiscal	Separate ETS for buildings, road transport and additional sectors, which puts a price on carbon in these sectors. The ETS2 will be implemented in 2027. A share of the revenues from the ETS2 will be used for the Social Climate Fund in support of vulnerable households and small businesses.
Effort Sharing Regulation (ESR)	All	Strategy	Sets national targets for reducing GHG emissions in transport, buildings, agriculture, small industry and waste management (i.e. sectors currently not included in the EU ETS).

Building decarbonisation and renewable integration in the European Union

Decarbonising the European building stock while increasing the share of renewables is considered key for reaching EU climate targets. As of 2022, 41% of electricity and 25% of heating and cooling is supplied by renewables in the European Union[47]. The revised Renewable Energy Directive (RED) sets a target of 49% renewable energy sources (RES) in buildings by 2030[48]. Furthermore, heating and cooling should gradually increase their renewable supply by 0.8% per year until 2026 and by 1.1% from 2026 to 2030. These new targets are intended to be reflected in the Member States' national regulations, building codes and support schemes, particularly with public buildings playing an exemplary role.

3.5. Germany

Germany does not have a definition of deep energy retrofit, although as an EU MS, their policies abide by the definition of deep renovation provided in European Energy Performance of Buildings Directive. A study by the European Commission estimated that the deep renovation rate in Germany was 0.1% compared to the 0.2% EU average[42].

Although not clearly defined, deep energy retrofit remains a key element of Germany's building decarbonisation strategy, as buildings represent 35% of the total final energy use in Germany and account for about 30% of total direct emissions. Germany's Update of the Integrated National Energy and Climate Plan draft[49] was published in November 2023, providing an outline of the measures to meet its climate targets. The plan mentions that its building measures support stimulation of '*cost-effective deep renovation*'; however, a definition of what deep renovation means is not provided. Additionally, Germany published its latest LTRS in 2020 in pursuant to Article 2a of the EPBD, with the aim to scale up renovation to decarbonise the building stock by 2050. Deep renovation is not explicitly defined in the LTRS, although Germany is expected to present an updated strategy mid-2024 when submitting its revised NECP[49].

Similar concepts used in Germany relate to deep energy retrofits. For example, the concept of '*best possible principle*' for retrofit advice is used by energy advisors as part of the Individual Building Renovation Passport programme to assess a building's best possible energy efficiency rating (rather than cost-optimality)[45]. Furthermore, Germany uses the concept of *Passive House*, a building standard for buildings which are highly energy-efficient while also comfortable and affordable[45]. In addition, the German Efficiency House Standards (*Effizienzhausstandards*) establish a set of energy efficiency standards for residential buildings with varying classes, e.g. EH 40, 55, 70 and 85; the lower the number, the lower the energy requirement of a property.

[47] Eurostat (2024), Share of renewable energy in gross final energy consumption by sector
[48] RED Article 15a
[49] EC(2023), Update of the integrated national Energy and climate plan draft

The comparison is made with a reference building that meets the requirements of the Building Energy Act (GEG), which can also be referred to as EH 100, and is measured by considering the primary energy requirement and transmission heat loss of the building[50]. In this sense, there is an established understanding of variation in energy retrofit intensity in Germany relating to the savings achieved.

Germany also sets energy efficiency standards for new buildings and for retrofitting single components. The Building Energy Act, enacted in 2020 and amended in 2023 and again in 2024, specifies energy requirements for buildings, primarily relating to heating technologies and thermal insulation standards for new and retrofitted buildings. The law does not provide a definition of deep energy retrofits, although efficiency standards are specified. Germany's main retrofit support programme, the Federal Funding for Efficient Buildings (BEG), sets even higher standards, where higher efficiency achievements are rewarded with more financial support (see textbox below for additional details)[45].

[50] KFW (n.d.), Die Effizienhaus-Stufen für bestehende Immobilien und Baudenkmale

Textbox 3-2 The Federal Funding for Efficient Buildings (BEG) initiative

The Federal Funding for Efficient Buildings (BEG), set up in 2021, is intended to support as many people as possible to improve the energy performance of buildings and to encourage the use of renewable energies to generate heat. The Fund is a central policy instrument to achieve climate neutrality in existing buildings by 2045 and draws on a budget of EUR 13 billion in 2023 to provide appropriate incentives in the market. It has four sub-programmes, three for renovation under the leadership of the Federal Ministry for Economic Affairs and Climate Action of Germany (BMWK) and one for new buildings under the leadership of the Federal Ministry for Housing, Urban Development and Building (BMWSB). The three sub-programmes for building renovations are described in further detail below.

1. BEG **residential** buildings for renovation measures (systemic renovations) of existing residential buildings in accordance with efficiency house standards.
2. BEG **non-residential** buildings for renovation measures (systemic renovations) of existing non-residential buildings in accordance with efficiency house standards.
3. BEG individual measures for individual renovation measures of **existing residential and non-residential buildings** (heating system exchange and other efficiency measures such as window replacement, building insulation, etc.). In this sub-programme, individual grants are the key instruments to stimulating energy-efficient retrofits of parts of the building (i.e. not a retrofit of the entire building). This includes measures for the building envelope and heat generators, including installation or connection to building or heating networks or for heating optimisation.

The funding programme can be accessed by private citizens, homeowners' associations, companies, communal entities and other stakeholders active in the housing industry. From February 2024, higher rates of funding are available for renewable heating systems depending on income (income-based bonus) and for the rapid replacement of particularly inefficient, old heating systems (speed bonus). Technology-neutral funding of up to 70% of the investment costs is provided for climate-friendly heat generation.

Germany's key policies for enabling energy efficiency in buildings are listed below[51].

Table 3-6 Overview of Germany's key enabling policies

Policy	Building type	Policy type	Description
Building Energy Act (GEG)	All	Regulation	The Act specifies energy efficiency requirements for buildings, primarily aimed at reducing energy consumption and emissions, in particular, through mandating energy performance standards of heating technologies and thermal insulation standards for new and retrofitted buildings (i.e. parts of the building, not the entire building), and to promote the adoption of renewable energy technologies. Standards for whole buildings apply only to new buildings.
2023 Energy Efficiency Law	All	Regulation	The regulation includes targets for reducing energy consumption by 2030 and by 2045, as well as obligations for public authorities to play an exemplary role. There are no specific targets for the building sector, though it is expected that building retrofits will play a major role in achieving these targets.
2020 Long-term Renovation Strategy	All	Regulation	With the strategy, Germany indicates their intention to reduce non-renewable primary energy consumption in the building sector to 556 TWh by 2030.

[51] As an EU Member State, Germany also must abide by EU law (overview of key EU policies can be found in Table 3-5).

Policy	Building type	Policy type	Description
Energy efficiency requirements of Federal government buildings (new and renovation)	Public	Regulation	Requirements go beyond the legal requirements of the Building Energy Act for annual primary energy needs and structural heat protection.
Carbon pricing for heating sector[52]	All	Regulation – Fiscal	Implemented in 2021, the German law sets a consistently increasing fixed price for GHG emissions, reaching EUR 55/tCO_2 in 2025.
Tax support for energy renovation of buildings (2020)[53]	Residential (owner-occupied)	Enabling - Fiscal	Tax deduction of 20% of investment cost over a period of 3 years, with a maximum of EUR 40 000
Federal Funding for Efficiency Buildings (BEG)	Residential and commercial	Enabling - Fiscal	This fiscal scheme is implemented by both Kreditanstalt für Wiederaufbau (KfW), the state-owned investment and development bank, and the Federal Office for Economic Affairs and Export Control (BAFA), depending on the type of support requested. It enables long-term financing for energy-efficient construction and retrofit via loans and grants. There are also specific *bonuses* for worst-performing buildings and for changing to renewable heating and cooling.
Energy Performance Certificates (EPCs)	All	Enabling - Awareness	These certificates are mandatory for new and existing buildings when renovated, rented or sold.
Individueller Sanierungsfahrplan (Building Renovation Passport)[54]	Residential	Enabling - Awareness	Publicly funded energy audit instrument, where energy audits can be subsidised to up to 60%. This scheme focuses on a staged approach to renovation. The existence of a building renovation passport enables an extra 5% bonus under the BEG scheme.
Best Practice Portal	All	Enabling - Awareness	The German Energy Agency (dena) has an online platform for best practices for climate-neutral construction and renovation, including more than 100 cases.

Building decarbonisation and renewable integration in Germany

Germany has no specific renewable energy targets for the building sector, although it will set an indicative target as required by Article 15a of the revised Renewable Energy Directive. Renewable integration in buildings have significant potential, given that 48% of electricity and 17% of heating and cooling is supplied by renewables in Germany as of 2022 (compared to 41% and 25% respectively in the European Union)[47]. National targets have been set to increase the renewable share of electricity mix (2030: 80%) and of district heating (2030: 50% of average generation on national level). Another target was set to install 500 000 heat pumps annually, beginning 2025.

