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Energy Cooperation Platform

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Market Financing for Energy Efficiency in Buildings in EU and China

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EU-China Energy Cooperation Platform was launched on 15 May 2019 to support the implementation of activities announced in the 'Joint Statement on the Implementation of EU-China Cooperation on Energy'. The overall objective of ECECP is to enhance EU-China cooperation on energy. In line with the EU's Green Deal, Energy Union, the Clean Energy for All European initiative, the Paris Agreement on Climate Change and the EU's Global Strategy, this enhanced cooperation will help increase mutual trust and understanding between EU and China and contribute to a global transition towards clean energy on the basis of a common vision of a sustainable, reliable and secure energy system. Phase II of ECECP is implemented by a consortium led by ICF, and with National Development and Reform Commission - Energy Research Institute.

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Glossary

Term	Description
EC	European Commission
EEC	EU Energy Efficiency Directive
EIB	European Investment Bank
EMC	Energy Management Contracting
EPBD	EU Energy Performance in Buildings Directive
EPC	Energy Performance Contracting / Energy Performance Certificate
ESCO	Energy Service Company
ETS	Emissions Trading System
Five-Year Plan	Five Year Plan in China
GHG	Greenhouse Gases
IEA	International Energy Agency
IPO	Initial Public Offering
JRC	EC Joint Research Centre
NZEB	Nearly Zero Energy Buildings
PPP	Public-private partnership
RED	EU Renewable Energy Directive
tce	Tonnes of coal equivalent
ULEB	Ultra-low-energy buildings

Executive Summary

In both the EU and China, buildings account for a significant proportion of overall energy consumption and emissions in their respective economies. In Europe, buildings are responsible for about 40% of total energy consumption. In China, the proportion is between 26% and 29%. China's building sector accounts for more life-cycle energy consumption than any other sector, and is therefore central to the country's energy-saving transformation. The vast majority of buildings in both regions have not yet been renovated to reduce emissions, leaving potential for significant energy efficiency improvements.

This study focuses on the role the market plays in driving further improvements and aims to provide a deeper understanding of the role of market instruments in building sector segmentation (residential, commercial, existing, new build). The market reacts to the policy environment, and market players need an understanding of the priority that policy makers accord to improvements to the energy performance of buildings as part of their long-term energy and climate objectives. Decision makers, for their part, need to have an insight into the importance of these priorities as drivers that give market signals to the financial community.

While both the EU and China realise that they need to improve the energy performance of their building stock, the task is complex, requiring many separate elements to be addressed. Fortunately, both the EU and China each have considerable experience relating to building energy efficiency within the specific contexts of their own regions. Now is an opportune time to evaluate the measures taken in each region and assess whether they can be adapted for wider use, for more rapid energy efficiency savings.

This report includes two chapters outlining the current approaches to building energy efficiency, first in the EU and then in China. Two chapters follow on the various options available in both regions that can help finance building energy efficiency, first in the EU and then in China. The main bottlenecks and barriers hampering financing energy efficiency in buildings are then discussed, followed by an overview of the important lessons learned from both the EU and China that can be shared to inform further improvements as both regions race to cut emissions. Notable recommendations to policymakers and the financial community include:

- While state finance and policy support are crucial, it is also vital for a wide range of financial instruments to be available in order to mobilise the market and ensure adequate levels of investment to deliver the necessary efficiency savings.

- Ensure that high energy-performing new and existing buildings are monitored for effectiveness and that technical standards remain under regular review.

- Incorporate the building sector into the ETS market so that carbon assets can be traded for financing; create carbon financial products to secure long-term bank loans.

The report also highlights the EU taxonomy regulation and China's updated taxonomy, which were released in the same week. The EU Taxonomy is intended to drive capital to climate-related investments, while China's taxonomy update makes it more closely aligned to that of the EU. The two economies are actively working to develop a 'common ground' taxonomy to drive global investment in sustainable solutions. Looking ahead, we advocate further work to see if there is scope for further harmonisation to facilitate the flow of investments between the two regions.

This report demonstrates that the EU and China would benefit from further cooperation on building energy efficiency: both regions have separately developed an array of financial instruments to meet the needs of different consumer categories. Innovative approaches such as green mortgages and one-stop shops could help boost public awareness and increase the impact of energy efficiency measures.

Both regions are accelerating renovation of buildings in order to meet more ambitious long-term climate and energy objectives. On policy, financial instruments, forward planning, and building standards, there is ample room for an exchange of information on the impact of individual measures applied in both the EU and China. As the urgency of action on climate becomes increasingly evident, the value of sharing insights and experience has become indisputable.

1. Introduction

1.1 Background

The EU-China Energy Cooperation Platform was launched on 15 May 2019, to support the implementation of activities announced in the 'Joint Statement on the Implementation of EU-China Energy Cooperation'. The overall objective of ECECP is to:

'enhance EU-China cooperation on energy. In line with the EU's Energy Union, the Clean Energy for All European initiative, the Paris Agreement on Climate Change and the EU's Global Strategy, this enhanced cooperation will help increase mutual trust and understanding between EU and China and contribute to a global transition towards clean energy on the basis of a common vision of a sustainable, reliable and secure energy system.'

There are many aspects to cooperate on energy, particularly as both the EU and China are endeavouring to address long-term climate and energy objectives that, for many reasons, are becoming more ambitious as the impacts of climate change become more evident.

One of the areas covered by ECECP is energy efficiency. ECECP focuses on two themes in the field of energy efficiency: 1) Using market-based mechanisms to promote energy efficiency; 2) Sharing experiences and practices in the development of energy efficiency labelling for water heaters, coolers, etc., providing a reference for policy makers and related companies, in order to strengthen green competitiveness in selected industries. This report focuses on the first theme.

1.2 Objectives

The overall objective of this study is to build on the lessons learned from experience in both the EU and China on the use of market instruments to improve the energy performance of existing buildings and high-performance new build in order to foster greater cooperation so that both regions can achieve long-term energy and climate objectives.

1.3 Scope of the Study

This study will focus on the role the market plays in driving further improvements and aims to provide a deeper understanding of the role of market instruments in building sector segmentation (residential, commercial, existing, new build). Naturally, the market reacts to the policy environment, and it is important to understand the priority given to improving the energy performance of buildings when seeking to meet long-

term energy and climate objectives. Decision makers need to have an insight into the role of these priorities as drivers that give market signals to the financial community.

1.4 Definition of Building Energy Efficiency

Buildings are designed to last for decades, sometimes centuries. Thus, buildings have an impact on long-term energy consumption.

Building efficiency must be considered as improving the performance of a complex system designed to provide occupants with a comfortable, safe, and attractive living and working environment. This pertains to existing buildings and new build.

The energy performance of buildings is improved through the implementation of energy-efficient technologies and techniques and is normally measured in terms of reduced energy consumption per square metre. However, there are many indicators used to monitor improvements.

1.5 Rationale of the Study

In both the EU and China, buildings consume a significant proportion of overall energy consumption in the economies. In Europe, this is about 40% of total energy consumption. In China, the proportion is between 26% and 29%. Whilst accounting for high energy consumption (and high levels of greenhouse gas emissions), buildings also offer potential for energy efficiency improvements.

Both regions are prioritising improvements to the energy performance of buildings, both new and existing. Each has a strong policy foundation that needs constant monitoring and updating. There are technical aspects that must be addressed. These include ensuring strong standards for energy performance and for technologies. State policies need to ensure that there is the capacity to make the improvements and that there is funding available. This includes financial support from public authorities and the private sector.

The challenge is to find the right balance, since public sector funding is generally limited. Financial institutions require a reasonable return on investment and the asset owner (of a residential or commercial building) needs to invest cost-effectively. However, what is cost effective for the owner may not be adequate to meet long-term climate policy objectives. This makes it necessary to find innovative approaches, often bundling financing to ensure all three are satisfied with the results.

Improving the energy efficiency of buildings is complex, with many elements having to be addressed. This report examines the use of market instruments that are used to improve building energy efficiency. Fortunately, both the EU and China have considerable experience even though they have significantly different contexts. This

is important for sharing and learning from each other's experience. In the EU, there are actually 27 different contexts because traditionally the buildings sector was an individual responsibility held by each Member State[1]. However, given the common energy and climate goals, more policy instruments are required that entail shared methodologies and approaches. Even taking into account the size of both regions, the weather variations and differing building designs, there are more similarities than seems evident at first glance.

1.6 Structure of the Report

Following this introduction, the report includes two chapters on building energy efficiency, first in the EU and then in China. Two chapters follow on financing building energy efficiency, first in the EU and then in China. The report then assesses the main bottlenecks and barriers hampering financing energy efficiency in buildings, again first in the EU and then in China. This is followed by an overview of the important lessons learned from the experiences in the EU and China that can be shared to help further improvements as both regions raise their level of ambition. Finally, the report includes some recommendations to policymakers and the financial community to benefit from cooperation on policy improvements and on the use of market instruments to further encourage building energy efficiency.

1 The 2010 Energy Performance of Buildings Directive states: 'It is the sole responsibility of Member States to set minimum requirements for the energy performance of buildings and building elements.'

2. Building Energy Efficiency in the European Union

2.1 Importance of Buildings in Overall Energy and Climate Objectives

The European Union has embarked on a multi-faceted approach to address its long-term climate and energy objectives. As will be shown, improvements to the energy performance of Europe's buildings are a key priority. In recent years, efforts have gained momentum as the EU sets in motion more policies to help Europe meet its 2015 Paris climate agreements, recover from the impacts of the Covid pandemic and take more action to improve energy security resulting from the war in Ukraine.

The following diagram provides an overview of the development of the EU policy and legal framework for energy efficiency in buildings since the approval of the first buildings directive in 2002. The various elements will be discussed below.

Table 2.1: Development of EU Policy and Legal Framework for Energy Efficiency in Buildings since 2002

2030	EU targets for GHG emissions, energy efficiency and renewable energy
2023	European Parliament approved position on EPBD and trialogues with European Council will soon start
	The EU agreed to more ambitious target in 2030 for energy efficiency
2022	EU agrees to strengthen and expand emissions trading, and creates a Social Climate Fund to help people in the transition
	REPowerEU plan: affordable, secure and sustainable energy for Europe
2021	European Bauhaus announced
	Fit for 55 package proposed
2020	Renovation Wave proposed
2019	European Green Deal
2018	EPBD and EED revisions approved
2012	Energy Efficiency Directive approved
2010	Recast of Buildings Directive approved
2002	Buildings Directive approved

Improving energy efficiency to reduce energy demand and GHG emissions is considered key to meeting its climate and energy objectives. To reach the overall goal of the European Green Deal, i.e. a climate neutral Europe by 2050, a balanced,

realistic, and prudent pathway to climate neutrality by 2050 has to be taken. The 2020 Communication on Stepping up Europe's 2030 Climate Ambition[2] indicates that apart from a more ambitious emissions reduction target of 55% by 2030, energy efficiency improvements will need to be significantly stepped up to deliver around 36% of savings in terms of final energy consumption by 2030.

In July 2021 the European Commission published its 'Fit for 55' package[3] that sets out the legislative changes required to meet the more ambitious targets. The package proposes important changes to the Energy Efficiency Directive (EED) and Renewable Energy Directive (RED) as well as to the Energy Performance in Buildings Directive (EPBD). The revised EED was adopted on 25 July 2023. The others should be approved later in 2023.

In May 2022, the European Commission published *REPowerEU*, its response to the global energy market disruption caused by the outbreak of hostilities between Russia and Ukraine. The measures include energy savings, diversification of energy supplies, and the accelerated roll-out of renewable energy to replace fossil fuels in homes, industry and power generation. The package also includes a 'Save Energy' Communication which proposes a two-pronged approach to accelerate reductions to energy demand:

- Achieving immediate energy savings through voluntary choices.
- Accelerating and strengthening structural, mid- to long-term energy efficiency measures.

The key targets for 2030 are[4]:

- At least 40% cuts in GHG emissions (compared to 1990 levels), with an overarching target of 55%.

- Renewable energy to account for at least 32% of power generation, with provisional agreement to reach 42.5%. An additional 2.5% indicative top-up could bring the figure to 45%.

- At least 32.5% improvement in energy efficiency with an option for the figure to reach 36% of final energy consumption and 39% of primary energy consumption compared to the 2007 Reference Scenario.

These targets are currently being reviewed, as mentioned above.

By 2050[5] the EU aims to be climate-neutral – with net-zero greenhouse gas (GHG) emissions throughout the economy. This objective is at the heart of the European Green Deal[6] and is in line with the EU's commitment to global climate action under the Paris Agreement.

2 COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, Stepping up Europe's 2030 climate ambition: Investing in a climate-neutral future for the benefit of our people (COM(2020) 562 final)

3 https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541

4 https://ec.europa.eu/clima/policies/strategies/2030_en

5 https://ec.europa.eu/clima/policies/strategies/2050_en

6 The European Green Deal is intended to make the EU's economy sustainable. It is designed to ensure the efficient use of resources by moving to a clean, circular economy. The action plan outlines the investments needed and financing tools available. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

Importantly, the International Energy Agency (IEA) stresses that improvements in energy efficiency could contribute around half of the reduction in energy-related GHG emissions that is required over the next two decades. These mitigation efforts will require significant energy efficiency measures, particularly in buildings.

2.1.1 Financing Energy Efficiency is Key to EU Strategy

Implementing energy efficiency fully will require considerable resources, both public and private. Chapter 4 details the financial instruments that are used in the EU. It is important to introduce here the five main categories for mobilisation of private co-financing:

- EU programmes: This includes programmes such as the Recovery and Resilience Facility, cohesion funds, InvestEU, Horizon Europe and many more.

- De-risking investments: The EU has a structured dialogue with the finance industry to de-risk energy efficiency financing and make private investments more attractive. The Energy Efficiency Financial Institutions Group (EEFIG) is one such approach. Horizon Europe has financed many de-risking projects such as TrustEE[7].

- Innovative financing: The EU supports the development and scaling up of innovative energy efficiency financing products and schemes. Innovations include one-stop shops, a guarantee facility, and projects funded by Horizon 2020 and Horizon Europe.

- Capacity building and technical assistance: The EU supports energy efficiency projects and initiatives, from idea to implementation, by financing legal, technical and financial support. These have been offered to cities, individuals or businesses that need assistance to take their energy efficiency projects from idea to implementation.

- Building renovations: Many of the programmes mentioned above focus on the renovation of buildings to help achieve the region's long-term objectives. Financial instruments provided by EU Member States, the European Investment Bank (EIB) and the EU itself, are used to help address financial and investment gaps.

2.1.2 The Importance of Buildings

The importance of buildings in the EU's long-term climate and energy objectives is well expressed in the 2018 revision of the EPBD (2018/844/EU). It is worth quoting the seventh paragraph in full[8]:

'The 2015 Paris Agreement on climate change following the 21st Conference

7 This is now active in the European market and had initial funding from Horizon Europe. https://www.trust-ee.eu/

8 https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018L0844&from=EN

of the Parties to the United Nations Framework Convention on Climate Change (COP 21) boosts the Union's efforts to decarbonise its building stock. Taking into account that almost 50% of the Union's final energy consumption is used for heating and cooling, of which 80% is used in buildings, the achievement of the Union's energy and climate goals is linked to the Union's efforts to renovate its building stock by giving priority to energy efficiency, making use of the "energy efficiency first" principle as well as considering deployment of renewables.'