[52] German Government (n.d.), Climate Action Programme 2030.
[53] German Government (n.d.), Climate Action Programme 2030.
[54] BPIE (2018), The Concept of the Individual Building Renovation Roadmap

3.6. Korea

Korea does not yet have a clear definition of deep energy retrofit, although it has enacted several policies enabling energy retrofits. One such policy is the Green Buildings Construction Support Act[55], which prescribes the actions needed to decarbonise the building stock. Support for energy retrofits from national and local governments are also defined in Article 27 of the Act.

Korea's energy efficiency policy focuses on new construction, rather than energy retrofit. Residential buildings represent nearly half of the total gross floor area in Korea, of which 49.1% is older than 30 years[56]; comparatively, 66% of the residential building stock in the European Union is more than 30 years old[57]. One of the factors for this is the tendency for older buildings to be demolished and the property redeveloped with a new building with greater gross floor area[58]. This trend gives way for greater focus on new buildings in setting energy efficiency standards. Nonetheless, about 17.5% of dwellings are between 20 and 30 years old[59] and would require energy retrofits to reach climate targets, i.e. to reduce total greenhouse gas emissions by 40% by 2030 as compared to 2018 levels, and to achieve climate neutrality by 2050.

Korea has made efforts to prioritise energy efficiency of existing buildings in recent national policies (see Table 3-7 for an overview*)*. By 2030, Korea aims to reduce their building-related emissions by 32.8% compared to 2018; and by 2050, to reduce their emissions by 88.1%[60]. As part of Korea's aim to reach these targets, the Basic Plan for Green Buildings was established as stipulated in Article 6 of the Green Building Construction Support Act. The current plan, the 2nd Basic Plan for Green Buildings (2020-2024), identifies key measures to decarbonise the building sector, which include increasing building energy standards for new buildings, improving the energy performance of existing buildings, increasing equipment efficiency and renewable energy use and digitalising the building sector. Additionally, the Green Buildings Construction Support Act includes energy certification to a limited extent.[8] Furthermore, the Ministry of Trade, Industry and Energy will introduce a new programme to reward owners of private and residential buildings for energy savings.

[55] Statutes of the Republic of Korea (n.d.), Green buildings construction support act
[56] The Ministry of Land, Infrastructure and Transport of the Republic of Korea, 'Building Status of South Korea in 2021'
[57] Cho, J., Bae, S., & Nam, Y. (2023). Analysis of the energy and economic effects of green remodelling for old buildings: a case study of public daycare centres in South Korea
[58] Amoruso, Fabrizio & Sonn, Min-Hee & Chu, Soyeon & Schuetze, Thorsten. (2021), Sustainable Building Legislation and Incentives in Korea: A Case-Study-Based Comparison of Building New and Renovation
[59] The Ministry of Land, Infrastructure and Transport of the Republic of Korea, 'Building Status of South Korea in 2021' (no link available)
[60] GESI, IGT, NEXT Group & Aurora Energiewende (2022), 2050 Climate Neutrality Roadmap for Korea K-Map Scenario

Table 3-7 Overview of Korea's key enabling policies

Policy	Building type	Policy type	Description
The 2nd Basic Plan for Green Buildings[61]	Public	Strategy	A statutory plan that is established every five years in accordance with relevant laws; the plan includes policies to promote retrofits of existing buildings. It presents the vision and provides guidance for the decarbonisation of the building sector and for creating a healthier living environment for its citizens.
Energy saving design standards for buildings (Building energy code compliance)	Public & Private	Regulation	Obligatory requirements for new buildings on energy saving design (to prevent heat loss and require the installation of energy efficient facilities)
Green Remodelling Support Project	Public & Private	Enabling - Fiscal	Assistance for implementing green remodelling in both public and private buildings via the *Public Building Green Remodelling Project* and the *Private building Green Remodelling Interest Support Project*. Supported projects are subject to post-management.
Zero-energy building certification system and the building energy efficiency rating certification system	Public & Private	Enabling - Certification / awareness	Building certification to promote energy efficiency and renewable energy in buildings.

Building decarbonisation and renewable integration in Korea

Renewable energy policies for buildings are mainly focused on new construction in terms of obliging that a certain proportion of energy is supplied by renewable sources. Korea set a target of supplying 3 456 000 tonnes of oil equivalent (toe) of RES to buildings by 2034.

[61] Aurum (2019), 제2차 녹색건축물 기본계획, in Korean only

3.7. Saudi Arabia

Saudi Arabia does not yet have a clear definition of deep energy retrofit, though has enacted several policies enabling energy retrofits. This includes establishing the Saudi Energy Efficiency Center (SEEC) in 2010 with aim to rationalise and increase the energy efficiency in production and consumption. As part of SEEC's Initiatives to enable energy building retrofitting in the Kingdom, (SEEC) has developed a licensing scheme to certify energy service providers in the Kingdom to ensure quality of the energy efficiency services provided. SEEC has also developed a national measurement and verification user guide that serves as a reference to the service provider and beneficiary to ensure that the energy saving implemented are measured in accordance to national standards and procedures.

Saudi Arabia requires energy retrofits in the public sector. This initiative, driven by a governmental mandate, requires energy retrofits for all existing public buildings and facilities. The execution of these retrofits falls under the scope of The National Energy Services Company (Tarshid). Tarshid is a Super-ESCO funded by The Public Investment Fund (PIF) and aims to enhance energy efficiency, particularly through retrofitting public buildings. The initial capital provided for Tarshid is to secure EPC financing in the public sector, in addition to leverage on commercial financing. Licensed energy service providers play a crucial role by participating in a competitive bidding process to implement retrofit projects. Their expertise and execution drive energy efficiency improvements across the public sector

In addition, there is an energy efficiency programme mandated by several royal decrees. This programme is focusing on all government entities, aiming to improve energy efficiency in the public buildings. Furthermore, SEEC has developed an incentive scheme related to the air conditioning in residential buildings.

Table 3-8 Overview of Saudi Arabia's key enabling policies

Policy	Building type	Policy type	Description
Mandatory retrofit of all public buildings with the aim of improving energy efficiency through the National Energy Services Company (Tarshid).	Public	Regulation	The National Energy Services Company (Tarshid) which is a Super ESCO was established and funded by The Public Investment Fund (PIF)[62] to advance energy efficiency, including retrofitting public buildings and facilities. To date, Tarshid has successfully completed numerous retrofit projects throughout the country, which are anticipated to generate annual energy savings exceeding 1,000 GWh by the end of 2023.

[62] The Public Investment Fund establishes super energy service company – "Super Esco"

Policy	Building type	Policy type	Description
Individual energy auditors	Residential	Regulation	An initiative for Individual energy auditors has been launched, which allows energy efficiency specialists to obtain an Individual energy auditor license from the Saudi Energy Efficiency Center, and provide energy audit services in residential facilities, with the aim of improving energy efficiency in the residential sector.
To Last (National Energy Efficiency Campaign)	All	Awareness	The campaign is designed to increase public awareness of the importance of energy conservation and changing energy -consumers' behaviors. It employes a variety of communication strategies to reach different segments of the population with messages about energy efficiency.
Human Capital Development in the Energy Efficiency field.	All	Skills	The Saudi Energy Efficiency Center (SEEC) Offers different professional certification programmes in energy efficiency. SEEC also works with multiple universities and technical colleges to include energy efficiency educational programmeds in curriculums.
Building Code	All	Regulation	National requirements for energy-efficient design and construction of buildings (Including Minimum requirements for building elements (Including Insulation and energy consuming products).
Improve the energy efficiency in the public sectors	Public	Regulation	According to the royal decrees, each government entity is required to nominate an energy efficiency team dedicated in executing the programme's objectives. This programme is focusing on 3 areas as follow: • **Technical** which focusing on providing the electricity consumption data by the EE team in the government entities. • **Awareness** which focuses to raise awareness of energy efficiency in the public sectors among EE team members and employees. This includes major campaigns and workshops. • **Training** which aims to provide training to teams who are involved in the process of reducing energy consumption to ensure they are equipped with knowledge and skills to maintain energy efficiency practices.
High Efficiency Air Conditioning Initiative (Saudi Energy Efficiency Centre)	All	Incentive/ Fiscal	This initiative aims at motivating citizens to replace their old AC (low efficiency) with another new highly efficient AC, locally manufactured with attractive prices. This initiative helps to boost production and adoption of high efficiency air conditioners.

3.8. Deep Retrofit in other countries

Deep retrofit concepts and policies in other countries outside of the scope of the EEB Task Group have also been explored, which provide greater context to defining deep retrofit and how different countries enable deep energy to retrofit of buildings. The countries selected are based on their willingness and ability to provide best practice insights. Namely, the information for Belgium-Flanders, Canada, France, Ireland and the United States were supplemented by contributions provided by representatives via survey and workshop participation.

Belgium – Flanders	
Definition of deep energy retrofit	Flanders: Deep retrofit is defined as reaching an EPC level A (100 kWh/m²/year) through energy efficiency improvements.
Key enabling policies	• *Woningpas and EPC+*: Building Renovation Passport (BRP) linked to long-term performance targets for building stock, which are linked to EPCs and include a digital logbook.
Relevant regional policies	• *Flemish Renovation Pact Minimum requirements for roof insulation and glazing (Flanders)*: Requirement for rental housing for minimum insulation and glazing based on a penalty point system and enforced at municipal level. • *Gent Knapt Op (Gent)*: Innovative financial pilot project in the city of Gent, where residents are provided funds to renovate with the help of technical experts; financing is returned to the fund when the building is sold, which is guaranteed by the mortgage on the building.