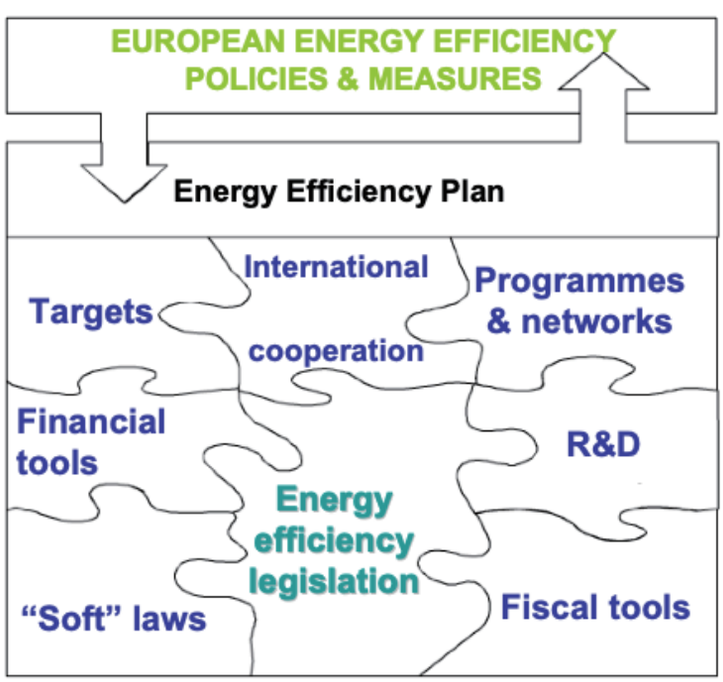
This one paragraph explains why buildings are so important in the EU's climate and energy strategies. Altogether, buildings represent around 36% of the EU's GHG emissions and about 40% of energy consumption. If 2030 and 2050 targets for GHG emissions reductions are to be achieved, building efficiency has to be addressed. This includes renovation of existing buildings and construction of mandated highly-efficient nearly zero-energy buildings from now on. The challenge is that there are currently approximately 240 million buildings of which between 75% and 97% need renovating to a high standard if they are to be carbon neutral by 2050.

How this work will be financed will be addressed later in this report.

It is worth taking a look at the overall buildings policy framework and the various EU-wide initiatives.

The diagram below shows how the complex policies and measures currently in place fit together. Many of these are outside the scope of this paper but it does illustrate what many refer to as the puzzling world of energy efficiency policy in the EU.

Figure 2.1: European energy efficiency policies and measures



Source: Presentation by R. Janssen, Santiago, Chile, December 2018, adapted from Paul Hodson, former DG ENER head of unit.

The legislative framework includes three main framework directives that are intended to drive improvements to the energy performance of new and existing buildings9:

- **Energy Performance of Buildings Directive (EPBD)**[10] – this establishes a legislative framework that will help the EU achieve a highly energy-efficient and decarbonised building stock by 2050; it creates a stable environment for investment decisions and enables consumers and businesses to make more informed choices to save energy and money.

- **Energy Efficiency Directive (EED)**[11] – this establishes a set of binding measures to help the EU meet its 2030 energy efficiency targets. Several of the obligations relate to the energy performance of buildings.

- **Renewable Energy Directive (RED)**[12] – this sets rules for the EU to achieve its 32% renewables target by 2030. There is a core interest in heating or cooling from renewables.

These three directives are currently being revised to raise the level of ambition and help improve implementation.

2.2 Existing Buildings

The European Energy Performance of Buildings Directive (EPBD) includes some articles on technical aspects relating to existing buildings and, since the 2018 revision of the Directive, requires Member States to prepare long-term renovation strategies (LTRS) to support the renovation of their national building stock into a highly energy efficient and decarbonised sector by 2050. The European Commission stresses that long-term renovation strategies must be underpinned by a solid financial component (effective use of public funding, aggregation, de-risking)[13]. The Member States last updated their LTRS in 2020.

In December 2021, the Commission proposed a review[14] of the current framework within the revision of the Energy Performance of Buildings Directive[15] (EPBD) and suggested replacing the LTRS with more demanding ‹Building Renovation Plans›. These national plans should be submitted every five years, following the submission of a draft plan, and should have clear and specific chapters, based on a common template. In an approach that will make it easier to compare progress, the plans should include national targets (instead of indicative milestones), an outline of the investment needs for their implementation and an overview of policies and measures.

Building renovation plans are to be aligned with the Governance Regulation Framework but will be better synchronised with the national energy and climate plans.[16]

9 A framework directive sets overarching objectives and targets to be achieved by means of a set of measures that are coherent and mutually reinforcing. It gives Member States flexibility to implement measures in accordance with their own national context.
10 https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en
11 https://ec.europa.eu/energy/topics/energy-efficiency/targets-directive-and-rules/energy-efficiency-directive_en
12 https://ec.europa.eu/energy/topics/renewable-energy/renewable-energy-directive_en
13 https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/long-term-renovation-strategies_en
14 https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_6686
15 https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en
16 https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en

To support the LTRS, the European Commission launched the Renovation Wave Strategy in October 2020[17]. This is an important new policy initiative to renovate 35 million buildings between 2020 and 2030.

The Renovation Wave Strategy includes:

- Stronger regulations, standards and information on the energy performance of buildings to set better incentives for public and private sector renovations.

- Ensuring accessible and targeted funding, including through the 'Renovate' and 'Power Up' flagships in the Recovery and Resilience Facility under NextGenerationEU, simplified rules for combining different funding streams, and multiple incentives for private financing.

- Increasing capacity to prepare and implement renovation projects, from technical assistance to national and local authorities through to training and skills development for workers in new green jobs.

- Expanding the market for sustainable construction products and services.

- Creating a new European 'Bauhaus', an interdisciplinary initiative co-steered by an advisory board of external experts from business, public administration, science, research and innovation, culture, citizen engagement, and civil society organisations.

- Developing neighbourhood-based approaches for local communities to integrate renewable and digital solutions and create zero-energy districts, where consumers become prosumers selling energy to the grid.

The challenge in Europe is to mobilise all the varied aspects to ensure about 3.5 million buildings can be renovated each year to reach the overall target of 35 million by 2030. One of the major problems is that currently only about 1% of building stock is currently being renovated and the average renovation achieves energy performance improvements of between 9% and 17%. The European Commission estimates that there is an annual green investment gap of up to EUR 275 billion.

2.3 Accelerating High Energy-Performing New Build

The Energy Performance of Buildings Directive (EPBD) has been revised three times since 2002 to ensure new buildings become near zero-energy buildings. The EPBD covers a broad range of policies and supportive measures (such as energy performance certificates) that will help national EU governments boost the energy performance of new buildings. The EPBD is currently being revised and includes a number of new proposals to improve building efficiency.

The relevant elements for new buildings are as follows:

17 https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1835

- EU countries must set cost-optimal[18] minimum energy performance requirements for new buildings.

- All new buildings must be nearly zero-energy buildings (NZEB) from 31 December 2020. Since 2019, there has been a requirement for all new public buildings to be NZEB.

- Electro-mobility is supported by introducing minimum requirements for car parks over a certain size and other minimum infrastructure for smaller buildings.

- An optional European scheme for rating the 'smart readiness' of buildings has been introduced.

- Smart technologies are promoted, including through requirements on the installation of building automation and control systems, and on devices that regulate temperature at room level.

- The health and well-being of building users are prioritised, for instance by setting standards for air quality and ventilation.

As mentioned above, the EPBD is being revised and the elements will change[19].

For China, it is important to understand that it is already a requirement for all of the EU to have nearly zero-energy buildings. This concept was introduced into the 2010 revision of the EPBD. The near-zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources. The EPBD essentially provides principles for Member States to use when defining NZEBs in their own context. This concept applies to buildings in all sub-sectors (residential, commercial, institutional/public). This has avoided a requirement for passive design but has given considerable leeway to Member States to define their own approach, within certain parameters.

2.4 Other Policy Initiatives to Improve Building Energy Performance

There are other initiatives to facilitate the improvement of the energy performance of buildings, both new and existing. These play a key role in mobilising support for such improvements. The measures described below exclude measures to encourage investment. Those will be discussed separately.

- **Renovate Europe**[20] – a political communications campaign with the ambition to reduce the energy demand of EU building stock by 80% by 2050 through legislation and an ambitious renovation programme. Launched in 2011, Renovate Europe is an initiative of the European Alliance of Companies for Energy Efficiency in Buildings (EuroACE), and enjoys the support of 47 partners

18 https://ec.europa.eu/energy/topics/energy-efficiency/energy-performance-of-buildings/energy-performance-buildings-directive/eu-countries-2018-cost-optimal-reports_en?redir=1

19 https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_6686

20 https://www.renovate-europe.eu/

from industry and civil society and 17 partners active at a national level. It is the only EU-wide campaign that focuses exclusively on the ambitious renovation of the building stock in the EU.

- **Concerted Action EPBD**[21] – This aims to contribute to the reduction of energy use in European buildings, through the exchange of knowledge and best practices in the field of energy efficiency and energy savings between all 27 EU Member States plus Norway. The CA EPBD is a joint initiative between the EU Member States and the European Commission. It involves representatives of national ministries or affiliated institutions who are in charge of preparing the technical, legal and administrative framework for the Energy Performance of Buildings Directive in each EU Member State, plus Norway. The objective is to enhance the sharing of information and experiences from national adoption and implementation of this important European legislation. One of its work streams is on finance. There are other Concerted Actions for the Energy Efficiency Directive[22] and the Renewable Energy Directive[23]. These also cover some aspects of improving the energy performance of buildings.

- **Build Up - The European Portal for Energy Efficiency in Buildings**[24] – this interactive web portal provides access to a wide range of information on implementing the EPBD. It was created in 2009 to support EU Member States to implement the EPBD. The web portal targets professionals working in the building sector (public or private) with an interest in the latest developments at technical or practice level, policy legislation, financial issues, etc related to energy efficiency. There are 16 170 members worldwide, including several from China.

21 https://epbd-ca.eu/
22 https://www.ca-eed.eu/Homepage
23 https://www.ca-res.eu/
24 https://www.buildup.eu/en

3. Building Energy Efficiency in China

3.1 Policy Framework and Importance of Building Energy Efficiency

3.1.1 Introduction

As traditional fossil energy sources become depleted, an energy crisis looms, and therefore solutions are vital. Such solutions entail strengthening the development and utilisation of new energy sources and cutting costs, which means using energy sparingly and improving the efficiency of energy utilisation. The building sector is one of the three major 'energy consumers' in China, and is therefore central to the country's energy-saving transformation.

China adds about 2 billion m^2 of new construction area each year, nearly half of the total annual construction volume worldwide. The end-user energy consumption of the building sector is roughly equivalent to the industry sector and transportation sector. However, from the perspective of life-cycle energy consumption (LCEC), the building sector is the highest of all sectors. Between 2005 and 2020, the LCEC of the building sector[25] rose 2.4 times with an annual growth of 6%. In 2020, the LCEC of building sector was 2.27 billion tonnes of coal equivalent (tce), accounting for 45.5% of national total energy consumption. Among them, the energy consumption of building material production was 1.11 billion tce, or 22.3% of national total energy consumption. The energy consumption of building construction was 0.09 billion tce (1.9% of national total energy consumption) The energy consumption of building operations was 1.06 billion tce (21.3% of national total energy consumption) [26].

Therefore, improving building energy efficiency is key to sustainable social development and China's 2060 carbon neutrality goals.

3.1.2 Overall Policy Framework in the 14th Five-Year Plan Period

In order to meet the goal of peaking CO_2 emissions before 2030, the building sector must improve its energy efficiency and reduce energy consumption. Therefore, five key areas have been identified in the 14th Five-Year Plan Building Energy Conservation and Green Building Development Plan (2021-25):

- **Existing buildings:** Continue to renovate more than 350 million m^2 of existing buildings, including 100 million m^2 of existing residential buildings, and 250 million m^2 of existing public buildings.

25 Full-process energy consumption of building sector includes energy consumption for building material production, building construction, and building operation.

26 China Building Energy Consumption and Carbon Emissions Research Report, China Association of Building Energy Efficiency, 2022.

- **New buildings:** Build more than 50 million m^2 of ultra-low-energy buildings (ULEB), and Nearly Zero-Energy Buildings (NZEB). Improve the proportion of prefabricated buildings to 30% of new buildings in urban areas.

- **Electrification in buildings:** Increase the proportion of electricity in the building energy consumption to more than 55%; increase renewable energy utilisation by 8%; develop more than 50 GW additional PV capacity, as well as adding 100 million m^2 of geothermal heating in buildings.

- **Implementation and supervision:** Strengthen energy efficiency standards of buildings and building materials. In 2025, new urban buildings will fully comply with the current China Green Building Rating Standards (GB/T 50378-2019)[27].

Overall, the policy framework relating to building energy efficiency in the 14th Five-Year Plan is comprehensive and aims to promote the transformation and upgrading of the building sector towards sustainable development. The implementation and effective supervision of these policies and associated financial measures are crucial to achieving the targets set in the 14th Five-Year Plan.

3.2 Existing Buildings

Energy efficiency renovation of existing buildings refers to the renovation of existing residential and public buildings that do not meet the requirements of building energy efficiency standards, according to the climatic regions in which they are located. Energy efficiency renovation is defined as the process of modifying the building envelope (including walls, windows and doors, etc.), heating and air-conditioning systems, so that their thermal performance and the efficiency of the energy supply system meet the requirements of the corresponding energy-saving building design standards.

China is in a period of rapid urbanisation and the construction industry in both urban and rural areas is developing rapidly. As outlined above, buildings use a lot of energy and natural resources during their construction and operation, which has a significant negative impact on the environment. Although China's construction industry is large overall, its economic efficiency is low. The amount of existing construction space in China is significant and makes up a significant portion of the country's total construction area when compared to newly developed space. Due to the constraints of the prevailing design standards, the level of economic development and other conditions, most existing buildings have problems such as high energy consumption, poor functional use and weak disaster resilience. It is unrealistic to demolish all such buildings: this approach would represent a waste of resources and would also cause serious environmental problems. However, action on building renovation relates to the safety of people's lives and property as well as the implementation of resource-saving, environment-friendly public policy and sustainable development. Therefore, the renovation of existing buildings has become an important part of the building sector.

27 English version of China Green Building Rating Standard (GB/T 50378-2019) http://www.ccpitbuild.org/d/file/p/2021/10-25/e2da141382212b3075a3a8293d609958.pdf

3.2.1 Current Status of Existing Building Renovation

China has made significant progress over the past decade, with a strong focus on improving energy efficiency and indoor environmental quality in existing public and residential buildings. This commitment to building renovation can be traced back to the 11th Five-Year Plan[28], which kicked off the campaign to renovate old and deteriorating buildings. Since then, a series of supportive policies and regulations have been put in place to incentivise building renovation, such as the 12th Five-Year Plan for Building Energy Conservation, the Green Building Action Plan, and the Green Buildings Renovation Demonstration Project.

To support building retrofits, China has also implemented various financial incentives and subsidies to boost building renovations that achieve higher energy efficiency levels than the national standard. In addition, the government has launched the Energy Performance Contracting (EPC) model, which allows building owners to outsource building renovation to energy service companies (ESCOs) and pay for the renovation through energy savings over time.

Since the start of its building renovation programme, China has been through four different approaches:

- Large-scale demolition and construction.
- Renovation of dangerous buildings.
- Renovation of old housing.
- Combining renovation and conservation.

Between 2005 and 2020, China renovated over 1.6 billion m^2 of existing buildings. The focus of residential building renovation has gradually shifted from ensuring winter heating in the northern regions to enhancing housing comfort in the summer-hot and winter-cold regions of the south. In the 11th Five-Year Plan, 182 million m^2 of residential buildings in northern China regions were renovated, resulting in 2 million tce energy savings per year. During the 12th Five-Year Plan, China in total renovated 990 million m^2 of residential buildings in northern regions and 70.9 million m^2 of existing residential buildings in southern regions where it is hot in summer and cold in winter. Subsequently, 514 million m^2 of residential buildings were renovated in the 13th Five-Year Plan period.

So far, China has launched three batches of key public building renovation projects in 32 cities. As a result, the country has implemented public building renovations covering a total area of 295 million m^2, which could save 1.15 million tce per year. To support these efforts, the Ministry of Housing and Urban-Rural Development (MOHURD), in collaboration with the Ministry of Finance and National Development and Reform Commission (NDRC), has developed an online system to monitor energy consumption for large public buildings, and gradually expanded it to medium and small public buildings. By the end of 2021, 18 000 public buildings in 33 provinces and cities were included in this system[29].

28 Notice on Issuing the 11th Five-Year Plan on Building Energy Conservation, Ministry of Housing and Urban-Rural Development (MOHURD).
29 14th Five-Year Plan on Building Energy Conservation and Green Building Development Plan, MOHURD, 2022

3.2.2 14th Five-Year Plan Policy Framework on Existing Building Renovation

Following the successful progress made over the past decade, the 14th Five-Year Plan aims to further strengthen existing building renovation through a set of specific targets and measures.

The target for residential building renovation is for it to rise to over 100 million m^2 by 2025, though the focus on building renovation varies by the regions and climate zones. In severe cold and cold regions of northern China, key measures for renovation include improving user-side energy efficiency in buildings, heat preservation in the heating pipe network, and the development of building energy management systems. In the southern regions, building renovation will focus on indoor comfort such as air conditioning and ventilation. In rural areas and older residential buildings, renovation will focus on the purchase of high-energy-efficiency products, replacing doors and windows, air conditioners, wall-hung boilers and other parts in the building.

While public buildings renovation is set to affect over 250 million m^2 of buildings during the 14th Five-Year Plan, a big difference this time is the introduction of an electricity usage allowance for public buildings which will force public buildings to conduct renovation and reduce their energy consumption. Building on the online energy consumption monitoring system established in the 13th Five-Year Plan, more public building will be connected to this system. China is set to further strengthen its energy audit and enforcement regulations, and intends to disclose public building energy consumption to the public as a means of social supervision. Public building renovation in the 14th Five-Year Plan places an emphasis on the development of smart energy management systems such as optimised energy consumption controlling strategies, and the renovation of building envelopes, heating and air conditioning systems, electrical systems, LED lighting systems, and intelligent elevator control systems.

By 4 March 2023, Guangdong, Guizhou, Anhui, Jiang Su, Shanxi, Shenzhen, Tianjin, Chongqing, Dalian, and Hohhot[30] had formulated their own regional 14th Five-Year Plan targets in order to promote the renovation of existing buildings, taking into account their own regional characteristics.

3.2.3 Supporting Measures

To support the acceleration of existing building renovation, China plans to introduce a series of measures to support building renovation during the 14th Five-Year Plan. These measures include the revision of national mandatory standards such as the Technical Specifications for Existing Residential Building Energy Conservation and Renovation, the Technical Specifications for Public Buildings Energy Conservation and Renovation, and the General Specifications for Building Energy Conservation and Renewable Energy Utilisation. These updated standards will raise the requirements and subsidy thresholds for existing building renovation.

The Ministry of Finance (MOF) will continue to provide tax incentives for building renovation projects, with the first three years exempt from corporate income tax and

30 The official websites of local governments.

the fourth to sixth years subject to a 50% reduction in tax. However, the incentives depend on compliance with the three standards above. In addition, the MOF has launched a Special Fund for Affordable Housing which provides monetary support for building renovation. The scale of funding available for specific renovation projects is calculated based on the renovated surface area, number of households, number of buildings, and the number of renovated communities.

3.3 New Buildings

3.3.1 Current Status of New Building Energy Efficiency

The evolution of new building energy efficiency regulations in China can be traced back to the 1980s. The former Ministry of Construction prioritised the work on building energy efficiency improvement by region and building type: northern first (cold and cold regions), then central (hot summer and cold winter regions) and southern (hot summer and warm winter/moderate regions); residential buildings first, then public buildings; new construction first, then renovation. Priority was given to residential buildings above public buildings, and to new construction above renovation projects. This approach led to the development of current building energy efficiency standards covering five climate zones and the whole building construction process.

In 1998, the Energy Conservation Law introduced the concept of building renovation for the first time. This law, which was updated in 2007, laid the legal foundation for promoting energy-efficient building design and construction.

By 2005, just before the start of 11th Five-Year Plan, the concept of green buildings was introduced and became widespread in China. Following implementation of the voluntary Green Building Evaluation Standard (GB/T 50378-2006) in 2006, China gradually developed a green building rating system suitable for its own national context. Green buildings are rated with one to three stars against various indicators such as maintenance structure, sound insulation performance, and energy efficiency. The Green Building Rating Standard was updated in 2014 and 2019. Due to the pressure of carbon peaking, the one-star green building standard has become a mandatory requirement for new buildings in many cities.

On top of the green building rating system, China introduced new concepts including ULEB, NZEB, zero-energy buildings (ZEB) and prefabricated buildings. ULEB, NZEB and ZEB standards in China were based on the EU passive house. In 2016, the State Council published Opinions on Further Strengthening Urban Planning and Construction Management, proposing to 'support and encourage develop green and energy-efficient buildings such as passive houses, taking into account natural climatic characteristics'. In the following year, the 13th Five-Year Plan on Energy Efficiency and Green Development of Buildings, the 13th Five-Year Plan for the Development of Building Sector, and the 13th Five-Year Plan for Construction Science and Technology Innovation clearly identified the importance of ULEB and NZEB development. Therefore, the Technical Guidelines for Passive Ultra Low Energy Green Buildings (2015) and the Technical Standard for Near-Zero Energy Buildings (GB/T 51350-2019) defined the concepts of ULEB, NZEB, and ZEB. The two standards specify binding indicators including indoor environmental parameters and building energy consumption

indicators. They propose corresponding technical performance indicators, technical measures and evaluation methods, and develop near zero-energy building calculation and evaluation tools.

In general, the ULEB, NZEB, and ZEB concepts emphasise local natural conditions and climatic characteristics in building design, specifying a building envelope that has good airtightness and thermal insulation properties to provide a comfortable indoor environment for users while also minimising energy consumption. They represent different energy-saving stages for the building industry, with ZEB being the most challenging to achieve, followed by NZEB and ULEB. The energy consumption of ULEBs and NZEBs are respectively more than 50% and 75% lower than the current mandatory standards for new buildings. These are: Design Standard for Energy Conservation of Public Buildings (GB 50189-2015), Design Standard for Energy Conservation of Residential Buildings in Severely Cold and Cold Areas (JGJ 26-2018), Design Standards for Energy Conservation of Residential Buildings in Hot Summer and Cold Winter Areas (JGJ 134-2016), and the Hot Summer and Warm Winter Areas Design Standard for Energy Conservation of Residential Buildings (JGJ 75-2012). The ULEB standard does not include a renewable energy requirement, while NZEB and ZEB require more than 10% renewable energy integration in the building design.

The development of ULEB and NZEB construction is still in its infancy. During the 13th Five-Year Plan period, a series of policies were put together by central and provincial governments to promote the development of ULEB and NZEB. Following 50 demonstration projects in four climate zones, ULEB and NZEB development is transitioning from demonstration to scaling up, but technical aspects such as standards, evaluation, and monitoring need further optimisation to better suit the varying needs for different climate zones and building types. By the end of 13th Five-Year Plan period in 2020, 23 724 new building projects had been labelled as green buildings. Among new buildings, the proportion of green buildings accounted for 63% with the accumulated construction surface exceeding 2.43 billion m^2. The cumulative construction surface of ULEB and NZEB reached 10 million m^2 [31].

Prefabricated building is an efficient and energy-saving building option, and therefore many cities are promoting a combination of green and prefabricated buildings. The total area occupied by prefabricated buildings in China reached 1.6 billion m^2 in 2020, with an average annual growth rate of 54% during the 13th Five-Year Plan period (2016-20). In 2021, prefabricated buildings accounted for 20.5% of new building construction[32].

ZEB are still at the demonstration stage. The Nanjing Green Lighthouse is one of the best-known such projects. This is a collaborative demonstration project between China and Denmark, inspired by the Green Lighthouse in Copenhagen. The building features full-angle lighting from the top and all sides, achieved through sustainable and innovative architectural design methods. It will be used as an exhibition hall for a high-tech industrial park. The building's energy consumption is 60% lower than the current mandatory standards and maximises renewable energy generation to meet 20% of the building energy demand.

31 https://www.ndrc.gov.cn/xwdt/ztzl/2021qgjnxcz/bmjncx/202108/t20210827_1294904.html

32 Press Conference of the State Council Information Office on the Opinions on Promoting Green Development of Urban and Rural Construction.

3.3.2 14th Five-Year Plan Policy Framework on New Building Energy Efficiency

The 14th Five-Year Plan aims to establish a solid foundation for achieving carbon peaking in the urban and rural construction sector before 2030. China intends to build more than 50 million m^2 of ULEB and NZEB, with prefabricated buildings accounting for 30% of new buildings in urban areas. The ambition for development of ULEB and NZEB is five times higher than the 13th Five-Year Plan target. Four key actions are identified to achieve the ambitious targets:

- Green Building Creation Action (second phase). Following the first phase in 2018-20, the second phase starts with the application of green standards to new residential buildings, then widens its scope to all new buildings in the urban area to achieve full compliance with green building standards by 2025.

- 3-star Green Building Rating Scheme Promotion Action. This adopts a 'mandatory + voluntary' model to promote the 3-star Green Building Rating Scheme. It is intended to increase the proportion of 3-star green buildings in government-invested public buildings. It encourages local governments to develop policy incentives such as green finance facilitation and floor area ratio incentives.

- ULEB Promotion Action. The project focuses primarily on relatively developed regions, such as the Beijing-Tianjin-Hebei and the Yangtze River Delta, and encourages local governments to invest in ULEB and NZEB.

- High-Performance Doors and Windows Promotion Action. This promotes the installation of high-performance doors, windows, and shading facilities to improve building energy efficiency. It will also include a technical analysis that will devise higher energy efficiency standards for doors and windows.

3.3.3 Supporting Measures

In support of green building initiatives, the State-owned Assets Supervision and Administration Commission (SASAC) will also collaborate on the Green Building Creation Action. All newly-constructed public buildings will be required to meet or exceed the 1-star threshold set by the Green Building Evaluation Standard (GB/T 50378), while larger public institution buildings will be encouraged to meet or exceed the 2-star building standard.

Updated buildings standards have been updated in the 14th Five-Year Plan, to foster promotion of green buildings, ULEB and NZEB. These include the following measures:

- The national mandatory standard General Code for Building Energy Conservation and Renewable Energy Utilisation (GB 55015-2021) which took effect in April 2022. This standard further improves energy efficiency in new residential and public building design by 30% and 20% respectively on top of the current national and building industry energy efficiency design standards. For residential buildings, building energy efficiency should be above 75% and 65% respectively in very cold and cold areas as well as other climate zones. Energy efficiency in public buildings is required to exceed 72%.

- The updated national standard Residential Building Performance Evaluation (GB/T 50362-2022) came into effect in February 2023. The revised standard includes new provisions related to building new technologies, products, and other pertinent aspects. It enhances the assessment weighting of building energy consumption.

- Other relevant standards are under revision/planned to be revised in the 14th Five-Year Plan. These include:

    - Code of Practice for the Operation and Management of Air-conditioning and Ventilation Systems (currently under revision).
    - Technical Specification for Ground Source Heat Pump Systems (currently under revision).
    - Architectural Lighting Design Standard (currently under revision).
    - Energy Conservation Design Standard for Public Buildings (GB 50189-2015).
    - Residential Building Energy Consumption Standard (GB/T 51161-2016).
    - Thermal Design Code for Civil Buildings (GB 50176-2016).
    - Design Code for Heating Ventilation and Air Conditioning in Industrial Buildings (GB 50019-2015).
    - Building Light Design Standard (GB 50033-2013).

At a regional level, most provincial and urban authorities have developed their own 14th Five-Year Plans to promote green buildings, ULEB and NZEB. In general, the policies include overall targets on the proportion and total surface of green buildings in urban areas, with sub-targets on the proportion and total surface of star-rated green buildings and ULEB respectively, as well as the number of NZEB and smart building demonstration projects. The results show that the cumulative ULEB and NZEB regional targets have exceeded the national 14th Five-Year Plan target of 50 million m^2, reflecting the top-down pressure to achieve carbon neutrality goals. Some provinces and cities have even developed medium- to long-term plans for ULEB and NZEB development up to 2030 or 2035, such as Hubei, Guangzhou, and Hangzhou, indicating the local governments' determination to lead in this area..

4. Building Energy Efficiency Financing in Europe

4.1 Introduction to Financing Energy Efficiency Across Europe

The EU has extensive experience in implementing financial and fiscal instruments that support the uptake of energy efficient buildings. There are many forms and types of financial mechanisms that support this uptake and many different market players who are making changes. These instruments originate from different sectors of society: directly from the European Commission, institutional investors, EU banks, local and national banks, investors, local and national authorities and governments, and from individual investments. Often funding sources are coupled, for example, *inter alia*, EU structural funds linking with banks, institutional investors with local authorities, bank financing supporting energy services, or national funds leveraging individual investment. To give an idea of the scope of financial instruments across Europe, the Joint Research Centre (JRC) of the European Commission has identified a total of 129 continuing public financial and fiscal schemes that support energy renovations, of which 61% are in the form of grants and subsidies, 19% are soft loans, 10% are tax incentives and the remaining 10% are a combination of the above[33].

Different sectors support energy efficiency measures in various ways. For buildings to support the energy transition to net zero energy efficiency, appropriate financing is needed from a wide range of public and private sector sources[34]. The public sector, national and local governments and the EU largely base their support on financial incentives to support and encourage investment in energy efficiency. Public funds are used to address market failures and Member States deploy various public financing instruments in order to address these failures. Banks now see the investment case for energy efficiency and are beginning to develop their own mechanisms, such as energy efficiency mortgages and covered bonds to aggregate energy efficiency projects and make them attractive to institutional investors. This is critical for developing energy efficiency projects at scale: meeting the net zero 2050 target will rely on private sector investment as well as public finance. There is a growing recognition that for institutional investors to invest in energy efficiency, projects need to be de-risked using supporting mechanisms such as project aggregation, guarantees and securitisation.

A map of the financial landscape for energy efficient buildings in Europe has been developed for this report, highlighting that a vast range of financing is available in Europe – from well-established traditional mechanisms such as grants, subsidies and loans to more innovative mechanisms such as on-bill finance models and energy service contracts. For the purpose of this report, the activities within the European finance sector have been broken down into five sections:

33 Marina Economidou et al, Accelerating energy renovation investments in buildings, Joint Research Centre, 2019.

34 Concerted Action Energy Efficiency Directive, Funds and financing for energy efficiency, 2016. Access: https://www.ca-eed.eu/ia_document/core-theme-series-report-funds-and-financing-january-2013-to-october-2016/

- Traditional market instruments - fiscal instruments, subsidies and grants and loans.

- EU financial tools bridging the market gap - Multiannual Financial Framework (MFF), InvestEU, NextGenerationEU (NGEU) and the Recovery and Resilience Facility (RRF), EU Renovation Loan (ERL), The European Fund for Strategic Investments, European Renovation Financing Facility, European Structural and Investment Fund, EU Cohesion Policy, Smart Finance for Smart Buildings Initiative, and project development assistance – European Local Energy Assistance (ELENA), sustainable energy financing facilities.

- Banking instruments - Energy Efficiency Mortgages and Energy Efficiency Covered Bonds, Private Finance for Energy Efficiency (PF4EE).

- Institutional investor instruments - De-Risking Financial Initiatives and Securitisation.

- Innovative Finance Tools - EU Sustainable Taxonomy, Energy Performance Contracting, On-Tax Financing, One-Stop Shops and Carbon Emission Trading.

- The following sections will describe each mechanism and how they are used within the European context of upscaling energy efficiency.