Canada	
Definition of deep energy retrofit	Deep retrofit in Canada is defined as *a holistic approach, with energy savings of at least 50%, and may also include measures to improve resiliency and adaptation to climate change*[63].

Key enabling policies	Energy efficiency polices are included in broader targets:
	• The *Canadian Net-Zero Emissions Accountability Act* enshrines the Government of Canada's pledge to achieve net zero greenhouse gas emissions by 2050, establishing a framework of accountability and transparency.
	• Canada's *2030 Emissions Reduction Plan* outlines a sectoral pathway to reach a 40% emissions reduction target below 2005 levels by 2030, en route to reach net zero by 2050.
	  • As part of the 2030 Emissions Reduction Plan, the *Canada Green Buildings Strategy* - released in July 2024 - provides a critical step forward toward reducing buildings-related emissions.
	  • The *Canada Green Buildings Strategy* will focus on accelerating building retrofit rates, ensuring new buildings are green and resilient, and transforming space and water heating.
	Canada has a variety of public retrofit programmes at the national, provincial/territorial, municipal and utility levels. Some programmes focus specifically on deep retrofits, while others have broader definitions.
	The programmes below highlight select federal initiatives:
	• The *Deep Retrofit Accelerator Initiative* provides funding to "retrofit accelerator" organisations that assist building owners in developing and

[63]Government of Canada (n.d.), Deep Retrofit Accelerator Initiative –Application Guide

	implementing deep retrofits in commercial, institutional and mid-to-high-rise multi-unit residential buildings (note: it does not cover capital costs). Natural Resources Canada has also launched the Retrofit Hub in early 2024 hosting information and resources to support retrofit projects. • The Canada Infrastructure Bank's *Building Retrofits Initiative* offers financing to reduce investment barriers and decarbonise buildings. It includes a team of experts working with the public and private sectors to modernise and improve the energy efficiency of existing buildings. • The *Greener Neighbourhoods Pilot Program* focusses on clusters of low-rise housing, aiming to pilot the Energiesprong aggregated deep energy retrofit model in the Canadian market. • The *Greener Homes Grant Program* provides homeowners with grants of up to CAD 5 000 (Canadian dollars) to improve energy efficiency, with up to CAD 600 for pre- and post-retrofit evaluations. • The *Green and Inclusive Community Buildings Program* supports green and accessible retrofits, repairs or upgrades of existing public community buildings and the construction of new publicly-accessible community buildings that serve high-needs, underserved communities across Canada. • The *Canada Greener Homes Loan Program* offers interest-free loans of up to CAD 40 000, repayable over 10 years, for the same types of retrofits covered by the Greener Homes Grant. • The Canada Greener Affordable Housing Program provides forgivable and low-interest loans to help affordable housing providers complete deep energy retrofits on existing multi-unit residential buildings. Other examples include the Federation of Canadian Municipalities' Green Municipal Fund (Community Buildings Retrofit Initiative) and the First Nation Infrastructure Fund.

France	
Definition of deep energy retrofit	The concept of deep renovation is shaped by the *Bâtiment Basse Consommation* (BBC) Energy Renovation Label (80 kWh/m²/year), where a scenario of 'rénovation performante' is equal to BBC stepwise renovation.
Key enabling policies	France has a comprehensive policy aiming at enhancing the energy efficiency of existing buildings, both housing and commercial. It articulates regulation, fiscal and financial incentives. Public aid also includes grants and zero rate loans. Examples are: • *MaPrimeRénov*: Grant programme financing energy renovations in residential buildings, where funding intensity is based on income and energy savings. The service "France rénov" assists households in their projects and decisions. • *Passeport Efficacité Energétique*: Building Renovation Passport via an online platform, including indicators for additional benefits (e.g. comfort) and also linked to financing opportunities.

Ireland	
Definition of deep energy retrofit	Deep Retrofit is defined in the renovation grant scheme as carrying out multiple energy upgrades at once to achieve a BER rating of A[64].

[64] SEAI (n.d.), home energy grants.

Ireland	
Key enabling policies	• *Deep Retrofit Grant Scheme*: Low-energy-performing residential buildings are eligible for a grant of up to 50% of a typical deep retrofit if renovations lead to high energy performance. • *Warmer Homes Scheme*: Grant scheme targeting low-income households and worst-performing buildings.

United States	
Definition of deep energy retrofit	The US definition of deep energy retrofit was established under Executive Order 14057: *A deep energy retrofit leverages whole building approaches and integrative design to maximise energy efficiency and emissions reductions. …[A] deep energy retrofit is a facility retrofit or renovation project that reduces annual site EUI [energy use intensity] by at least 40 percent from a pre-renovation, FY 2019 baseline.* This definition is applied for requirements on federal buildings.

United States	

Key enabling policies	• *US Buildings Decarbonisation Blueprint*: National strategy to decarbonise US buildings by 2050, including targets to achieve or exceed an annual retrofit rate of 3% for residential buildings and 2% for commercial buildings by 2035; not necessarily deep retrofits.
	• *Better Buildings Initiative*: Knowledge-sharing platform focused on energy efficiency strategies in buildings.
	• *Buildings Upgrade Prize*: Financial scheme to support energy efficiency improvements of residential and commercial buildings, awarding funding and technical assistance to innovative concepts.
	• Affordable Home Energy Shot: Initiative to accelerate innovative retrofit technology breakthroughs and reduce costs to decarbonize residential buildings. Through this Energy Earthshot, the Department of Energy aims to reduce the upfront cost of upgrading a home by at least 50%, while reducing energy bills by 20%, within a decade.
	• *Weatherization Assistance Program*: Programme by the Department of Energy that supports job creation and energy efficiency improvements in low-income households.
	• *State Energy Program*: National programme to allocate funds to states for their energy-related initiatives, including building energy efficiency. Funding allocation is based on state size and energy use.
	• The United States has several national public financing schemes, including:
	  • Tax deductions, credits and rebates:
	  ○ *Energy Efficiency Commercial Buildings Deduction,*
	  ○ *Energy Efficient Home Improvement Credits,*
	  ○ *Residential Clean Energy Credit,*
	  ○ *Home Efficiency Rebates Program,* and
	  ○ *Home Electrification Rebates Program.*
	  • Funds (grants and loans):
	  ○ *HUD's Green and Resilient Retrofit Program*
	  ○ *Conservation and Zero Building Energy Code Adoption,*
	  ○ *Funding for Green Federal Facilities,*
	  ○ *Funding for Sustainable Technologies and Programs at Federal Facilities,*
	  ○ *Greenhouse Gas Reduction Fund,*
	  ○ *Enhanced Use of the Defense Production Act, to accelerate domestic heat pump manufacturing*
	  ○ *State-Based Home Energy Efficiency Contractor Training Grants,*
	  ○ Funding for DOE *Loans Programs Office for Energy Efficient Projects,* and
	  ○ *Affordable Housing Energy / Water Efficiency and Climate Resilience Grant Program.*

United States	
Relevant regional policies	• *RetrofitNY program* (New York): Programme to test scalable approaches to decarbonise multi-family buildings with a holistic approach (no longer in effect). • *MassSave Deep Energy Retrofit program* (Massachusetts): Technical assistance and additional financial support for deep energy retrofit of commercial buildings. • *SmartRegs program*[65] (Boulder, Colorado): A minimum energy performance standard using a point system based on energy and carbon emissions, where privately-rented houses must meet the minimum standard; rental licenses must be renewed every four years. Additional examples can be found in the publication *Retrofitting America's Homes: Designing Home Energy Programs that Leverage Federal Climate Investments with Other Funding*.[66]

[65] EESC (2022), Minimum Energy Performance Standards (MEPS) in the Residential Sector

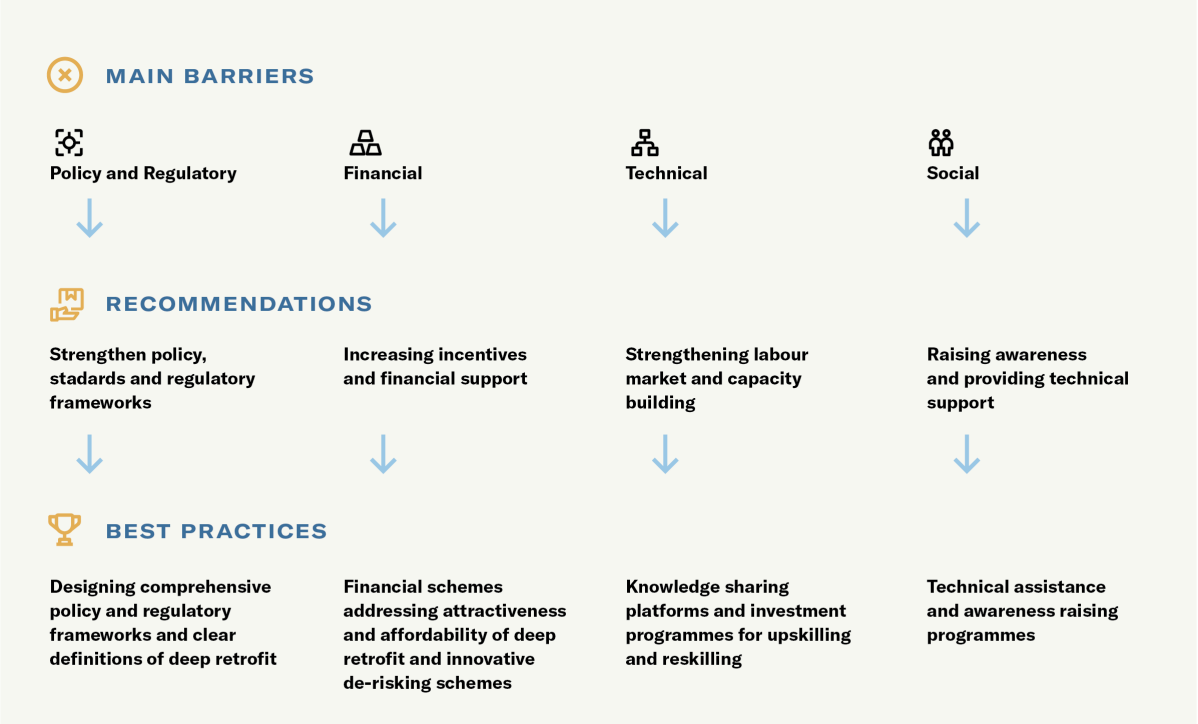
[66] Amann, Jennifer, and Kara Saul-Rinaldi. 2024. Retrofitting America's Homes: Designing Home Energy Programs that Leverage Federal Climate Investments with Other Funding. Washington, DC: ACEEE.

4. Enablers and recommendations

The following recommendations address the challenges faced by EEB members, as well as create a framework for how deep retrofits enable building decarbonisation. Mirroring the barriers, the main recommendations are:

A. Strengthening policy and regulatory frameworks,
B. Increasing financial support and incentives,
C. Strengthening labour market and value chain, and
D. Raising awareness and providing technical support.

Figure 4-1 Main barriers and recommendations



Source: Energy Efficiency in Buildings Task Group, 2024.

For each main recommendation, sub-recommendations are added, providing details on barriers addressed, its relevancy to EEB members and best practices.

The following recommendations are formulated based on commonalities among the best practices highlighted for each barrier in the report. The section is based on the ***core enabling measures*** to develop a tailored set of recommendations, taking into account the specific stage of progress in each country.

The following recommendations assume that EEB members prioritise deep energy retrofits as a key decarbonisation strategy. While the scope of this study focuses specifically on deep energy retrofit, we acknowledge that this is just one of the many approaches to reducing greenhouse gas emissions and achieving decarbonisation goals. Therefore, countries may choose to focus on other decarbonisation solutions instead of deep energy retrofits of their existing building stock. Such decisions can be influenced by overall country context (section 1.3), the share of renewables in their energy mix, the characteristics of the existing building stock, economic conditions and social and cultural factors, all of which are outside the scope of this study.

4.1. A. Strengthening Policy, Standards, and Regulatory Frameworks

Core enabling measures
Core enabling measures for strengthening energy efficiency policy in buildings include 1) establishing clear, enforceable standards and regulations; 2) providing adequate funding and resources for implementation and compliance; 3) fostering stakeholder collaboration and 4) ensuring robust data collection and analysis are crucial pre-conditions.

A stable, long-term strategy drives deep energy retrofit by setting standards and building confidence among stakeholders to invest in the construction workforce, research and development and retrofits themselves. Furthermore, specific steps, milestones and timelines should be laid out to support the achievement of the strategic objectives, through the development of a roadmap, with interim steps for improvement measures. Some considerations for developing a roadmap are elaborated in the textbox below.

Textbox 4-1 Considerations for developing a roadmap for deep energy retrofit

Some considerations for developing a roadmap to achieve deep energy retrofit targets include, but are not limited to the following:

- ***Include both staged and one-step renovations*** (see overview in section 1): Both approaches have different pros and cons. For example, staged renovations are often less disruptive and more cost-efficient, while one-step renovations provide the opportunity for an integrated approach thereby minimising potential connections and lock-in problems[67], and may lead to higher energy savings over time[68];
- ***Identify 'no-regret' actions*** that can be taken in the short term (low-hanging fruits) and longer term;
- ***Maximise potential of retrofits to achieve co-benefits*** (e.g. reduce energy poverty, improving indoor air quality and health);
- ***Design suitable support mechanisms*** in terms of communications, financial schemes and incentives, training, etc.;
- ***Bolster monitoring and reporting mechanisms***;
- ***Engage relevant stakeholders.***

EEB members are at various levels of developing strategies for deep energy retrofit. Best practices for strengthening policy and regulatory frameworks are identified in Section 4.1.3.

[67] Connection and lock-in problems can occur when different systems and components in a building are not compatible with future improvement plans, and therefore an initial renovation decision limits the feasibility or cost-effectiveness of future improvements.
[68] Fritz, Pehnt & Mellwig (n.d.), Planned staged deep renovations as the main driver for a decarbonised European building stock

4.1.1. A.1: Strengthen and harmonise existing policies and regulations to set ambitious energy efficiency targets

For countries with an existing policy and regulatory framework for (deep) energy retrofit, it is important not only to maintain these frameworks, but also to ensure that they are fit-for-purpose in terms of meeting ambitions required to reach emissions targets. This requires reviewing the ability of current strategies to achieve required emissions reduction and the whether the resulting measures are being effectively implemented.

Barriers addressed

- ✓ Inefficient building decarbonisation ambitions to reach emissions targets
- ✓ Lack of integration of strategies
- ✓ Lack of stable policies

Relevant EEB members

This recommendation is most relevant for **China, Germany** and **Korea**, as they already have existing policies and regulations on energy renovation.

For Germany, a comprehensive framework of policies in the European Union targets building decarbonisation (see Section 0). The current EU Directives provide Member States with several targets and policy tools to increase (deep) renovation rates. As the updates of these directives are being implemented, it will be important to ensure that Member States develop clear strategies (e.g. BRPs, NECPs) and are able to implement these strategies and continue implementing important renovation policies (MEPS, EPCs, BRPs).

For Korea, the current policies and regulations are more focused on public buildings and energy retrofit in general, where the residential sector is gradually gaining focus. Expanding existing renovation policies to residential buildings and emphasising *deep* energy retrofit would send a stronger signal to local stakeholders (owners / end users / investors) and promote deep energy retrofits of residential buildings.

4.1.2. A.2: Develop comprehensive energy efficiency policies and regulations including an established definition of deep energy retrofit

If not already in place, a clear national definition of deep energy retrofit should be established. For countries without a policy and regulatory framework for (deep) energy retrofit, establishing comprehensive energy efficiency policies and regulation would serve as a useful guide to direct building decarbonisation.

A clear national deep energy retrofit definition is fundamental for developing a clear, comprehensive policy strategy. A common definition creates consistent expectations of what constitutes as deep energy retrofit and can be used to set up targeted policies (e.g. financial incentives and regulations).

Barriers addressed

- ✓ Limited political support
- ✓ Lack of policies addressing deep retrofit
- ✓ Lack of definition of deep retrofit

Relevant EEB members

This recommendation is most relevant for **Argentina, Brazil** and **Saudi Arabia**, as these countries currently do not have comprehensive policies for energy renovation of existing buildings. To some extent, this recommendation is relevant for **Korea**, as they do not yet have a clear definition of deep energy retrofit.

Particularly for Argentina and Brazil, policies on (deep) energy renovation of buildings are limited. A comprehensive energy efficiency policy framework would send a clear signal to local stakeholders of the government's intentions to support - and where applicable - mandate, deep energy retrofits. This can create policy stability, enabling local stakeholders to be more confident in making long-term renovation decisions.

4.1.3. Strong examples for designing comprehensive policy and regulatory frameworks

Below is a list of high-level, solid examples from the survey responses and desk research of designing comprehensive policy and regulatory frameworks.

- ✓ ***Long-term, comprehensive policy strategies for deep energy retrofit***
  - **Canada's 2030 Emissions Reduction Plan and the Canada Green Buildings Strategy**: Canada has developed a national plan that outlines sector-by-sector opportunities for Canada to reach its emissions reduction targets. The Canada Green Buildings Strategy focuses on increasing the rate of buildings retrofits, building green from the start with low-carbon, energy efficient, climate resilient and affordable new construction, and transforming space and water heating.
  - **The United States' Buildings Decarbonization Blueprint**: A national strategy to decarbonise the US building stock by 2050, including targets to achieve or exceed an annual renovation rate of 3% for residential buildings and 2% for commercial buildings by 2035. The United States also has many programmes and initiatives supporting (deep) energy retrofit.
  - **European Union's Renovation Wave Strategy**: Published in 2020 by the European Commission, the Renovation Wave Strategy aims to improve the energy and carbon performance of buildings, hoping to double the renovation rate by 2030 and promote deep renovation. The key principles of the strategy tackle several areas: efficiency, affordability, decarbonisation, circularity, health and digitalisation.