4.2 Traditional Market Instruments

Driven and supported by policies and banking, traditional financing mechanisms have been instrumental in demonstrating the benefits of energy efficiency measures from both a political and commercial perspective. The three funding mechanisms that are traditionally used across the EU are fiscal instruments, subsidies and loans. These tools are straightforward and have been shown to be effective when it comes to individual buildings, though they do not always achieve the demand necessary to drive investments at scale.

4.2.1 Fiscal Instruments

Tax incentives increase the demand for energy efficient building projects by reducing the cost of a project by means of reduced taxes for households and businesses. If the tax collection rate in a country or region functions well, the likelihood of the fiscal scheme working is increased and can even be used to promote new efficient technologies that are less profitable in the early stages of development. Tax incentives can be found in various forms, such as accelerated depreciation, tax exemptions, income tax or Value Added Tax (VAT) reduction. The three main types of tax incentive are:

- Income tax credits/deductions. These represent the most common type of tax incentive across Europe whereby income tax is either credited or deducted based on efficiency measures being undertaken.

- Property taxation. This type of taxation links a building's energy class or label with the property itself and property tax levels are increased or decreased depending on the efficiency of the building.

- VAT reduction schemes. These offer lower VAT rates when various energy efficiency intervention measures are purchased or installed – thus providing the consumer with purchasing power to select the most efficient product or material.

4.2.2 Subsidies and Grants

Grant and subsidy schemes are established by a state or a public body to help ensure energy efficient buildings are adopted, developed or renovated by households or businesses. They keep the price of efficient products or installations low by subsidising part of or all of the cost of efficiency measures. Grants and subsidy schemes are useful in stimulating energy efficiency by reducing the high upfront costs and hence shift the market towards efficient products and installations. These subsidies tend to cover measures such as efficient materials or equipment, advice, certification and installation. The grants offered by Member States vary significantly from a few thousand to over EUR 1 million, depending on the scheme and the level of efficiency. If the efficiency of the building is not fully covered by the subsidy or grant scheme the remaining costs are either self-financed or covered by a loan.

4.2.3 Loans

The loan is a common financial mechanism involving a financial institution lending money to an individual or organisation to pay for efficient materials or installations. Loans are seen as important market levers as they can provide direct access to capital. The financial institution sets a reimbursement period with scheduled transfers making them easy to manage. Loans can either be secured or unsecured (if secured, it means they are backed by assets) although energy efficiency loans tend to be unsecured loans with varying interest rates. In order to make loans attractive, they are often coupled with subsidies from governments to cover interest on the loan. EU or national funding schemes have been set up as revolving funds, allowing such schemes to continue thanks to borrower repayments which constantly replenish the fund.

4.3 EU Financial Tools Bridging the Market Gap

The amount of public EU funds made available for energy efficiency has increased in order to support the transition to a clean energy system and decarbonisation by 2050. That said, in order to decarbonise, private sector funding needs to be unlocked and mobilised to overcome market failures. An additional EUR 275 billion per year is needed over the period 2021-30 to meet the energy and climate objectives of EU's Renovation Wave Strategy for 2030. The Strategy's objectives are to at least double the EU's renovation rate annually and foster deep energy renovations, resulting in the

renovation of 35 million building units (residential and non-residential) by 2030.

To secure full engagement with the public sector, the EU has developed frameworks, conditions and funds to ensure that private funding streams are developed and market conditions are triggered. These tools are intended to stimulate a fully sustainable efficiency market that is assured by public finance which offers reduced investment risks. This section is divided into two parts:

- Part One. Tools that are currently used by the EU institutions (legislation, funding initiatives/programmes, financing and financial instruments).

- Part Two. Tools and innovative solutions that are used or proposed in Europe but that are not (yet) endorsed or used by EU institutions.

4.3.1 Tools That Are Currently Used by the EU

a. Multiannual Financial Framework (MFF) 2021-27

The EU has released a seven-year framework running between 2021-27 called the Multiannual Financial Framework (MFF), which includes provisions to support the EU in a short-term economic recovery and a green and digital future. The total MFF budget is EUR 1.211 trillion[35] which is being combined with several financial mechanisms to harness change. Within this budget, there are funds dedicated to building energy efficiency measures. Financial mechanisms that support energy efficiency renovations found under and supported by the MFF include InvestEU – an investment support mechanism; NextGenerationEU (NGEU) – a temporary European recovery instrument; and the Recovery and Resilience Facility (RRF) – a loan and grant making programme. These mechanisms are instrumental in funding deep renovations across Europe and are described in the following sections.

b. InvestEU

InvestEU is one of the largest recent targeted EU financial instruments that supports building renovations. Its implementation period runs between 2021 and 2027. It is designed to centralise EU funding (combining 13 centrally managed EU financial instruments) in order to deliver on EU policy objectives, minimise overlaps and synergise existing mechanisms. InvestEU's goal is to provide access to public funding and make this simpler, more efficient and more flexible by establishing an advisory hub and a comprehensive project database.

InvestEU is the EU's main instrument to leverage private investment, therefore has the potential to lead investment towards net zero greenhouse gas emissions and climate resilience, consistent with the Paris Agreement. The proposed InvestEU budget guarantee is EUR 26.2 billion. It aims to mobilise EUR 650 billion of public and private investment over the budget period of 2021-27 in four areas: sustainable infrastructure; research, innovation and digitalisation; social investment and skills; and SMEs. The InvestEU guarantee is implemented in partnership with selected

35 Buildings Performance Institute Europe (BPIE), Report on the evolution of the European regulatory framework for buildings efficiency, Brussels, 2022. Access: https://www.bpie.eu/wp-content/uploads/2022/02/rev6_SPIPA_EU.pdf

financial partners, or 'implementing partners'.

The sustainable infrastructure area includes energy efficiency, building renovation and the integration of buildings-connected energy sources. In order to support this, InvestEU deploys financial products that allow public authorities or energy service companies (ESCOs) to access finance through guaranteed loans blended with grants to secure longer-term investments. For example, the programme will enhance the supply of green mortgages by allocating a EUR 5 billion guarantee (via the European Renovation Financing Facility) that is intended to mobilise EUR 50 billion investments attracting a mass-market finance product to be used for renovations when a building is sold or re-mortgaged. This funding will be used to reduce the risk for mortgage lenders so that they cover the costs of the building works but with at the same low interest rate and with the same long-term conditions of a standard mortgage.

c. NextGenerationEU (NGEU) and the Recovery and Resilience Facility (RRF)

NextGenerationEU (NGEU) is an EU recovery instrument that is intended to support Member States by directly financing their own national recovery plans as they emerge from the Covid-19 pandemic. NGEU has a budget of EUR 806.9 billion[36] and is intended to support and reinforce the MFF budget, providing additional funds to be distributed to the Member States in the form of grants and loans. The main programme under NGEU is the Recovery and Resilience Facility, with a budget of EUR 723.8 billion. This makes up 90% of the NGEU fund. This facility aims to mitigate the social and economic impact of the pandemic whilst also looking towards the future to make Europe's societies and economies more '*sustainable, resilient, and better prepared to meet the challenges and opportunities of the green and digital transitions*'.[37]

One of the eight flagships of the project is 'renovation', which is seen as an indispensable tool to support the recovery whilst bringing many co-benefits such as job creation, monetary savings from energy bills and better health. The budget for renovation is available in the form of loans and grants for Member States to use to renovate their building stock to help reach their climate targets. In order to receive this financial support, Member States must submit a national reform programme and a Recovery and Resilience Plan (RRP) that should be in line with the objectives set out in their National Energy and Climate Plans (NECPs). Member States are strongly encouraged to base their renovation plans on their NECPs and their Long-Term Renovation Strategies, making efficiency a top priority in order to access funds. A key feature of the RRPs is to include both investment and reform plans in a holistic approach that bridges policy measures and funding streams to support the uptake of energy efficient renovations.

d. The European Renovation Fund

The Renovation Wave's ambitions, as described above, require a holistic approach to enable the housing, building construction and renovation market and practitioners to mobilise and access funding for the materials and skills needed for such a rapid

36 European Commission, Directorate-General for Budget, The EU's 2021-2027 long-term budget and NextGenerationEU : facts and figures, Publications Office of the European Union, 2021, https://data.europa.eu/doi/10.2761/808559

37 BPIE, op.cit. 2022

change. This means the private sector, Member States, municipalities and local authorities need to work together to develop finance packages for schemes that combine different types of funding mechanisms. Renovations come with a cost risk, significant up-front costs, long payback periods, and split incentives. For years, the energy efficiency sector has struggled to find ways to make renovations desirable, easy and capable of being upscaled. This is why it falls on the EU and its Member States to mobilise all the existing tools, such as bundling funding sources, minimising administration, increasing technical assistance and training and providing a funding guarantee.

The European Renovation Fund is a framework managed at EU level that can be used at a regional or national level to aggregate demand, scale capacity and encourage new business models. It is a fast-track mechanism for renovation project approvals and funding which is open to city authorities as well as social, public and cooperative housing companies to leverage both private and national funding whilst providing technical and tendering assistance.

e. European Fund for Strategic Investments

As part of the transition towards a low-carbon and healthy economy, a joint initiative between the European Commission and the European Investment Bank (EIB) was set up called the European Fund for Strategic Investments (EFSI), which was in effect between 2015 and 2020. The EFSI's purpose was to mobilise private funding for strategic investments. It offered a EUR 16 billion guarantee from the EU budget that was complemented by EUR 5 billion from the EIB's capital, so unlocking an additional EUR 500 billion in mobilised investment over five years. The EFSI fund was able to de-risk energy efficiency projects, accelerate private finance and maximise the effective use of resources. In 2021, it was replaced by InvestEU.

f. European Renovation Financing Facility

In 2020, the Commission proposed a European Renovation Financing Facility (ERFF) with at least EUR 90 billion of EU funding per annum, which is intended to achieve an estimated EUR 350 billion in investments per annum. This fund is linked to the additional funds under the EU Recovery Plan and targets all types of building and a wide range of improvements. The fund is managed centrally and combines EUR 25 billion in grants and EUR 65 billion of guaranteed ring-fenced funds.

g. EU Cohesion Policy

The EU Cohesion Policy is intended to reduce disparities between Europe's regions whilst strengthening economic, social and territorial cohesion. Between 2014-20, over EUR 352 billion was allocated to this initiative, and in the latest period, 2021-27, funding is expected to reach EUR 273 billion[38]. As of 2020, both the European Regional Development Fund (ERDF) (which has existed since 1975) and the Cohesion Fund (CF) (which has existed since 1994) have been brought together to cover the period 2021-27. Regional development investments are allocated via the ERDF and Cohesion Fund. The funds are provided as non-repayable grants, the allocation of which is largely based on GDP per capita as well as youth unemployment, low education level, climate

38 European Parliamentary Research Service, European Regional Development Fund and Cohesion Fund 2021-2027, 2019. Access: https://esifa.eu/wp-content/uploads/2019/06/European-Regional-Development-Fund-and-Cohesion-Fund-2021_2027.pdf

change, and the reception and integration of migrants. The policy supports locally-led development strategies and empowers local authorities to manage the funds.

The Cohesion Policy promotes energy efficiency by mandating a minimum share of each region's ERDF to be invested in measures supporting the shift to a low-carbon economy. The ERDF's main allocation of funding (between 65% and 85%) is directed towards making Europe greener, carbon free and smarter[39]. The CF funding focuses on reducing social disparity and promoting sustainable development through environmental and transport infrastructure. Using these funding streams, countries offer grant-based systems to contribute to the costs of energy renovations. In future, these financial tools are expected to put a greater emphasis on integrated tools for grants and financial instruments, making it easier to combine instruments.

h. Smart Finance for Smart Buildings Initiative

The Smart Finance for Smart Buildings Initiative (SFSB) is an EU initiative that forms part of the 'Clean Energy for All Europeans' package. It includes solutions that enable private financing for energy efficiency to be mobilised so that public funds are used more effectively. The initiative provides assistance to create project pipelines so that the risk perception of financiers and investors is changed. This facility aims to work with financial and legal regulations so that EU, national public and private funds share the investment risk of energy efficient projects and hence make finance options more attractive to beneficiaries. As part of this initiative, a flexible guarantee model is being developed by the Commission with the EIB, primarily at national level. This instrument helps financial intermediaries (such as commercial banks) to develop and deploy attractive financial products for the energy renovations.

i. Project Development Assistance - ELENA

The EC has set up a number of facilities to support the funding of Project Development Assistance initiatives (PDA). These facilities help local authorities to set up and develop sustainable energy projects that are bankable. The European Local Energy Assistance (ELENA) facility project[40], established in 2009, has been a successful PDA and has supported the uptake of energy efficient projects across Europe. It is a joint initiative by the EC and the EIB that provides grants to aid the technical assistance on the implementation of energy efficiency programmes. ELENA covers up to 90% of the technical assistance and project development costs, supporting energy efficiency programmes over EUR 30 million with a three-year implementation period.[41]

4.3.2 Tools and Innovative Solutions That Are Used or Proposed in Europe but That Are Not (yet) Endorsed or Used by EU Institutions

a. EU Renovation Loan[42] (ERL)

In 2022, as part of its revision to the Energy Performance of Buildings Directive

39 EC, New Cohesion Policy, 2023. Accessed: https://ec.europa.eu/regional_policy/en/2021_2027/

40 EIB, ELENA – European Local Energy Assistance, 2023. Accessed: https://www.eib.org/en/products/advising/elena/index.htm

41 Ibid.

42 EurActiv, An EU Renovation Loan can unlock EUR 2 trillion of future energy savings, 2023. Accessed: https://www.euractiv.com/section/energy/opinion/an-eu-renovation-loan-can-unlock-e2-trillion-of-future-energy-savings/

(EPBD), the European Parliament's Committee on Industry, Research and Energy (ITRE) included the term 'EU Renovation Loan'. [43] This new tool, although not yet on the market, could offer millions of home owners energy efficiency loans through 138 000 bank branches across the EU. It works by combining three pre-existing EU tools: 1) an EU guarantee allowing banks to offer EU Renovation Loans to clients who cannot access green mortgages; 2) ECB liquidity-enabling low-cost loan rates; and 3) a trusted network of accredited renovation project managers. The reasoning behind these loans is that while efficiency and deep renovation rates need to be upscaled rapidly in order to meet EU climate targets, it is not possible to upscale until the supply chain matures and expands. The EU Renovation Loan (ERL) is intended to provide low-cost, accessible and long-term finance for European homeowners. The ERL would provide the mechanism for homeowners to borrow the finances they require to renovate their homes without having to make upfront payments: they would not have to pay back the loan until sale, transfer or after 30 years. The interest rate would be below market rates.[44]

Retail-facing financial institutions are able to invest in this critical market Renovation Loan, provided they have the guaranteed support and incentives from the EU to do so. This approach would see EU institutions work together with Member States, de-risking renovation costs for homeowners by offering secure, low interest rates through simple processes, with guaranteed results.

b. European Structural and Investment Fund

Five funds are set up through the European Structural and Investment Fund (ESIF) to support EU countries in financing sustainable development and the transition to a low-carbon economy. These are: European Regional Development Fund (ERDF), Cohesion Fund (CF), European Social Fund (ESF), European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF). The total amount of funding provided by the five funds is EUR 454 billion. The funds are intended to prompt interest among financial institutions in co-financing mechanisms with the EU. Over the period 2014-20, EUR 18 billion was allocated to energy efficiency via the ESIF. These funds lower the risk for financial institutions. The key features of the ESIF fund are[45]:

- The funds are delivered via multi-annual programmes at national or regional level.
- The funds require national co-financing.
- The funds offer support mainly via grants, with increasing emphasis placed on the use of financial instruments.
- The funds are to be implemented by Member States and their regions under shared management.
- The funds have geographical and sectoral eligibility criteria as stipulated in the regulations, programmes and national eligibility rules.

The funds that apply to energy efficiency are integrated into the EU's Cohesion Policy: these are the ERDF and the CF.

43 Climate Strategy, The EU Renovation Loan, 2023. Accessed: https://www.climatestrategy.es/en/informe_23.php
44 Climate Strategy, The European Renovation Loan: a new instrument to fund the Renovation Wave, 2020.
45 Damien Cocard, SEIF Bucharest, 2018. [no longer available on line]

c. Sustainable Energy Financing Facilities

The Sustainable Energy Financing Facilities (SEFF) are supported by the European Bank for Reconstruction and Development (EBRD). They support local banks, leasing companies and microfinance institutions to step up their financing activities relating to energy efficiency. The SEFF provide long-term funding in the form of loans together with project development assistance to energy efficiency programmes for municipalities. The financing of these projects is realised by the EBRD extending credit lines to local banks who participate in the SEFF[46]. Local banks use the credit lines to provide commercial loans to lenders with appropriate investment opportunities. The credit lines are supported by a technical assistance package, ensuring lenders and banks are supported in their loan applications and sustainable efficiency investment opportunities. The amounts awarded can range from several thousand euros to several hundred thousand euros, depending on the building type. The type of eligible efficiency activities include double glazing, wall insulation, roof insulation, high-efficiency biomass stoves/boilers, solar water heaters, high-efficiency gas boilers and heat pumps. The SEFF loans are intended to make industries more competitive, lenders more comfortable and local experts more competent in identifying efficiency investment opportunities. Hence, local capacity building and self-supporting markets for energy efficiency are key outcomes of the SEFF.

4.4 Banking Instruments

Banks across Europe are fast becoming attuned to the burgeoning investment opportunities in energy efficiency. The following two sections detail how the banking sector is finding innovative ways to support the transition of the building sector, aiding it to become efficient through green mortgages, green bonds. We evaluate how they are supporting the market uptake of energy efficient buildings across Europe.

4.4.1 Energy Efficiency Mortgages

Energy efficiency mortgages (EEM) are a new product from the banking sector and are fast taking on an important role in improving the efficiency of Europe's building stock. EEMs channel private capital to drive efficient renovations on the basis of banks offering preferential interest rates and/or added funds at the time a building is mortgaged or re-mortgaged (International Monetary Fund, 2020). These instruments are provided on the basis that the building's efficiency rating or label will be improved. This incentivises the borrower to undertake energy efficiency upgrades for existing buildings or to improve the energy performance of a new building, which is evidenced by the building's Energy Performance Certificate (EPC). The EEM repayments are funded by the cost savings delivered by the building's lower operating costs due to the energy savings, allowing the borrower to pay more of their income into their mortgage as they save money on energy bills. This model allows the financier either to offer these mortgages at below market interest rates or to increase the initial loan due to the lower credit risk.

46 BPIE, Financing Energy Renovation in Buildings, Guidance on financial schemes with a focus on Bulgaria and Romania, 2019. Accessed: https://www.bpie.eu/wp-content/uploads/2019/11/EUKI-Financing-energy-renovation-in-buildings_Nov2019.pdf

The EU's Energy Efficient Mortgages Initiative encourages major banks, mortgage lenders, data providers, valuation professionals, companies and organisations from the building and energy industries to come together to upscale the uptake of EEMs across Europe. The assumption is that an EEM lowers the risk for financiers because the energy improvement of the property is shown in its EPC. An energy efficiency improvement increases the property value and ensures that borrowers will have more disposable income due to lower energy bills, so reducing the bank's credit risk.

4.4.2 Energy Efficiency Covered Bonds

Covered bonds have existed for over 250 years and have proved to be an efficient debt instrument that allows banks to mobilise private sector finance for long-term investments that benefit the public. Energy efficiency covered bonds are a package of loans issued by banks and sold to financial institutions for resale. The money is used to finance energy efficiency improvements. Individual energy efficiency loans that are part of a bond package remain on the books of the banks that issued them, serving as a collateral pool that acts as a security layer and gives confidence to the covered bond holders. Green covered bonds and energy efficiency bonds play an important role in the mobilisation of debt covered markets to finance green efficient solutions. Green covered bonds directly link to real estate and housing and hence are a suitable instrument to add value for the investors. The energy efficiency bond market is a new asset class that helps issuers find the right investors to push energy efficiency into the market. As the covered bond market is linked to real estate, it plays a huge role in tackling global warming. It is primarily placed to be a front runner in solutions-based financing. Green funding and bonds are being placed at the heart of corporate strategies.

In 2019, the EU adopted the Covered Bond Legislative Package, comprising a Covered Bond Directive and a Regulation Covered Bond Directive to help secure the covered bond market and clarify what is considered to be a covered bond. The directive will have an impact on covered bond markets, bringing new risks and opportunities and will play a role in the European transition to clean energy. In February 2023 the European Parliament and Member States agreed to establish requirements for a European green bond standard, in order to prevent financial greenwashing and to regulate the term 'European Green Bond'. This will result in a labelling system that will define the financial products that can be defined as a green bond and allow investors to identify the bonds that are aligned with the EU's climate goals.

4.4.3 Private Finance for Energy Efficiency (PF4EE)

Alongside the EIB, the European Commission developed the Private Finance for Energy Efficiency tool which is administered through national partner banks in some European countries to provide more affordable funding for energy efficiency investments: it is in effect an EE Guarantee. This guarantee sets a standard for equity investment fund initiatives and securely engages institutional investors to invest in green assets. The PF4EE's core objectives are to make financing energy efficiency projects a more sustainable activity across financial institutions and increase the availability

of debt financing for investments in energy efficiency, hence the PF4EE encourages participation by private institutional investors (e.g. banks, insurers and pension funds). Private and public sector banks (the financial intermediaries) are able to offer preferential PF4EE loans / energy efficiency financing in their national markets[47]. The banks benefit from the tool as they are able to combine the EIB loan with a Risk Sharing Facility and an Expert Support Facility. Currently, the PF4EE partnered countries (and hence banks) are Belgium (Belfius), Greece (Piraeus), Italy (BPER), Latvia (ALTUM), Poland (BNP Paribas Bank Polska), and Portugal (BPI).[48]

4.4.4 European Energy Efficiency Fund (EEEF)

The EEEF is an alternative investment company that sets out to enhance energy efficiency and renewable energy via private-public partnerships, developed together with the EC (with a contribution from the EU budget). It is funded by the European Commission along with the EIB, the Cassa Depositi e Prestiti SpA (CDP), the Deutsche Bundesstiftung Umwelt (DBU) and WEPLA.[49] The Fund provides dedicated financing via direct finance and partnering with financial institutions to facilitate sustainable investment in the public sector on a city, regional and community level. The Fund finances technologies for energy efficiency, small-scale renewable energy and clean urban transport. All projects funded must achieve at least 30% primary energy savings or greenhouse gas savings compared to the baseline. The Fund comes in the form of a combined loan and grant that is managed by a financial intermediary on behalf of an EU Member State.

4.5 Institutional Investor Instruments

An institutional investor is an organisation that invests money on behalf of an individual investor, for example asset managers, infrastructure funds, insurance companies, pension funds, private equity and sovereign wealth funds. Institutional investors can help to upscale investments in energy efficient buildings by allocating long-term capital to private assets and by requesting their corporate investors to improve their own energy efficiency. Progressive institutions understand and see the multiple benefits of energy efficiency in relation to society and the economy and hence embed efficient practices within their investment processes. These investors are not only conducting their own energy efficiency upgrades, but also developing new tools and business models geared towards energy efficiency investments including crowdfunding for energy efficiency and energy efficiency insurance. When institutional investors crowdfund for energy efficiency, they provide traditional financial access to consumers who would not normally be eligible. Energy efficiency insurance protects the risks of energy efficient projects and hence builds investor confidence. In Europe, institutional investors provide finance through three main avenues:

- companies – listed equities shareholding, bonds purchase.

47 Private Finance for Energy Efficiency (PF4EE), 2023. Accessed: https://pf4ee.eib.org/partner-banks

48 European Commission, Investment Plan for Europe supports new fund to finance energy efficiency in buildings across Europe, Public Affairs Bruxelles, 2022. Accessed: https://www.pubaffairsbruxelles.eu/eu-institution-news/investment-plan-for-europe-supports-new-fund-to-finance-energy-efficiency-in-buildings-across-the-eu/

49 European Energy Efficiency Fund, 2023. Accessed: https://www.eeef.lu/objective-of-the-fund.html

- projects – equity stakes in assets, bonds purchase.
- funds or pooled investment vehicles based on energy assets.

The following sections will explain the institutional programmes and projects that are helping to upscale energy efficiency across Europe.

4.5.1 De-risking Financial Initiatives

An on-going barrier to institutional investment is the perceived risk associated with energy efficiency investments, based on a lack of evidence on how well these investments perform. This makes it difficult for institutions to carry out a risk assessment of the benefits and finance of these investments. The Energy Efficiency Financial Institutions Group[50] (EEFIG) in collaboration with the European Commission has developed two products that aim to change the risk perception of financiers and investors: The De-risking Energy Efficiency Platform (DEEP) and the Underwriting Toolkit.

DEEP is a pan-Europe database providing the technical and financial details of over 10 000 energy efficiency projects in buildings. This data is open-source and accessible to public and private investment funds, financial institutions and national and regional authorities, offering market-based evidence. This evidence helps financial institutions to conduct risk assessments of the benefits and finance of these programmes, hence breaking down the main barrier to institutional investment.

The Underwriting Toolkit is a guide that helps investors to value and risk-assess energy efficiency financing with the purpose of supporting institutions in upscaling the deployment of capital towards energy efficiency projects. It also helps project managers to understand and develop bankable projects.

4.5.2 Securitisation

A system to reduce the associated financial risk barriers facing energy efficiency investments for institutional investors is green or energy efficiency securitisation. Securitisation allows institutional capital to be tapped by transforming a single asset into a pool of liquid revenue assets, for example:

- The money received from energy savings into tradable financial instruments (securities) – asset backed security (ABS).
- Loans and leases to small-scale efficient building projects can be securitised and then sold to the capital market – asset backed security (ABS).
- Energy efficient mortgages – mortgage-backed security (MBS).

These pools of assets can be securely sold by banks to investors, and the capital raised through secure sales can be used to create a new portfolio of assets. ABS and MBS are the most commonly used securitisation instruments in the capital market.

50 EEFIG, 2023. https://ec.europa.eu/eefig/index_en

Once energy-efficiency ABS and MBS become secure, they do not differ from any other asset on the market.

4.6 Innovative Finance Tools

Innovative financing schemes support the construction and renovation of energy efficient buildings without encumbering the home, business or municipality. There are many of these across Europe, delivering a plethora of co-benefits including competition, job creation, market penetration, consumer awareness, etc. The following mechanisms have been established to upscale energy efficiency across Europe.

4.6.1 Sustainable Taxonomy

The EU has developed a Sustainable Taxonomy tool that defines whether economic activities around Europe are sustainable or not and thus whether investments are aligned with Europe's environmental targets. Sustainable Taxonomy makes it easier for investors, companies and citizens to know what is sustainable and highlights the companies, investments and activities that are on track in supporting a net-zero economy. Although currently very few companies will be 100% in alignment with the Sustainable Taxonomy criteria, many will be able to demonstrate their commitment towards the transition by increasing their sustainable activities over time and having clear decarbonisation targets and milestones. The taxonomy system identifies those companies that are making improvements. The tool also recognises that each sector is decarbonising at a different pace. Therefore, in the sectors that are harder to decarbonise, companies are recognised for investing in low-carbon solutions and being taxonomy-aligned (for example highly efficient steel production).

The Taxonomy allows companies and investors to obtain credits for their low environmental impact. Companies who are in alignment, or partial alignment, with the Sustainable Taxonomy criteria are eligible to raise green financing from the market and access a wider pool of potential investment, for example via the EU Green Bond Standard or by getting a green loan from a bank.

In terms of the building sector and the uptake of energy efficient buildings, the Taxonomy is used to assess new buildings and renovations and assess whether they are taxonomy-aligned based on the efficiency of the buildings. Equally, manufacturers, installers and construction companies can be assessed based on how efficient their building products and operational practices are. Innovative technology that helps another sector get to net zero will be included in the taxonomy criteria, thus spurring different markets to support each other, as well as to compete against each other.

4.6.2 Energy Performance Contracting

Energy Performance Contracting (EPC) is a tool that supports the upscaling of efficient buildings. An energy efficiency contract is drawn up between the service provider and a client or project owner. The contract guarantees the energy efficiency or energy productivity of buildings without requiring any upfront costs. The energy

savings measures that are offered by the service provider are measured and verified. The guaranteed energy savings can come from a diverse range of energy efficiency improvements, for example, efficient building envelopes, efficient material use, new heating systems, new lighting systems, efficient heating, ventilation and air-conditioning systems, building management systems, combined heat and power (CHP), renewable and low carbon electricity and heat generation. The financial set-up of an EPC is a fund that provides the upfront capital for energy efficiency work that is paid back by the client or project owner using the money saved by their reduced energy consumption. EPCs provide the client with an efficient or smart building with no upfront investment, hence they are buying efficiency as a service just as they would with lighting or heating.

4.6.3 On-Tax Financing

On-tax financing is a mechanism that collects the repayments for the finance borrowed in order to invest in building efficiency improvements. Working with municipalities and their citizens, such as a property tax system, the investors lend out upfront finance for efficiency renovations and get repaid via a property-linked tax, known as on-tax financing. The system can be used for different building types. Typically, on-tax financing focusses on energy efficiency but it is also possible to use this system for demand-side flexibility, renewable energy upgrades and other environmental solutions that benefit the municipalities' citizens. A model used in both the US and the EU is EuroPACE which covers up to 100% of a project's costs whilst offering technical support to homeowners, business owners, etc throughout the full duration of a project. The EuroPACE on-tax financing can be linked to or embedded in a municipality, utility or state incentive programme (subsidies or grants). Its unique quality is that the liability is attached to the property, not the property owner. In order for the project to be trusted and investable, it is funded using low-risk bonds that are stable investments due to the enhanced repayment security and are therefore attractive to institutional investors.

4.6.4 One-Stop Shops

A One-Stop Shop (OSS) is an advisory tool or platform that informs and assists consumers with their energy efficiency renovations. The OSS provides relevant financial instruments supporting consumers with each step of a renovation process. It offers a comprehensive advisory tool for clients and an innovative business model for energy efficiency suppliers that is set up to facilitate and guide stakeholders through the complex energy contracting process between ESCOs, building owners and financial institutions. The diverse range of services offered throughout the project's development includes:

- project management – marketing, tender preparation & evaluation, contract/ legal advice.
- project aggregation/bundling.
- financial advice – loans, subsidies, etc.
- certification of ESCOs or energy services.
- energy auditing.

Often, individual projects are not economically feasible and at such times the OSS can overcome this barrier by aggregating or pooling projects with different energy efficiency requirements which together offer an adequate investment pay-back[51]. By aggregating projects, the transaction costs and risks are reduced for financial institutions so that renovation projects are able to access the capital market through securitisation or green bonds.

4.6.5 New European Bauhaus

As part of the EU's Green Deal, a new virtual green initiative has been established, known as the New European Bauhaus (NEB). Since its launch in September 2020, the NEB has implemented on-the-ground change using broad funding from a variety of EU programmes - including Horizon Europe, the European Regional Development Fund (ERDF), LIFE 2021-27, the Single Market Programme and Digital Europe. In 2022, work began on six demonstration projects and another ten are set to launch in 2023. The first six demonstration projects are being implemented in 14 separate locations and cover building renovation, circularity, arts, cultural heritage, education, smart cities, coastal areas, urban and rural regeneration and more. The 2023 demonstration projects will come under the European Urban Initiative under the EU Cohesion Policy, and are being supported with EUR 50 million from the ERDF to support urban challenges in the areas of construction and renovation '*in a spirit of circularity and carbon neutrality, preservation and transformation of cultural heritage, adaptation and transformation of buildings for affordable housing solutions, and regeneration of urban spaces*.'[52]

4.6.6 Energy Efficient Mortgages Initiative (EEMI) Bauhaus

The Horizon 2020 Energy Efficient Mortgages Initiative[53] (EEMI) Bauhaus[54] model is intended to support the banking sector by playing a transformative role in catalysing a systemic acceleration towards a sustainable and green economy. It provides a new methodological approach to accelerate the green and social transition – inducing change in consumer, lender and investor behaviour, and in wider society. The model combines smart digital technology and existing sustainable solutions to change the market.