- **European Union's Regulatory framework**: The European Union established a regulatory framework that addresses decarbonisation in buildings, namely the Energy Performance of Buildings Directive and the Energy Efficiency Directive. These two Directives provide specific targets for improving building energy performance and set out mandatory and voluntary measures for Member States to implement to reach these targets. See Table 3-5 for details on the European Union's regulatory framework and associated enabling measures.

✓ ***Clear definition of deep energy retrofit***

- Available definitions for deep energy retrofit are provided in Sections 0 and 3.7 for Canada, the European Union (and some of its Member States) and the United States.

4.2. B. Increasing financial support and incentives

Core enabling measures
Core enabling measures for increasing financial support incentives include 1) creating attractive tax benefits and subsidies for energy-efficient investments and 2) establishing dedicated funding programmes or green financing options to encourage widespread adoption of energy efficiency measures in buildings.

Although deep energy retrofits offer significant benefits in terms of energy savings, comfort, health and environment, they also often come at a high price. Financial support (e.g. loans, grants) can help bridge the gap between the high upfront costs and the long-term energy savings, making deep retrofit more affordable and attractive. Additionally, de-risking schemes (without direct financial contributions) should also be considered.

All these support schemes are most effective in the context of market prices for energy, possibly reflecting also environmental and climate considerations. Subsidised energy prices constitute often a barrier to engage in energy efficiency measures, and may be justified only in temporary crisis situations.

EEB members are at various levels in regard to developing financial support schemes for deep energy retrofit. Therefore, recommendations are differentiated for countries with and without existing financial support schemes. Best practices of innovative financial support schemes are identified in Section 4.2.3.

4.2.1. B.1 Expand existing financial support mechanisms to encourage deep energy retrofits

Existing financial support mechanisms for (deep) energy retrofit in EEB members mainly focus on encouraging energy retrofit in general. There remains an opportunity to target financial support towards *deep* energy retrofits.

Financial support mechanisms, such as grants, low-interest loans and tax incentives, can encourage building owners to undertake deep energy retrofits with a more tailored approach. This will require in-depth knowledge of the condition of the existing building stock and an understanding of the most cost-effective types of deep energy retrofits. Their potential scale for implementation, targeted financial schemes and incentives can be designed to maximise the decarbonisation potential of existing building stock. For example, grants can be designed to increase depending on the expected level of savings (see examples in Germany and France in Section 4.2.3). Other supporting measures include 1) the development of a strong communication and dissemination strategy that is tailored to relevant stakeholders, 2) close cooperation with financial institutions and 3) exploration of innovative financing models.

Barriers addressed

- ✓ Lack of economic incentives

- ✓ Difficulty for low-income households to access financial resources
- ✓ Split-incentive problem

Relevant EEB members

This recommendation is most relevant for the **European Union and Germany**, as they already have well established financial support mechanisms for energy renovation.

4.2.2. B.2 Establish dedicated funding mechanisms or funds to provide support specifically for deep energy retrofit

Financial support mechanisms, such as grants, low-interest loans and tax incentives, play an important role in encouraging and incentivising (deep) energy retrofits. In addition to the type of financial support schemes described in Recommendation B.1, it is recommended for countries with (budgetary) difficulties developing funding schemes to explore innovative financing models and to seek international collaborations and partnerships to access financing options and technical expertise. Examples of financial models include the '*Energy Savings Insurance'* and '*Energy as a Service*' models below.

Textbox 4-2 Innovative solutions to de-risk (deep) energy retrofit investments

In addition to financial support mechanisms, other innovative solutions have potential to de-risk (deep) energy retrofits.

Energy Savings Insurance (ESI)[69]

By providing a contractual guarantee that the anticipated energy savings will be realised, ESI reduces the investment risk for both businesses and investors. ESI works with local insurers, development banks and financial institutions. ESI is being implemented in various countries, listed according to the phase of implementation:

- Operational phase: Colombia and Mexico;
- Implementation phase: Brazil, Chile, Croatia, El Salvador, Greece, Italy, Mongolia, Peru, Portugal, Slovakia and Spain;
- Design phase: Argentina, Morocco and Paraguay[70].

Governments can support the wider adoption of ESI through various means: partnering with insurers and financial institutions to offer partial/full risk coverage for ESI policies, offering tax incentives/subsidies for ESI-backed projects, or providing technical assistance/capacity-building for projects using ESI. Additionally, governments could mandate ESI for public sector projects, establishing it as a standard practice and building confidence in its effectiveness.

See Annex 2 for a summary of BASE and their energy-savings insurance initiatives.

Energy as a Service (EaaS)

EaaS allows for the use of energy services without investment in physical assets. In this context, clients pay for the service output rather than the high-efficiency equipment itself. BASE, as Swiss non-profit, has collaborated with several national governments and financial institutions to implement EaaS in various settings, such as for cooling as a service in Colombia, public buildings in Costa Rica and energy service projects in India.

Barriers addressed

- ✓ Lack of economic incentives
- ✓ Difficulty for low-income households to access financial resources
- ✓ Split-incentive problem

Relevant EEB members

This recommendation is most relevant for **Argentina, Brazil** and **Korea**, where financial support mechanisms to support energy renovation are not as well-established.

[69] More information about the ESI can be found on: OECD (2023), Summary savings insurance: International focus group discussion and Climate Finance Lab (n.d.), Energy Savings Insurance. Although ESI can be a solution for some projects, it is not a solution for all. For instance, insurance schemes can significantly increase the transaction costs for a project and some projects may not qualify for insurance.

[70] Climate Finance Lab (n.d.), homepage

4.2.3. Strong examples for increasing financial support and incentives

Below is a list of strong examples for increasing financial support and incentives.

- ✓ ***Financial schemes addressing attractiveness of deep energy retrofit***
  - **Kreditanstalt für Wiederaufbau (KfW) renovation support (Germany)**: The KfW is a state-owned investment and development bank which provides long-term financing for building energy efficiency improvements via loans and grants. These schemes reward higher efficiency achievements with more financial support, encouraging deep energy retrofit. There are also bonuses for worst-performing buildings.
  - **National Home Energy Upgrade Scheme (Ireland)**: Low energy performing residential buildings are eligible for grants up to 50% of a typical deep retrofit if renovations lead to high energy performance.
- ✓ ***Financial schemes addressing affordability of deep retrofit***
  - **Greener Affordable Housing Program (Canada)**: This programme supports affordable housing providers with forgivable and low-interest loans for deep energy retrofit of multi-unit residential buildings. The programme also provides contributions for pre-retrofit activities needed to plan, prepare and apply for retrofit funding.
  - **MaPrimeRénov (France)**: This grant scheme for financing energy renovations bases funding intensity on income and energy savings. As of 2024, the MaPrimeRénov is split into two parts: light and major renovation.
  - **Warmer Homes Scheme (Ireland):** This grant scheme targets low-income households and worst-performing buildings. The energy renovations are fully funded for homeowners who already receive welfare payments (e.g. fuel allowance, disability allowance, etc.).
  - **Weatherization Assistance Program (United States)**: This programme by the Department of Energy supports job creation and energy efficiency improvements in low-income households.
    - **Argentina** has also implemented a pilot project in Buenos Aires, **Weatherizers without borders**, based on this programme.

4.3. C. Strengthening labour market and capacity building

Core enabling measures
Core enabling measures for strengthening the labour market and capacity building include 1) investing in specialised training programmes for energy efficiency skills, 2) certifying professionals and 3) promoting workforce development initiatives to ensure a steady supply of qualified personnel in the building sector.

Large-scale implementation of deep energy retrofit requires scaling-up a skilled workforce to meet growing demands. This will require support from national governments to facilitate job creation and capacity building.

Recommendations to reinforce the labour market and capacity-building are:

- Establish training initiatives, capacity-building programmes, and certifications to be included in curriculums.
- Continue knowledge-sharing among national governments and local stakeholders.

Best practices for strengthening the labour market and capacity building are identified in Section 4.3.3.

4.3.1. C.1: Establish training initiatives and capacity building programmes

Establishing comprehensive training initiatives and capacity-building programmes is a critical step for national governments to develop a skilled workforce capable of implementing energy-efficient practices, especially for large-scale deep energy retrofit projects. Table 4-1 highlights elements that governments should consider in developing such programmes.

Table 4-1 Overview of areas of development for training initiatives and capacity building programmes

Vocational Training and Apprenticeships	• Create or expand vocational training programmes and apprenticeships focused on energy efficiency retrofitting skills, such as building energy auditing, retrofit design and installation of energy-efficient technologies. • Collaborate with technical and vocational schools, community colleges and industry associations to develop tailored curricula and hands-on training opportunities. • Offer subsidies, scholarships or financial incentives to encourage participation in these programmes and attract more individuals to the energy efficiency workforce.
Certification and Continued Education	• Develop industry-recognised certification programmes for energy efficiency professionals, covering areas such as building energy assessments, retrofit project management and the installation and maintenance of energy-efficient equipment. • Establish continued education requirements and ongoing training opportunities to ensure that the workforce stays up-to-date with the latest technologies, best practices and industry standards. • Partner with professional associations and industry groups to coordinate and promote these certification and training initiatives.
Workforce Development Initiatives	• Implement job creation schemes and employment programmes, specifically targeted at the energy efficiency sector, to attract and retain a skilled workforce. • Provide support and capacity-building assistance to small and medium-sized enterprises (SMEs) in the energy efficiency industry, enabling them to expand their workforce and participate in deeper retrofit projects.