With regard to buildings, the initiative is set up to develop energy efficient mortgages by stimulating cross-sectoral ideas on a new industry value chain that encourages digitalisation and supports sustainable principles in building design. This arena allows stakeholders to present innovative ideas, overcome barriers and proposals for sustainable building design through cross-sectoral cooperation. The NEB is intended to support the EU climate transition and a green recovery by mobilising creativity and innovation in the market. It supports the EU's need to leverage EUR 300 billion

51 Benigna Boza-Kiss and Paolo Bertoldi, One-stop-shops for energy renovations of buildings, EC Joint Research Centre 2018. Access: https://e3p.jrc.ec.europa.eu/publications/one-stop-shops-energy-renovations-buildings

52 EC New European Bauhaus, 2023. Accessed https://new-european-bauhaus.europa.eu/system/files/2023-01/CP-003%20-%20Report%20from%20the%20Commission%20%28EN%29%20Part%201.pdf

53 https://energyefficientmortgages.eu/

54 https://hypo.org/emf/market-initiative/eemi-bauhaus-lets-greenstorm/

of additional investment to meet its 2030 targets in buildings by channelling private finance to complement public finance using mortgage finance solutions[55].

4.6.7 Carbon Emission Trading – European Emissions Trading System (ETS)

Carbon emission trading and markets represent a cost-effective tool for reducing greenhouse gas emissions: emissions in the ETS sectors must be cut by 62% by 2030. The ETS enshrines the 'polluter pays' principle to achieve the objective of EU climate neutrality. In a carbon market, countries commit to reducing their emissions and the market is supported by a cap or limits on the amount of emissions businesses are allowed to 'spend'. Therefore, businesses reduce their own emissions to stay within the carbon cap.

The trading scheme works by allowing companies to buy and sell equivalent carbon reductions - in tonnes of carbon credits - from other companies for their own or other countries. This drives the price of carbon credits which depends on buyer demand and the availability of carbon credits on the market. The UN has set up a regulated international source of carbon credits known as the Clean Development Mechanism (CDM), which is a system for buying and selling certified emission reductions. The CDM links with the EU's European Trading Scheme (EU ETS) which is the largest worldwide trading scheme and the main source of CDM credit demand. The CDM allows for small-scale energy efficiency solutions to be aggregated to allow for upscaled implementation of projects and hence helps to reduce risks for institutional investors as well as project developers.

The EU has recently flagged up a follow up to the EU ETS – ETS II – which will affect buildings and road transport from 2025. This iteration requires fuel distributors to report the amount of the fuels they place on the market starting from 2024. From 2026, a cap will be placed on fuel distributors' emission allowances to support the EU in meeting its targets for these two sectors.

4.7 Summary of Financial Instruments

Table 4.1: An Overview of the Main Financial Instruments Used in the EU

Financial Instrument	Dates	Funding	Objectives/Comments
Multiannual Financial Framework (MFF)	2021-27	EUR 1.211 trillion.	Financial mechanisms supported by the MFF include InvestEU, NextGenerationEU (NGEU) and the Recovery and Resilience Facility (RRF).
InvestEU	2021-27	The proposed InvestEU budget guarantee is EUR 26.2 billion.	Aims to mobilise EUR 650 billion of public and private investment. The InvestEU guarantee is implemented in partnership with selected financial partners, or 'implementing partners'.

55 EC, New European Bauhaus, 2021, Accessed: https://hypo.org/app/uploads/sites/3/2021/11/New-European-Bauhaus-Ruth-Reichstein.pdf

Financial Instrument	Dates	Funding	Objectives/Comments
NextGenerationEU (NGEU) and the Recovery and Resilience Facility (RRF)	2021-27	Budget of EUR 806.9 billion.	The main programme under NGEU is the Recovery and Resilience Facility, with a budget of EUR 723.8 billion. One of the eight flagships of the project is 'renovation'.
EU Renovation Loan			Still in its design stage this could offer millions of homeowners energy efficiency loans through 138 000 bank branches across the EU.
The European Renovation Fund	Ongoing		EU and MS to mobilise all the existing tools; bundling funding sources, minimising administration, increasing technical assistance and training and providing a funding guarantee.
The European Fund for Strategic Investments	2015-20	EUR 16 billion guarantee from the EU budget that was complemented by EUR 5 billion from the EIB's capital	Replaced by InvestEU.
European Renovation Financing Facility	Ongoing	At least EUR 90 billion per annum aiming to mobilise an estimated EUR 350 billion in investments per year.	Proposed by the EC in 2020. The fund is managed centrally and combines EUR 25 billion in grants and EUR 65 billion of guaranteed ring-fenced funds.
European Structural and Investment Fund	2021-27	The total amount of funding provided by five funds is EUR 454 billion.	Over the period 2014-20, EUR 18 billion was allocated to energy efficiency.
EU Cohesion Policy	2021-27	EUR 273 billion is expected.	Between 2014-20 over EUR 352 billion was allocated to this.
Smart Finance for Smart Buildings Initiative	Ongoing		It includes solutions in order for private financing for energy efficiency to be mobilised so that public funds are used more effectively.

Financial Instrument	Dates	Funding	Objectives/Comments
Project Development Assistance - The European Local Energy Assistance (ELENA)	Ongoing	The ELENA facility has awarded more than EUR 180 million of EU support, mobilising an estimated investment of around EUR 6.6 billion (as of end 2019).	ELENA covers up to 90% of the technical assistance and project development costs, supporting energy efficiency programmes valued over EUR 30 million that have a three-year implementation period.
Sustainable Energy Financing Facilities (SEFF)	On-going	Since 2006 the EBRD has provided over EUR 2 billion in 20 countries.	SEFF is supported by EBRD, supporting local banks, leasing companies and microfinance institutions in increasing their financing activities surrounding energy efficiency.
Energy Efficiency Mortgages	Ongoing		The Energy Efficient Mortgages Initiative involves major banks, mortgage lenders, data providers, valuation professionals, companies and organisations from the building and energy industries to come together to upscale the uptake of EEMs.
Energy Efficiency Covered Bonds	Ongoing		As of 2019, the EU adopted the Covered Bond Legislative Package, comprising a Covered Bond Directive and a Regulation Covered Bond Directive the covered bond market.
Private Finance for Energy Efficiency (PF4EE)	Ongoing		PF4EE operates through national partner banks in some European countries to provide more affordable funding for energy efficiency investments.
European Energy Efficiency Fund (EEEF)	Ongoing		Enhances energy efficiency and renewable energy via private-public partnerships. All projects funded must achieve at least 30% primary energy savings or greenhouse gas savings compared to the baseline.

5.Building Energy Efficiency Financing in China

According to China's Ministry of Housing and Urban-Rural Development (MOHURD), it is estimated that the total market size of green buildings in China is expected to reach CNY 6.5 trillion by the end of the 14th Five-Year Plan in 2025, marking an increase of 91% from the market size of CNY 3.4 trillion in 2020. To achieve this, it is projected that 400-600 million m^2 of green buildings will need to be constructed each year, requiring corresponding development investment of CNY 3-5 trillion annually[56]. These figures highlight the significant growth potential of the green building market and the importance of building energy efficiency financing in China. This chapter outlines the various financing options available for green building projects. These include five main types of financing instruments: banks and other financial institutions; government financing; EPC; Public-Private Partnerships (PPP); and Initial Public Offerings (IPO). Each financing instrument complements the others and plays a unique role in promoting building energy efficiency. They each have advantages and disadvantages based on project scale, risk tolerance, and financial capabilities.

5.1 Financial Institutions

China has established a relatively comprehensive framework for green finance to support sustainable development including building energy efficiency. The framework includes several key founding policies. In 2015 the China Banking and Insurance Regulatory Commission published the Green Credit Guidelines, marking the start of green finance. In 2016, the People's Bank of China issued the Guiding Opinions on Building a Green Financial System, extending China's green financial policy framework to all financial markets, including insurance and capital markets. In 2017, the China Securities Regulatory Commission revised the Listed Company Governance Guidelines, requiring listed companies to incorporate environmental protection requirements into their development strategies and corporate governance processes. In the same year, the China Securities Investment Fund Association issued the Green Investment Guidelines to encourage fund managers to invest in environmental and sustainability projects. In 2019, the Guidance Catalogue of Green Industries was updated to provide clear criteria for eligible projects, including building energy efficiency. In the Green Bond Supporting Project Catalogue (2021) further emphasis is placed on development of green buildings, ULEB, fabricated buildings, existing building renovation, green building materials and NZEB demonstration projects.

56 https://caijing.chinadaily.com.cn/a/202205/13/WS627de00ca3101c3ee7ad521c.html

Table 5.1: Green Finance Policies on Building Energy Efficiency Financing

Ministry/Regulator	Time	Regulation/Policy	Main Content
Ministry of Environmental Protection (MEP) People's Bank of China (PBC) and China Banking Regulatory Commission (CBRC)	2007	Green Credit Policy	This encourages loans to environment-friendly and energy saving projects.
China Banking Regulatory Commission	2012-2013	Guidelines and suggestions to implement the 'green credit' policy	Building energy efficiency is considered to be an environment-friendly activity that private banks can lend to.
China Banking Regulatory Commission	2013	Notice on the Green Credit Statistics	Retrofitting, green building development and operation, energy saving and water saving.
Central Bank	2015	List of Supporting Projects Financed by Green Bonds	New green building and retrofitting.
CBRC and NDRC	2015	Guidance on Energy Efficiency Financing	Energy efficiency associated with residential, public and commercial buildings, central heating, air conditioning equipment, and renewable energy.
NDRC	2016	Guidance on Green Bond Issuance	Green building development, building industrialisation, retrofitting, low carbon pilot projects.
China Securities Regulatory Commission	2017	Support for the Development of Green Bonds	New green building and retrofitting.
Central Bank, NDRC and CBRC	2021	Green Bond Supporting Project Catalogue	Low energy consumption building, green building, building with renewable energy, 3-D building, and retrofitting.

Source: Analysis of barriers to green finance supporting the development of green buildings, Joint research team, Research Center for Green Finance Development THU and Center of Science and Technology and Industrialisation Development, MOHURD; and Government Documents, 2007-21.

Due to government support policies and regulation, financial institutions have developed various instruments to support building energy efficiency financing. The most common types of financial instruments include green loans, green bonds, green building insurance, green building funds, commercial mortgage-backed securities (CMBS)[57], asset-backed securities (ABS)[58] and real estate investment trusts (REITs)[59]. Of these, green loans and green bonds are the most popular and hold the most investments.

Table 5.2: Building Energy Efficiency Financing by Type of Financial Instrument

Types of Buildings	Green Loan	Green Bond	Green Fund	Green Insurance	ABS, REITS, and CMBS
Green Buildings	√	√	√	√	√
ULEB	√	√			
NZEB	√	√		√	
Building Renovation	√			√	

Sources: Center of Science and Technology and Industrialisation Development, MOHURD.

By the end of Q2 of 2019, green bank loans amounted to CNY 9 470 billion, accounting for 9.9% of the total corporate bank loans. Of the total green bank loans, transport and renewable energy represented 45% and 24%, respectively. Bank loans for new building construction amounted to CNY 110 billion, of which around half, or CNY 55 billion, were green loans based on the 13th Five-Year Plan. This means that green lending represented less than half of the total for building construction. According to data from the China Banking and Insurance Regulatory Commission (CBIRC), by the end of June 2017 green loans provided by 21 major banks amounted to CNY 83 billion, of which the total amount of loans for building energy efficiency was CNY 13 billion, or 1.6%[60]. It is clear that the proportion of green lending for building energy efficiency is low. However, by the end of 2021 the balance of green loans denominated in CNY and foreign currencies in China reached CNY 15.9 trillion, a year-on-year increase of 33%. China's green loan issuance scale now ranks first in the world[61].

The first green bond for the building sector was issued in 2017, with a total amount of green bond issued for that purpose throughout that year worth CNY 0.45 billion. Five years later, the amount of green bonds for building sector has increased significantly. In 2022, the total amount of green bonds listed on the market reached CNY 867.591 billion. Of these, 65 green bonds are for sustainable building projects[62] valued at CNY 76.6 billion. Clean energy was the most popular sector for investment, accounting for approximately 50.8% of the total, followed by green transportation at approximately 19.45%, and sustainable building at 10.15%, while other sectors did not exceed 10%. In terms of quantity, clean energy remained the highest at 36.83%, followed by

57 CMBS are fixed-income investment products that are backed by mortgages on commercial properties rather than residential real estate.
58 ABS are securities backed by a pool of assets, which can include loans or leases for green building projects.
59 REITs are companies that own or finance income-producing real estate across a range of property sectors.
60 China Bank and Insurance Regulatory commission, Statistics of green bank loans from 21 major banks: http://www.cbrc.gov.cn/chinese/home/docView/96389F3E18E949D3A5B034A3F665F34E.html
61 China Local Green Finance Development Report. International Institute of Green Finance, Central University of Finance and Economics, 2022.
62 The sustainable building projects here include green building, ULEB, NZEB, building renovation and other green building demonstration projects such as ZEB.

environmental pollution prevention and control at approximately 16.52%, and green transportation at approximately 14.38%, while other sectors did not exceed 10%[63].

5.1.1 Financial Instruments for Building Energy Efficiency: Case Studies

a. Green Loans: Case Studies

- Demand-Side Green Loan. Maanshan Agricultural and Commercial Bank provided two types of green loan: an energy efficiency loan and an ecological cycle loan. In order to facilitate the demand for green residential homes, the bank also provided green mortgage loans for its customers under the condition that the real estate should be attested as a green project by the China Green Building Certificate, Leadership in Energy and Environmental Design (LEED) of the US and the International Finance Corporation (IFC) Edge Certificate. The down payment for a green mortgage is similar to a standard mortgage, but the interest rate for a green mortgage is lower.

- Supply-Side Green Loan. Huzhou Bank classified a housing development into different stages of the sector chain: green real estate; green construction; green construction materials. It provided different types of loans for different stages of the sector chain at lower interest rates.

The above two cases suggest that the green loans can be used to finance building energy efficiency both from the demand side (consumer) and from the supply side (sector chain).

b. Green Bond: Case Study

- Henglong Real Estate Co. issued a green note worth CNY 1 billion and with three years to maturity to finance the construction of two squares in Kunming and Wuhan respectively in 2018 without guarantee. The company was rated AAA. The two projects were confirmed by the international LEED ratings system as green projects and were included in the list of projects supported by green bonds.

Table 5.3: Indicator Comparison of the Two Projects

Subprojects	Energy Saving (t/a)	CO_2 Reduction (t/a)	SO_2 Reduction (t/a)	NO_x Reduction (t/a)	Dust Reduction (t/a)	Water Saving (t/a)
Square, Kunming	5 370	13 211	15.41	16.11	4.83	214 577
Square, Wuhan	4 981	12 255	14.30	14.95	4.48	24 200

63 SynTao Green Finance, 2022 Annual Green Bond Market Review. https://www.casvi.org/h-nd-1760.html

c. Green Fund: Case Study

The China-US Green Fund is a private green fund established by firms from China and the US. The purpose of the fund is to invest in green energy and energy efficiency projects, green manufacturing and environmental projects, green consumption and service, and green travel and logistics. The Green Fund can be used to finance long-term building energy efficiency projects. For example, the 'Action Plan for Jointly Building the Yangtze River Delta Green Building Innovation Center' is a three-way partnership created in 2020 between Baoye Group, the China-US Green Fund, and the Shanghai Construction Science Group. The project focuses on design, intelligent manufacturing, operation of future buildings, and the aggregated building industry chain services to explore models for future building development.

In addition, it can be used as an alternative to debt financing such as loan and bond financing for the firms during the growth stage.

d. Green Insurance: Case Study

In 2019, an insurance company in Qingdao issued the first insurance contract for a NZEB located in the China-Germany Ecological Park in China. The NZEB included real estate covering an area of 70 000 m^2 and eight buildings. The insurance company authorised a third-party firm to assess the technical indicators (including energy efficiency) of the NZEB over all stages of development, from planning, design, construction, to delivery.

This case provides an innovative financing approach for building energy efficiency in China. In late 2019, a similar insurance contract was issued in Beijing.

5.2 Government Financing

Government financing is another popular instrument for green building projects, with the state providing subsidies and using its creditworthiness to attract financing. Central and local governments are offering significant financial incentives to promote development of green building, ULEB, NZEB and building renovation in the 14th Five-Year Plan period. Between January and November 2022, the People's Bank of China had supported financial institutions in issuing loans worth CNY 529.5 billion to the carbon reduction sector by providing special funds in the form of re-discounting.

By the end of 2022, 58 provinces and cities had developed various financial incentives including but not limited to direct financial subsidies, a floor area ratio bonus, higher allowances to develop commercial housing, tax reductions, inflation of loan limits and inflation of house prices, in order to encourage constructors to develop star-rated green building, ULEB, NZEB and ZEB demonstration projects.

Local ULEB financial incentives provide an example of what is available:

- Direct financial subsidies ranging from CNY 30-800 per m^2. In general, colder and coal-dominated regions, such as Ji'lin and Ningxia, offer higher subsidies.

- Maximum subsidy cap per project ranges from CNY 1.5 million to CNY 10 million. Hebei province provides the highest subsidy cap.

- Floor area ratio bonus ranges from 3% to 10%. Hebei province provides the highest bonus.

Certain regions have developed differentiated requirements to promote building energy efficiency. The following offer some typical examples:

- Tianjin and Shenzhen have made it a requirement to meet the ULEB standard or above in project bidding in order to achieve the goal of 100% green houses in new buildings.

- Hubei Province issued 'Regulations for the Implementation of Green Building Industry Loans' in February 2023, covering six building sectors including green buildings, prefabricated buildings, energy-saving and green renovation of existing buildings, green building materials, green building services, and green building consumption. This local initiative will help financial institutions provide various financial products and services, including project financing, working capital financing, supply chain financing, green insurance, energy contract financing, green mortgage loans, and green provident fund loans.

- In 2022, Xiong'an announced 'Measures for Pre-Recognition of Green Credit to Support the Development of Green Buildings'. These measures provide guidance for banking and financial institutions to offer targeted financial products and services for green building development in Xiong'an. It covers projects on ULEB, star-rated green buildings, the application of renewable energy in buildings, prefabricated buildings, energy-saving and green renovation of existing buildings, green logistics and warehousing, green construction, green building materials, construction and energy-saving services.

5.2.1 Government Financing for Building Energy Efficiency: Case Studies

a. Government financing in Hei Long Jiang province (2021-25)

To incentivise development of ULEB and NZEB, the government of Hei Long Jiang province in 2021 offers direct subsidy of CNY 600 per m^2, 10% floor area ratio bonus, 30% increase in housing prices, and 20% increase in loan quotas. The incentive measures gradually decrease after 2021. In 2022, the direct subsidy will be CNY 400 per square metre, while in 2023-24 it will drop to CNY 200 per m^2, and to CNY 100 per m^2 in 2025.

b. Government financing in Ningxia province (2021-2025)

Apart from ULEB and NZEB, the financial incentives in Ningxia include ZEB demonstration projects and new building projects in rural areas. Specifically, the provincial government will provide a direct subsidy of CNY 600 per m^2 to ULEB projects, with a maximum cap of no more than CNY 3 million per project. NZEB projects are eligible for CNY 800 per m^2 subsidy, with a maximum cap of no more than

CNY 4 million per project. ZEB projects are eligible for subsidy of CNY 1 000 per m^2, with a maximum cap of no more than CNY 5 million per single project. For NZEB rural residential projects, direct subsidies of CNY 600 per m^2 are available, with a maximum single-project subsidy of no more than CNY 80 000.

5.3 EPC Financing

Before 2015, the financing models for building energy efficiency were mainly in the form of mixed public and private financing through EPC models, thanks to the government incentive system.

The Central Government of China established an incentive system in 2010 to facilitate EPC and the development of the energy service sector. For EPC-based renovation projects, the central government offered USD 35.2 (CNY 228) per tonne of coal equivalent (tce) saved, and the local governments matched the reward of no less than USD 8.8 (CNY 58) per tce saved. In practice, building renovation projects received less than 10% of the reward. In May 2015, the EPC reward ended, marking the end of this incentive system.

EPC, also known as Energy Management Contracting (EMC), is the basic model used for renovating a single building. Under this model, energy service companies (ESCOs) bear all renovation costs and share the energy savings from the retrofitted building on an annual basis over the term of the contract. In practice, there are several variations of EPC models in China: shared savings, energy management outsourcing, guaranteed savings, finance leasing, and hybrids of the above.

The EPC is used mainly in the Chinese public and commercial building sector, but not in residential buildings. One reason is that commercial projects enjoy a large savings potential, high return on investment, short payback periods and a relatively easy financing process. In contrast, single residential building retrofit projects save far less energy, incur higher transaction costs, and the energy savings are often hard to quantify.

5.3.1 EPC Financing for Building Energy Efficiency: Case Studies

a. Tonghua model

With the Tonghua Model, the retrofit project is financed through a mechanism that pools various funding sources, including the national building retrofit subsidy fund, matching funds from local governments, and funds raised by district heating companies and residents/property owners of commercial buildings who will benefit from the project.

For the original project in 2009-11, the central government contributed CNY 74.18 million (USD 11.25 million) from the retrofit subsidy fund. The municipal government asked Jilin Provincial Trust Company Limited to provide a loan of CNY 51 million (USD 7.74 million) as the local government’s matching fund. The remaining funding was

contributed by the district heating companies (CNY 12.37 million/USD 1.88 million), residents (CNY 7.34 million/USD 1.1 million) and property owners of commercial buildings (CNY 27 million/USD 4.1 million). The project was completed within two years. Although around 70% of the finance was contributed by central and local governments, the project represents a large-scale energy efficiency retrofit pilot project in the building sector.

b. Chongqing model

With the Chongqing model, a large company that is highly experienced in managing multiple building projects, undertakes the retrofit project as a contractor in partnership with local ESCOs by utilising the bank loan. In return, the company gains a large share of income from aggregated energy savings. At the same time, the property owners benefit from a certain share of the energy savings and government subsidies.

For the original project in 2016, Tongfang Company Limited, a leading contractor in building efficiency, received a loan of CNY 2 billion (USD 0.3 billion) from the Bank of Chongqing. It received the central government's incentive of CNY 20 (USD 0.3) per m^2 for commercial buildings that saw a 20% cut in energy after retrofitting. At the same time, the municipal government provided a matching incentive: CNY 15/m^2 for retrofit projects that achieved between 20% and 25% reduction in energy intensity, and CNY 20/m^2 for over 25% reduction.

c. Shanghai model

In 2013, the World Bank provided a loan of USD 100 million to the municipal government with a grant of USD 4.345 million from the Global Environment Facility (GEF). Shanghai Pudong Development Bank and Bank of Shanghai worked as the World Bank's implementing agencies, providing another USD 100 million as a matching loan. The borrowing companies also contributed USD 46 million in matching funds. The municipal government negotiated a loan of USD 5.655 million to match the grant from the GEF. The total investment amounted to USD 256 million (CNY 1612.8 million). However, property owners have little interest in energy retrofits because the tariff in China is relatively low.

In 2011, Shanghai Pudong Development Bank received CNY 800 million from the Asian Development Bank. The fund was used for technical and financing support on building energy efficiency projects, both for new and existing buildings.

d. Wuhan model

Under the Agence Française de Développement (AFD) model, the French development agency provided a loan while local government offered matching funds. The project was implemented using an EPC approach.

For this model, based on an agreement between AFD and the Ministry of Finance in November 2011, AFD provided a loan of EUR 20 million with an interest rate of Euribor [64]+ 0.25%. The Hubei Provincial government contributed a counterpart fund of USD 3.96 million. The project was implemented via the EPC approach, while the energy savings generated are to be shared over a 12-year period.

64 Euro Interbank Offered Rate

5.4 PPP Financing[65]

When PPP is applied in the building sector, the government and social capital cooperate and sign a franchise contract. The constructor participates in the project as a social capital party and is responsible for financing, construction and operation. Due to the long cooperation cycle and high risk of developing building projects, PPP can significantly reduce the financing costs.

5.4.1 PPP Financing for Building Energy Efficiency: Case Studies

a. Tanglang Primary School Renovation PPP Project

The green renovation project at Tanglang Primary School in Nanshan District, Shenzhen is intended to achieve a 2-star green building standard for the campus. The sources of funding for the campus renovation include government subsidies of CNY 300 000, social capital amounting to CNY 620 000, and CNY 400 000 in funds from financial institutions - in total CNY 1.32 million. The project's construction company has been granted a franchise of 15 years to operate and benefit from the renovation. The first two years are for preparation and construction, followed by 13 years of operation. The government will take over after the 15-year period expires.

b. Taiyuan Building Renovation PPP Project

The building renovation PPP project for existing residential buildings in Taiyuan city is jointly funded and constructed by Shanghai Hongxin Construction Investment Corp. and China Railway Construction Corp. It is the largest existing residential building renovation project in Shanxi Province. The project covers 10 million m^2, 600 residential areas, 2 245 buildings, and about 400 000 residents. It has a total investment of CNY 2 billion with a yearly energy reduction of 200 000 tce.

5.5 Initial Public Offering (IPO)

An initial public offering on the stock markets offers a means of building financing, but is often not a suitable option for small-scale projects due to high costs. It is characterised by high listing requirements and a rapid fundraising process. The large amount of capital raised through listing may not be fully integrated into green building projects due to the nature of listing company operations. Major building companies that have listed include China State Construction Engineering Corporation and Beijing Steel Group Co., Ltd.

65 Public-Private Partnership

6. Bottlenecks and Barriers Confronting Building Energy Efficiency Financing in Europe

There are many discussions about bottlenecks and barriers to financing in the European Union. While there is plenty of literature on the subject that includes sections on financing, there is not much related to financing alone. Here we discuss barriers from various perspectives: the consumer (asset owner or tenant), financial institutions, intermediaries (suppliers, installers, services); and the public sector (national and regional governments, European Union). This section will discuss the barriers rather than the solutions.

6.1 Consumer/SME Perspective

For an asset owner, the up-front cost of a deep renovation can be daunting because the payback can be 10-20 years or more and is thus not deemed a priority without some form of public support. In some cases, the consumer/owner has no confidence in the cost or even quality of the renovation bids from contractors.

The asset owner may also not be aware of the full range of benefits that come from a deep renovation, be they related to air quality, noise, comfort, better affordability, etc.

The asset owner may not be aware of the range of financial support and the integration of support from commercial banks and public institutions.

For social housing, with limited resources, it can be difficult to obtain necessary financing for deep renovations.

For multi-family buildings, getting agreement through the housing association or owners' committee can be a major obstacle. In some cases, the housing association can act on behalf of the owners in terms of arranging financing; in other cases, this is not possible.

For rental properties, there can be split incentives. While the onus is on the owner to invest, it is usually the tenant who benefits from lower energy costs. This too often leads to total inaction or minimal action to improve energy performance. This can in part be solved by imposing a requirement for rental properties for a specified level of energy performance.

SMEs face several financing issues. Firstly, access to financing: the financial sector can view SMEs as high risk due to their precarious trading position, particularly following the Covid-19 pandemic. Secondly, SMEs lack an awareness of the benefits that follow a deep renovation. A significant reduction in energy costs could help their competitive position, but most SMEs have little understanding of this. Many SMEs also have difficulty developing a solid business case to take to a financial institution.

6.2 Financial Institution Perspective

The EU has a funding gap of about 275 billion euros per year for the Renovation Wave. There are concerns about the role that private financial institutions can play and this continues to be a major issue. Risk is always a concern for banks. Fortunately, physical buildings often represent good collateral against loans and mortgages, and with energy performance improvements the property value goes up and the risk normally goes down.

With the EU planning to renovate 3.5 million buildings a year under the Renovation Wave, there could be a capacity issue in underwriting mortgages.

Additionally, difficulties can arise when bundling public funding with private financing

SMEs have buildings that may require efficiency improvements but often, and especially during the Covid-19 pandemic, SMEs have been considered high risk because of their precarious trading position and the risk that they may not even be in business in the near future.

6.3 Intermediaries' Perspective

There are many intermediaries who play key roles. These may be information/advice providers, installers, service or equipment suppliers, architects and designers. They depend on transactions and, in many cases, are asked to help asset owners develop their business plan to take to a financial institution. This can lead to poor remuneration and cash flow concerns.

Information/advice providers can be classified as intermediaries helping asset owners or tenants understand the benefits of deep renovations and help them through the maze of issues ranging from deciding to undertake a renovation, choosing renovators, understanding the various financing possibilities, to linking public and private finance to reach the optimal renovation for the consumer.

6.4 Public Sector Perspective

While there is a strong policy framework, the biggest barrier is probably timing. Given the complexity of financing and renovation processes, trying to get all the pieces in place in order to meet relatively tight deadlines (even for 2030) is a tall order. For years, the EU has been trying to mobilise private sector funding through the Smart Finance for Smart Buildings initiative, the Energy Efficiency Financial Institutions Group (EEFIG), Sustainable Energy Investment Forums (SEIF), etc, but with limited effect.

For the EU as a whole, the Recovery and Resilience Facility and NextGenerationEU will play an important role when it comes to achieving the targets of the Renovation Wave.

Such initiatives need to link with EU regional/cohesion funds, the EIB and national

and local initiatives. Bringing all of them together to form a coherent package that is understandable to asset owners can be difficult and can create delays. There have already been some delays because not all Member States have submitted their Long-term Renovation Strategies, which were due in 2020.

There has been some confusion over the use of procurement procedures and of state aid. Experts from Member States can now come together in an EC-funded initiative called Concerted Action EPBD[66] to address such confusion and to improve implementation.

The idea of extending the Emissions Trading Scheme (EU ETS) to include buildings is not without its downsides. EuroACE's Secretary General writes:

> *'We are very concerned about such a possibility and the negative effects it could bring with it. The two effects of most concern are distributional effects that would penalise the already less well off in society through increased energy bills/ costs. Our second concern is that Member States would see this as a "market mechanism" that will solve the question of how to decarbonise buildings and thus lead to non-action on energy efficiency regulatory frameworks.'*

66 https://epbd-ca.eu/

7. Bottlenecks and Barriers Confronting Building Energy Efficiency Financing in China

The scale of financial instrument innovation and financing has increased significantly in recent years, and has played an important role in improving building energy efficiency. However, facing the annual demand of CNY 3-5 trillion investment in the green building market during the 14th Five-Year Plan period, the continuous improvement of building energy efficiency still faces a huge funding gap. To fill this gap, a series of bottlenecks and barriers need to be resolved to manage the conflicting demands of green building enterprises (including upstream building material suppliers, downstream developers, construction companies, etc.), financial institutions and governments. Some difficulties are evident:

- Building developers are finding it difficult to access affordable financing due to high financing costs, high risks, and a lack of collateral.
- Commercial banks are reluctant to finance green building projects due to the lack of standardised assessment and pricing methods, high credit risks, and insufficient loan periods.
- Central and provincial governments are finding it hard to balance fiscal subsidies, promote green buildings, and control financial risks.