	• Encourage the participation of underrepresented groups, such as women and minorities, in the energy efficiency workforce through targeted outreach and support programmes.
Knowledge-Sharing and Collaboration	• Facilitate knowledge-sharing platforms and best practice exchanges among industry stakeholders, including contractors, building owners and technology providers. • Promote cross-training and upskilling opportunities to enable workers to adapt to evolving technologies and industry practices. • Encourage collaboration between the public and private sectors to identify and address skills gaps and workforce development needs.

Barriers addressed

- ✓ Shortage of skilled labour in the construction/renovation sector

Relevant EEB members

The labour shortage in the construction sector is a global issue, impacting all EEB members to some extent. The members that are impacted the most are **Argentina**, **Brazil, Germany** (and all of the **European Union**), and **Korea**.

4.3.2. C.2: Continue knowledge sharing among national governments as well as local stakeholders

Continuing knowledge-sharing among national governments and local stakeholders is a crucial element in supporting the large-scale implementation of energy-efficient practices, especially for deep energy retrofit projects. This can be done via knowledge-sharing platforms and groups (such as the Energy Efficiency Hub and other international programmes, organisations and institutions), collaborative networks and partnerships. Sharing of best practices can be done via reports, conferences and workshops.

Barriers addressed

- ✓ Fostering knowledge-sharing in terms of new/innovation policies, shared challenges and success stories addresses many barriers.
- ✓ The sharing of technical best practices and lessons learnt between local stakeholders should be encouraged at a national level.

Relevant EEB members

This recommendation is relevant for **all EEB members**.

4.3.3. Good practices for strengthening the labour market and capacity building

Below is a list of examples for strengthening the labour market and capacity building.

- ✓ **Pact for Skills (European Union)**: This programme promotes joint action to

maximise the impact of investing in upskilling (improving existing skills) and reskilling (training in new skills) of the construction sector in the areas of energy efficiency, circular economy and digitalisation.

- ✓ **Best Practice Portal (Germany)**: The German Energy Agency (dena) has an online platform for best practices for climate-neutral construction and renovation, including more than 100 cases.
- ✓ **Better Buildings Initiative (United States)**: This knowledge-sharing platform focuses on energy efficiency strategies in buildings.

4.4. D. Raising awareness and providing technical support

Core enabling measures
Core enabling measures for raising awareness and providing technical support include 1) implementing comprehensive public education campaigns on the benefits of energy efficiency and 2) establishing accessible technical assistance programmes to guide stakeholders through the adoption and implementation of energy-efficient practices and technologies. These measures address common barriers to adoption by increasing knowledge and providing the necessary expertise to implement effective energy efficiency strategies.

Deep energy retrofit can be a daunting endeavour for owners and residents considering the high upfront costs, complex decision-making and energy savings in the long-term. Owners and residents are often not aware of the benefits of and opportunities for deep energy retrofit.

The following recommendations aim to address this:

- Launch public awareness campaigns highlighting benefits of deep energy retrofit
- Establish technical assistance programmes

Best practices for strengthening the labour market and capacity building are identified in Section 4.3.3.

4.4.1. D.1: Launch public awareness campaigns highlighting the benefits of deep energy retrofit

Launching public awareness campaigns and investing in educational programmes are critical components in driving the widespread adoption of deep energy renovations and energy-efficient behaviours.

National governments could spearhead public awareness campaigns that highlight the tangible benefits of deep energy retrofits (e.g. long-term cost savings, environmental/health benefits) for building owners, occupants and the broader community. By raising awareness, governments can stimulate demand for deep energy renovation projects and encourage building owners to take action. Such campaigns can target the general public and public-sector buildings to serve as a national best practice.

Through a combination of public awareness campaigns and targeted educational programmes, national governments can create a supportive social and cultural environment that nurtures the widespread adoption of deep energy renovation practices and energy-efficient behaviours. This holistic approach, complementing other policy and financial incentives, can accelerate the transformation towards a more sustainable built environment.

Barriers addressed

- ✓ Lack of awareness among owners and residents of the benefits of deep energy retrofit as well as the available support schemes

Relevant EEB members

This recommendation is relevant for **all EEB members**, where specifically **Brazil** and **Germany** have mentioned lack of owner/end user awareness as a challenge.

4.4.2. D.2: Establish technical assistance programmes and support

Offering comprehensive technical assistance programmes is a crucial strategy for national governments to support building owners not only in planning and executing deep energy renovation projects, but also in financing projects.

Governments can also develop guidelines and standard contracts to promote transparency in deep energy retrofit projects. Standardised frameworks and contract templates can:

- ***Establish clear performance metrics and measurement protocols,*** ensuring that energy savings and other project outcomes are consistently and transparently quantified and verified;
- ***Clarify roles, responsibilities and risk allocation,*** defining the responsibilities of each party involved (e.g. building owners, contractors, financiers) and how risks and liabilities are allocated;
- ***Facilitate third-party validation and monitoring,*** enabling the involvement of independent third-party entities to validate project performance and ensure transparency.
- ***Encourage the use of innovative financing mechanisms,*** incorporating provisions for the use of financing instruments like energy performance contracts, on-bill financing or green bonds.

In addition to establishing ambitious national energy efficiency targets and harmonising policies and regulations, governments can further strengthen their efforts by setting up **one-stop shops** to provide comprehensive support for building retrofits. This approach can significantly enhance the effectiveness of the overall policy framework. The textbox below provides an overview of the elements of implementation of one-stop shops.

Textbox 4-3 Establishing One-Stop Shops for Building Retrofits

One-stop shops (OSS) are centralised service centres that offer a single point of contact for building owners and occupants seeking to undertake energy efficiency retrofits. Support can range from high-level technical support to in-depth financial support. The range of integrated services and support includes:

- ***Technical assistance***: conducting energy audits, developing retrofit plans and identifying the most suitable energy-efficient technologies and solutions;
- ***Financial advice***: guiding building owners on available incentives, financing mechanisms and identifying optimal funding strategies to make retrofits more accessible and affordable;
- ***Project management support***: helping to identify and qualify contractors, coordinating the retrofit process and ensuring quality control; and
- ***Ongoing monitoring and optimisation***: providing post-retrofit performance evaluation and troubleshooting to maximise energy savings.

By consolidating these services within an OSS model, governments can significantly lower the barriers to the retrofit process for building owners. This comprehensive support can increase the uptake of deep energy retrofits, as building owners have a trusted and reliable source of guidance throughout the entire project lifecycle. Importantly, the OSSs should be tailored to the specific needs and contexts of different countries, taking into account local building types, retrofit practices and available financing options.

Integrating One-Stop Shops within the Broader Policy Framework

The OSS model should be closely integrated into national energy efficiency policies and regulations. This integration can include:

- Aligning OSS services and guidance with the energy efficiency targets and building code requirements,
- Leveraging OSSs to facilitate access to financial incentives and support schemes for building retrofits, and
- Establishing clear referral pathways and information-sharing mechanisms between OSSs and other relevant government agencies or programmes.

By seamlessly integrating OSSs within the broader policy framework, governments can create a comprehensive and user-friendly ecosystem to drive the widespread adoption of energy-efficient building retrofits.

Barriers addressed

- ✓ Lack of awareness among owners and residents of the benefits of deep energy retrofit as well as the available support schemes
- ✓ Lack of technical assistance

Relevant EEB members

Similar to public awareness campaigns, providing technical assistance programmes is relevant for **all EEB members**, more so for **Argentina, Brazil, China, Korea** and **Saudi Arabia**, than as for Germany, since it benefits from the well-established technical support mechanisms in the European Union (e.g. EPCs, BRPs, OSSs).

4.4.3. Good practices for raising awareness and providing technical support

Below is a list of strong examples for raising awareness and providing technical support.

- ✓ **Woningpas and EPC+ (Belgium)**: Building Renovation Passport (BRP) linked to long-term performance targets for the building stock, which are linked to EPCs and includes a digital logbook;
- ✓ **Homegrade (Belgium)**: OSS in Brussels catering to individual homeowners and homeowner associations, offering services for renovations including technical advice, financial aid navigation and contractor referrals; a key strength is their focus on accompanying homeowners throughout the entire renovation process, ensuring a smooth and successful experience;
- ✓ **Deep Retrofit Accelerator Initiative (Canada)**: provides funding to organisations (i.e. "retrofit accelerators") that helps building owners develop deep retrofits in commercial, institutional and mid- or high-rise multi-unit residential buildings in Canada[71], and that drive market transformation in a given region or market segment; in addition, the Retrofit Hub hosts information and resources to support retrofit projects to get off the ground;
- ✓ **EU Peers (European Union)**: a project, co-financed by the LIFE programme, which supports the development of OSSs in the European Union, focusing on residential buildings; the programme intends to provide a variety of exchange formats including capacity-building, assistance in the process of emerging OSS initiatives, and improvements of the framework conditions via policy recommendations and dialogues with stakeholders.
- ✓ **The European Local Energy Assistance (ELENA) (European Union)**: a joint programme of the European Commission and the European Investment Bank that provides technical assistance funding to support the planning and financing of energy efficiency projects, including business plans, audits and feasibility studies, to ensure project bankability and access to additional funding (see Annex 2 for more details);
- ✓ **Passeport Efficacité Energétique (France)**: Building Renovation Passport via an online platform, including indicators for additional benefits (e.g. comfort) and also linked to financing opportunities; and
- ✓ **Individueller Sanierungsfahrplan (Germany)**: Publicly funded energy audit instrument, where energy audits can be subsidised up to 60%; this scheme focuses on a staged approach to renovation.

[71] note: it does not cover capital costs

5. Summary and next steps

Effective building renovation policies benefit from sharing and adapting good practices on a global scale and from staying updated with policy trends aligned with sustainability goals. Countries have various needs to facilitate renovation based on their context and decarbonisation goals. Overall, a definition clarifies specific needs to achieve an energy-efficient building stock. Supportive policies, financing mechanisms, stakeholder engagement and workforce development ensure renovations are successfully initiated and completed.

Although the approach to deep energy retrofits is addressed differently among countries, several questions draw out considerations that could be taken to develop next steps for accelerating deep renovations:

- The purpose of deep renovations: Is the objective solely decarbonisation, or are there other national/regional considerations such as comfort and indoor air quality?
- National targets: What national and regional targets are officially in place – GHG targets, sector level, buildings targets, energy efficiency targets, targets for public buildings, etc?
- Milestones and policies: Is there a roadmap or strategy to consider?
- Enabling policies and measures: What awareness-raising is needed or already in place? Are grants and other funding available for deep energy renovations? Is there a clear understanding of building codes and the role of Minimum Energy Performance Standards, etc.?

Answering these questions could generate a clear definition deep energy retrofit. An established understanding would prove useful to enable more efficient benchmarking and progress-tracking, not only at the building level, but also in relation to regional and national targets. A well-defined concept would also allow for consistent measurement and comparison of energy efficiency improvements across different contexts and scales. It would help set realistic goals, assess the effectiveness of policies and ensure alignment with broader climate objectives.

A deep dive further into deep energy retrofits will continue to highlight the importance of the topic in reaching global climate targets. By establishing a benchmark and sharing best practices, stakeholders can develop more effective strategies, allocate resources more efficiently and create robust frameworks that support widespread adoption. Moreover, this clarity helps in identifying best practices, overcoming barriers and fostering innovation in the building sector.

Annex 1

Energy Efficiency Hub – Energy Efficiency in Buildings (EEB) Task Group – Deep Energy Retrofits Survey

Part 1: To be submitted end of day on Thursday, 15 February 2024

1. General details	
Name	
Organisation/ministry	
Country	

Background: Generally, deep energy renovations refer to major physical changes to buildings to improve energy efficiency and sustainability and can be carried out all at once or in stages; Retrofits are usually less major, where upgrades and replacement of systems of building technologies are made.[72]

2. National understanding and/or definitions of deep energy renovations / retrofits
a. Is there a national ***definition*** for deep energy renovations and/or retrofits? - If yes, can you please provide details, and share any relevant documents or websites to which this is indicated? - If not, are there existing and future plans establishing a national definition for deep energy renovations/ retrofits?
b. Are there any national ***targets*** set for deep building renovations / retrofits? - If yes, can you please provide details/share any relevant documents or websites? - If yes, to what extent are these national targets monitored? - If not, are there existing and future plans to do so?

[72] Implementing sustainability in existing building through retrofitting measures

c. Does the national government have a database of the energy performance of buildings? (i.e., including performance data, energy use, certifications, etc.) - If yes, can you please provide details, and share any relevant documents or websites to which this is indicated? - If yes, can you please provide information on the level of accessibility of this database(s) – for example, whether it is publicly available, available on request, or limited to the organisation / government etc.? If not, are there existing and future plans establishing a national definition for deep energy renovations/ retrofits?
d. Has the national government undertaken any studies to better understand how deep energy renovations / retrofits may be implemented in existing and/or new buildings? - If yes, can you please provide details/share any relevant documents or websites? If not, are there existing and future plans to do so?
e. Are there existing public financial mechanisms / support schemes (e.g. grants, subsidies, tax schemes, R&DI etc.) to support deep energy renovations / retrofit projects? - If yes, can you please provide details/share any relevant documents or websites? If not, are there existing and future plans to do so?

3. Strong examples of deep energy renovations / retrofits

a. Are there any examples of any initiatives or projects which showcase good practices of deep renovations / retrofits that have successfully been implemented or are ongoing, and could potentially be replicated for other projects and in other countries?

- If yes, can you please provide details, including achieved savings, and share any relevant documents or websites?
- If yes, can you please provide information about the costs of these projects?

4. National targets

a. Are there any national ***energy efficiency targets*** set to be achieved in the building sector?

- If yes, can you please provide details (including any specific quantitative requirements), and share any relevant documents or websites, including the measures that has / will be taken to achieve them?
- If yes, to what extent are these national targets monitored?
- If not, are there existing and future plans to do so?

b. Are there any national ***decarbonisation targets*** set for the building stock?

- If yes, can you please provide details (including any specific quantitative requirements), and share any relevant documents or websites, including the measures that has / will be taken to achieve them?
- If yes, to what extent are these national targets monitored?
- If not, are there existing and future plans to do so?

c. Are there any national targets set for the ***renewable energy share*** in buildings?

- If yes, can you please provide details (including any specific quantitative requirements), and share any relevant documents or websites, including the measures that has / will be taken to achieve them?
- If yes, to what extent are these national targets monitored?

If not, are there existing and future plans to do so?

d. Are there existing public financial mechanisms / support schemes (e.g. grants, subsidies, tax schemes, R&DI etc.) to support building decarbonisation projects?

- If yes, can you please provide details/share any relevant documents or websites?

If not, are there existing and future plans to do so?

5. Other comments

Please let us know if you have any other thoughts to share with us.

Annex 2

5.1. Workshop 2 (6 March 2024), Presentation: European Local Energy Assistance (ELENA)

In 2023, the European Investment Bank (EIB) provided EUR 88 billion in financing, with a quarter of that (EUR 8.4 billion) dedicated to energy efficiency projects. This represents 80% of the EIB's energy portfolio, with an even split of funding between existing and new buildings, though the greater impact has been on improving the energy efficiency of existing buildings.

The European Local Energy Assistance (ELENA) programme, a joint effort between the EU Commission and EIB, manages this portfolio to ensure the projects are bankable, enabling the mobilisation of additional finance. ELENA has been ongoing for 15 years, providing nearly EUR 300 million in total grants to over 160 projects. ELENA offers support during the critical planning phase before implementation, providing funds for business plans, energy audits, stakeholder engagement and technical financial studies. The technical assistance includes funding various studies across multiple aspects of energy efficiency projects.

One recipient of an ELENA grant is the Green Revolution of Wealth in Salento (GROWS) initiative led by Campi Salentina in Italy, where 23 local authorities have focused on improving the energy efficiency of public school buildings and street lighting. With a total investment of EUR 44 million supported by an ELENA grant of EUR 1.5 million, the project aims for a high-leverage effect, with each euro from ELENA expected to generate EUR 20 in investment. ELENA has also facilitated the hiring of municipal staff and external consultants to boost the human resources for this project.

5.2. Workshop 2 (6 March 2024), Presentation 2: Business models & financing strategies

Basel Agency for Sustainable Energy (BASE), a Swiss non-profit created in 2001 as a joint initiative of UNEP and the Swiss government, operates as an independent organisation developing financial strategies and business models for sustainable energy and climate solutions. It collaborates with various local stakeholders such as financial institutions, developers and technology providers to test these business models. BASE conducts operations on a global scale and focuses on increasing the competitiveness, reducing risk and scaling up investments in sustainability. The organisation addresses and presents barriers and challenges in the realm of sustainable buildings, as there are different

interpretations of what constitutes a sustainable or green building. Some criteria are stricter than others, highlighting the need for a common understanding.

One innovative approach advocated by BASE is Efficiency as a Service (EaaS), which allows for the use of energy services without capital investment in physical assets. EaaS is pushing market adoption of energy efficiency through service contracts, a trend known as *servitisation*, which includes utilities like lighting, cooling and heating. Under EaaS agreements, clients pay for the service output rather than the high-efficiency equipment itself, such as paying per copy made rather than purchasing the copier. This model is expanding rapidly in sectors like solar photovoltaics and transportation. BASE collaborates with governments and financial institutions to implement EaaS in various settings, with notable implementations including "Cooling as a Service" in Colombia, public buildings in Costa Rica, and energy service projects at Elpro Business Park and Elpro City Square in India.

Energy Savings Insurance (ESI) addresses the inherent risks in energy efficiency projects, which often require significant upfront capital. The goal of ESI is to reduce investment risk and provide assurance to investors. Initially launched in Latin America, ESI works in concert with local insurers, development banks and financial institutions. The initiative receives funding from the European Commission and has expanded to Mongolia and India.

The G7 has recognised ESI as an effective strategy to bolster energy efficiency efforts. ESI encompasses four key elements: 1) Contractual Agreement between the technology provider and the client, 2) Energy Savings Insurance that guarantees the client realises the anticipated savings, 3) Technical Validation performed by independent referees to confirm energy savings are achieved, and 4) Financial Support that offers financing assistance to businesses undertaking energy efficiency projects.

By addressing the risks associated with energy efficiency projects and providing the necessary contractual, insurance, validation and financial support, ESI aims to facilitate increased investment in these projects and drive greater adoption of energy-efficient technologies and solutions.

5.3. Workshop 2 (6 March 2024), Presentation 3 - Progress on energy efficiency renovation of existing buildings: China

The presentation defined energy efficiency and outlined key targets, focusing on upgrading existing building structures to comply with energy efficiency standards. The goal is to renovate 350 million square meters of existing building space. Research and practical demonstrations were emphasised as essential for advancing energy efficiency in renovations.

Fiscal funds and support schemes have facilitated energy efficiency upgrades, particularly in older residential areas of major cities like Beijing, Chongqing, and Shanghai. Clean heating initiatives have also received financial backing through subsidy policies in certain regions. Significant progress was made from 2015-2020, with 514 million square meters of residential buildings and 185 million square meters of public buildings undergoing energy efficiency improvements. These renovations resulted in better indoor temperatures and substantial savings in coal usage and carbon emissions.

The presentation highlighted Qingdao's successful financing and renovation practices. Since 2008, Qingdao has renovated 48 million square meters, addressing structural issues while saving 240,000 tons of coal and reducing carbon emissions by 650,000 tonnes. Qingdao's innovative "do first, reward after" approach requires upfront renovations before applying for government subsidies, promoting a market-oriented system that eases fiscal pressure and encourages faster development. Qingdao's energy efficiency progress has prioritised existing building upgrades for over a decade, leading to the remediation of building issues, improved aesthetics, and significant energy and emissions savings.

5.4. Workshop 3 (30 May 2024), Presentation 1: One-stop shops for deep energy retrofits, EU PEERS project

FEDARENE represents regional and local subnational energy agencies and is a nonprofit organisation with government mandates that provides support to facilitate the energy transition. Many of these agencies are developing energy renovation OSSs.

OSSs are useful because the renovation sector is fragmented, and homeowners often lack the capacity to oversee the entire process. OSSs offer solutions by providing services as a package, making the best use of local and regional resources, including local players and financial options. The EU PEERS project (co-financed by the LIFE programme) aims to support the development of OSS in the European Union. While the concept of OSSs is well-known, its implementation is not yet widespread.

The main goals of the EU PEERS project are to strengthen and upscale the OSS concept, support skilled practitioners actively involved in implementing OSS and build bridges between existing and emerging OSS initiatives. Additionally, the project seeks to build a vibrant, inclusive and helpful community by engaging and connecting practitioners for collaborative problem-solving, facilitating dialogue and insight-sharing and fostering a common culture among practitioners and beyond.

The EU PEERS project intends to provide support by offering various exchange formats at different levels and diverse capacity-building based on members' needs. It supports emerging OSS initiatives through comprehensive assistance

in the setup process and aims to improve framework conditions through policy recommendations, debates and stakeholder dialogues. The project fosters the creation of OSS through three pillars and targets community members (IHRS/OSS practitioners/IHRS supporters), local authorities, actors in the renovation chain (both supply and demand side), national and EU policy makers and the general public.

As an example, SERAFIN (The French Community) includes 31 OSSs, 47 regional SPEEs, has mobilised over 1 000 tradesmen, supported 6 000 households, issued 13 000 loans, and invested EUR 132 million. In these OSSs, each homeowner is assigned one contact who follows them throughout the journey, helping them find public and private financing as well as the right technical experts.

5.5. Workshop 3 (30 May 2024), Presentation 2: Leveraging private funds for energy renovation, Connecticut Green Bank

Since there is not enough grant money in the United States to retrofit all homes, private investment is being leveraged. With the Connecticut Green Bank, the aim is to leverage seven private dollars for each public dollar, using the limited public resources available to scale up the private market. In this context, it is essential for the state agency to maintain stability to keep operating effectively, while ensuring the benefits of these initiatives are available to everyone.

One financing scheme, C-PACE financing, is secured by a municipal property assessment, allowing the loan to be paid back alongside property taxes. This scheme offers up to 25 years of financing, enabling savings to outpace payments over time. C-PACE loans range from USD 100 000 to USD 14 million and are available for all types of commercial properties. The financing can cover up to 100% of project costs, typically requiring no equity from the borrower. The rules accommodate a comprehensive list of eligible projects, including energy efficiency, renewable energy systems, EV charging and climate resilience measures for both existing and new construction projects.

Additionally, C-PACE can be combined with tax credits, utility incentives and level feed-in tariffs for solar, allowing for co-investment and more comprehensive projects. It can also be used for new construction, either reducing costs or increasing available capital. One finance project benefitting from this scheme is Enko Chemical, a startup making environmentally friendly pesticides. (See slides for more details.)

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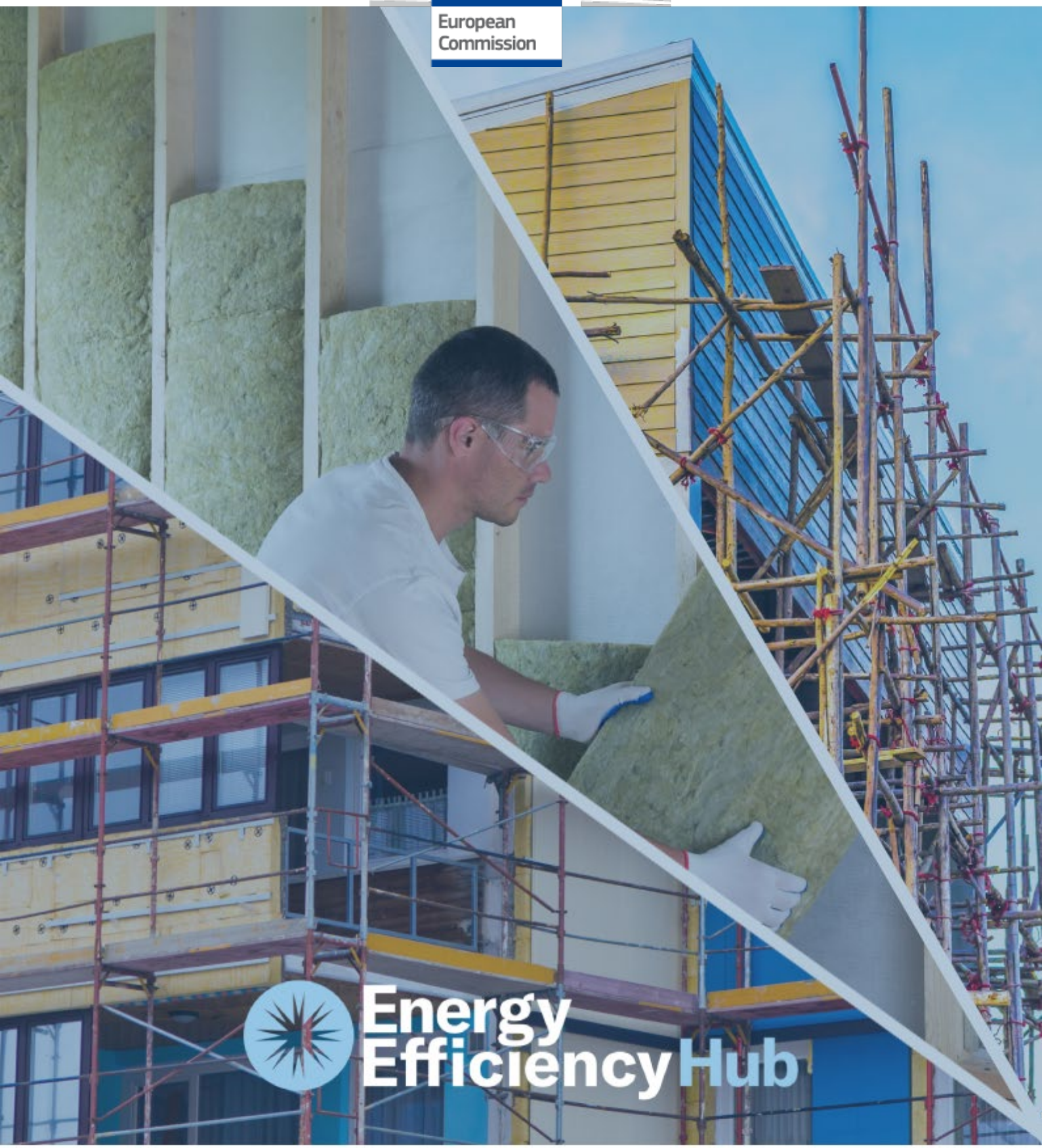

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