These challenges require innovative financial instruments and mechanisms to integrate the interests of the three main players effectively and promote the development of green building.

7.1 Policy Environment for Building Energy Efficiency

Although government subsidies are an important source of funding for green buildings, they can only serve as short-term incentives. In the long run, it is necessary for the market to play a decisive role in resource allocation and for the use of financial instruments to guide the flow of social capital into green building development. At the national level, there is no preferential interest rate to develop green building projects, and financing costs are high. Grants, subsidies and tax reductions help to achieve targets quickly, but the rush of activity soon dries up once the incentive disappears.[67] As China has decided to transition from a government-driven system to a market-based system for building energy efficiency, enabling legislative and policy support is key. Overcoming these obstacles will require systematic improvements to the Chinese legislative and policy framework, to create a healthy, self-sustaining and prosperous building energy efficiency market.

67 Large-scale renovation of existing buildings also requires the strong support of urban construction funds.

7.2 Equity Financing for Building Renovation

Due to high investment and operating costs and relatively small project sizes, building renovation projects are not attractive to investors as the projects are generally not very profitable. The internal rate of return (IRR) for a building renovation project is relatively low. Therefore, equity contributors are more reluctant to take on the long payback periods associated with building renovation projects. Although government grants, subsidies and tax reductions help to increase IRR, once grants and subsidies are reduced or disappear, the motivation for equity financing ebbs away. As a consequence, large ESCOs are trying to move away from building energy efficiency businesses to other more lucrative income streams.

Due to government credit endorsement, there is little risk linked to PPP model projects. However, the scale of financing is limited, and the approval process is complex. An additional negative factor is that the PPP model requires advance payments from the project developers.

7.3 Financial Institutions

Commercial banks are the most common third-party financing option used to finance green building and building renovation projects.

The long project cycle poses a challenge for financing green building projects, especially given the high incremental costs associated with the use of green materials and technologies. Green buildings normally take longer to achieve a positive cash flow, leading to difficulties for developers, construction firms, and material suppliers when meeting financial requirements. As a result, financing for green buildings needs to be tailored to match the project cycle and meet the capital needs of the various stakeholders involved in the construction process. Unfortunately, the current financing products of commercial banks can only meet short-term funding needs, and cannot meet the need for flexible financing throughout the life cycle of building development and operation. This mismatch in the duration of term results in an inability to provide long-term funds and means that it is not possible to provide a satisfactory turnover for building developers.

Currently, Chinese ESCOs and commercial banks have conflicting objectives. Commercial banks prefer customers that are involved in low-risk business with stable returns, while ESCOs are asset light; meanwhile, building energy efficiency projects are relatively high risk and offer low returns. Only by developing a market mechanism with win-win outcomes for commercial banks and ESCOs can the building energy efficiency market become self-sustainable.

7.4 Financial Innovation

As most financing institutions have limited innovative capacity, the current range of financial products cannot meet the growing financing demand for building energy efficiency in China. In particular, most financial institutions do not understand the

nature of the building energy efficiency business and associated risks and are not willing to lower their financing costs. As a result, there is no incentive for investment and financing. Fewer financial institutions have developed securitised financial products backed by green loans, green mortgage, and real assets to finance building energy efficiency. As a result, few institutional investors such as insurance companies and venture capital companies have any experience of building energy efficiency projects.

Yet venture capital and green insurance are two key instruments to meet financing demand from the building energy efficiency business. So far, several regional governments have developed targeted and specific guidelines for local financial institutions to provide innovative products to support green financing projects. More local guidelines are likely to be released that will help develop easier access to financing for green buildings and building renovation developers.

7.5 Technical Barriers to Financing from China's ETS Market

One way of boosting building energy efficiency financing would be to trade the GHG emissions reductions associated with building energy efficiency in the Chinese Emissions Trading Scheme (ETS) market. So far, this has not been the case. Further, measurement and verification (M&V) companies in China are hindered by the lack of a whole-building comprehensive M&V protocol that incorporates the interactions of individual energy efficiency technologies. Finally, the practice under which the energy service companies pay for the measurement and verification service creates a conflict of interests, resulting in unrealistic and often unreliable data.

7.6 Public Awareness

There is little public awareness of the potential impact of improvements to building energy efficiency. The state sector dominates action to renovate existing buildings in China, while public participation is still weak. This is evident in several respects: more 'individual' participation and less 'community organisation' participation; more 'passive' process participation and less 'active' decision-making participation; and more participation in the narrow interests of public entities and less in the wider public interest. There is no market driver for house owners to proactively renovate building energy efficiency because the house price is not linked to their property's energy performance rating.

Case Study: Impact of Evergrande debt crisis on building energy efficiency

Evergrande's recent debt crisis has caused ripples throughout the global real estate industry, raising concerns about its impact on green building and energy-efficient building renovation development. However, according to this report's analysis and interviews with experts in the field, the crisis is unlikely to have a significant impact on China's commitments to building energy efficiency improvements.

For real estate developers, it is true that the debt crisis of Evergrande may affect people with poor financial standing or cash flow. Yet the recent crisis has not changed the government's stance on building energy efficiency, and any potential impact on the industry is likely to be short-lived. Instead, other unaffected real estate developers are taking up the market space previously occupied by Evergrande and have prioritised the construction of green building and large-scale building renovation projects due to the attractive direct incentive policies.

For local governments, environmental protection and carbon peak & neutrality have become important criteria by which the central government evaluates their performance. Therefore, despite the economic impact on Covid-19 on local finance, regional governments are under pressure to achieve these goals and are willing to provide incentives to promote building energy efficiency, amongst other carbon reduction and environmental priorities.

According to the incentive policies issued by the governments of 58 provinces and cities, there has been a surge of activity to promote building energy efficiency. For example, Hebei province offers a subsidy of CNY 1 000 per m^2 for ULEB projects with a construction area exceeding 20 000 m^2. In addition, the floor area ratio bonus is even more attractive to building developers than direct cash subsidies. The additional revenue generated from the floor area ratio bonus can far exceed direct government subsidy. Through these incentives, green building developers can not only recoup the incremental costs incurred by improving building energy efficiency, but also earn higher profits from ULEB projects compared with buildings that have low energy efficiency.

In conclusion, while the debt crisis at Evergrande has caused concerns about its impact on building energy efficiency improvement, the Chinese government's commitment to environmental policies and sustainable development is likely to remain strong. As such, the momentum of green building development and building renovation is expected to continue in the long term.

8. Lessons Learned

This report has offered a general overview of the building sectors in the EU and China and reviewed the financing opportunities in the two regions. Improving the energy performance of buildings is important in both the EU and China. As has been shown, both sides have decades of experience.

The Secretary-General of EuroACE, already quoted above, explains that buildings are the world's most valuable asset, worth some EUR 150 trillion[68]. He goes on: 'The vast majority of these buildings will still be standing in 2050, but to make it that far and to ensure our climate targets can be met, they will need serious work.' Commenting on financing, he adds: 'The buildings sector is a behemoth and the number of moving parts in the financing machine makes the job more complex still.'

Undoubtedly, the buildings sector is truly a behemoth in both China and the EU.

First, let us look at the experience in Europe to give us some insight to the lessons learned.

8.1 Implications of European Building Energy Efficiency Financing for China

8.1.1 Policy framework

There are many factors that should be included in developing energy efficiency strategies for buildings and this complexity is multiplied by the number of Member States and local governments that are involved in different aspects of policy development, standards development, mobilising financing, ensuring effective implementation and proper monitoring and enforcement. For the EU, there is an interplay of the various levels of government together with the integration with a vast range of non-government stakeholders. At the EU level, policy development has expanded since the 1993 SAVE Directive (a move by the European Economic Council to limit carbon dioxide emissions by improving energy efficiency). Before that, the buildings sector was primarily the remit of individual Member States.

Since the 2002 Energy Performance of Buildings Directive, standards for new buildings and existing buildings have steadily become more ambitious. While there are mandatory building standards for new buildings (now NZEB), there are fewer regulations in place for existing buildings. The obligation for existing buildings is for Member States to issue Energy Performance Certificates and to prepare long-term renovation strategies. Member States have a great deal of discretion on the details.

There are, however, important targets and initiatives that are part of the policy framework. The targets for improved energy efficiency are actually energy demand

68 Adrian Joyce, Don't let our most valuable assets crumble away, eceee, 2021. https://www.eceee.org/all-news/columns/dont-let-our-most-valuable-assets-crumble-away/

targets to ensure reducing demand, not energy intensity targets. They are continually being tightened and they play an important role providing long-term signals to Member States and all stakeholders. The two main energy efficiency directives are designed to help achieve a highly energy efficient and decarbonised building stock by 2050 and to create a stable environment for investment decisions.

For buildings, the EU has launched ambitious initiatives such as Smart Finance for Smart Buildings and the current Renovation Wave that challenges the region to renovate 35 million buildings by 2030.

Much more could be discussed but this is outside the scope of this report.

The challenge for the EU is to put all the pieces together to effectively reach the immediate goals of the Renovation Wave, the European Green Deal and the Fit for 55 package.

The EU's policy framework offers their Chinese counterparts evidence of just how comprehensive the approach needs to be at the policy level. The policy framework also shows the important linkages between the EU level, the Member State level and the regional and local levels, depending on the institutional approach in each Member State. The policy framework also has to be seen as a work in progress, with constant monitoring, reviewing and updating.

8.1.2 Implementation

Implementation, understandably, is left to the Member States with a certain level of help from the EU. This is important to understand. First, after the framework directives were approved, the European Commission set up 'Concerted Actions' for each of the relevant directives on energy efficiency, buildings and renewables (which cover heat for buildings). These forums bring in experts from each of the Member States to share experience and discuss implementation issues. Having this regular dialogue has proved valuable and now the three CAs work together to integrate the implementation issues.

The buildings directives cover both existing buildings and NZEBs, building codes, renovation strategies, certification and training, smart buildings, technical elements, finance and information and impact, capacity and data.

Europe's priority is mainly to renovate existing buildings because the region is only adding about 1% annually to the building stock. However, as of 2023, all new buildings must be NZEB. There are reviews underway to see how well this is being implemented.

At the same time as the Renovation Wave announcement, the Commission launched the New European Bauhaus[69] which provides a network and contact point at the crossroads between culture, social inclusion, science and technology. It is intended to bring citizens, experts, businesses and institutions together and facilitate conversations about making tomorrow's living spaces more affordable and accessible. It will also provide financial support for innovative ideas and products by means of

69 https://europa.eu/new-european-bauhaus/index_en

ad-hoc calls for proposals and coordinated programmes included in the Multiannual Financial Framework.

The European Commission also funds many projects to accelerate the renovation of buildings, many of which relate to de-risking projects.

While much is going on, the EU must still find a way to average 3.5 million deep renovations a year under the Renovation Wave. While many elements are in place, no one has yet come up with the right combination of measures to come close to that number of renovations per year. This is more than a financing issue.

8.1.3 Financing

Financing is fundamental to buildings efficiency: a steady flow of financing is needed to meet long-term climate and energy objectives. No one source of funding will work, especially when there are 27 Member States with distinct housing situations. What has not been discussed above are the different economic situations of Member States which lead to different needs. Fortunately, the long-term renovation strategies should mitigate the differences. The varying needs of Member States also lead to differing allocations of public and private financing. The chapter above on EU financing shows the wide range of financial offerings. It is important that this range is retained, as long as it does not lead to confusion on the part of the investor. For that reason, the One-Stop Shop is valuable, allowing the consumer to assess all the options available. There have even been calls for the One-Stop Shops to be integrated within banks, though there is no agreed model at this point.

Banks and other financial institutions play a key role. Although they are competitors, they also have an important responsibility to coordinate their efforts. The Energy Efficiency Financial Institutions Group (EEFIG) and the United Nations Environment Programme Financial Initiative (UNEP FI) have important parts to play in sharing experience, determining where there are gaps in capacity, and ascertaining the priority for investing in energy efficiency, etc.

SEI Forums offer a series of events across the EU in order to showcase best practices in developing investment projects and programmes in sustainable energy, and engage in dialogue with the financial sector, public authorities, and all stakeholders involved in delivering investments in sustainable energy. These national and regional events offer a valuable opportunity to bring EU-wide concepts to the local level. They also improve networking at all levels.

One important development is the increase in green mortgages and labelling. More and more banks are participating and expanding such offerings. They also offer a way to integrate public support for energy efficiency with private mortgages.

Both the EU and China are developing the concept of taxonomy. The EU Taxonomy `provides a common language to describe and help drive capital to climate-related investments. It represents an extraordinary intervention in the EU financial sector'.[70]

70 Climate Bonds Initiative, Big day! Brussels releases EU Taxonomy as prelude to Biden Summit; China's PBOC releases updated equivalent on same day, 2021. https://www.climatebonds.net/2021/04/big-day-brussels-releases-eu-taxonomy-prelude-biden-summit-chinas-pboc-releases-updated

China has updated its own taxonomy and also incorporates language around the 'Do No Significant Harm' (DNSH) principle (taking a page from the EU Taxonomy) and also indicates the future possibilities of rolling out a 'transition finance' standard. As the Climate Bonds website states: 'it is a signal to the market of coordinated action between the EU and China to address climate change.'

8.1.4 Mobilising Stakeholders

The EU pays considerable attention to the full range of stakeholders, starting with consumers as asset owners or tenants through to service and technology providers, the financial sector, the public sector at all levels, consumers and environmental associations, etc. In Europe, the situation is further complicated because of the many languages in the region, but there are a lot of positive actions under way. Chapter 2 offers information about some of the initiatives such as EEFIG, SEIF, etc. They play a key role in bringing financial institutions together with both governmental and non-governmental stakeholders to create awareness; understand gaps in policy, finance, capacity building, etc.; support capacity building initiatives; and simply encourage networking.

8.2 Implications of China's Building Energy Efficiency Financing for Europe

8.2.1 Policy Framework

China has been developing a strong approach to improving energy efficiency in buildings since the early 1980s. In China, only the central government has right to form laws and regulations, while local governments issue supplementary regulations or policies. From a legislative and policy point of view, China usually adopts a top-to-bottom approach.

In the early 1980s, the former Ministry of Construction began to organise work on energy efficiency in buildings. The principles of consideration in terms of regions and building types were: northern (cold and cold regions) first, then central (hot summer and cold winter regions) and southern (hot summer and warm winter/moderate regions); residential buildings first, then public buildings; new construction first, then renovation. China currently has a system of energy efficiency standards covering five climate zones and the whole process of engineering construction. In November 2015, the Technical Guidelines for Passive Ultra Low Energy Green Buildings were completed and released.

By the end of 2015, China's 'three-step' strategy for building energy efficiency was complete. Energy-efficient design of residential buildings in cold regions reached 65% of the energy efficiency of buildings in the 1980s. Nationwide energy efficiency design for public buildings reached 65% of the energy efficiency of buildings from the 1980s. In addition to mandatory standards that continue to rise, there is a need for guiding standards that are future proof.

Released in 2019, the Technical Standard for Near-Zero Energy Buildings GB/T 51350-2019 defines for the first time the relevant concepts of ultra-low energy buildings, near-zero energy buildings and zero energy buildings in China. Building energy efficiency is becoming a global trend. In the course of global concerted efforts to promote energy efficiency in buildings, many countries have proposed similar but different definitions of buildings, mainly passive houses, ultra-low energy buildings, near-zero energy buildings, (net) zero energy buildings, etc.

From 2015 to 2019, Hebei, Beijing, Shandong, Qingdao, Heilongjiang, Henan, Shanghai, Qinghai and Jiangsu have all issued standards, guidelines and atlases for the design, construction and acceptance of passive ultra-low energy buildings in line with local characteristics, providing impetus for the demonstration of passive ultra-low energy buildings around the world.

In China, although there is a clear energy consumption target, there is no mechanism to coordinate different ministries/regulators at central and local levels to achieve the overall target in the country.

It should be noted that 12 Chinese cities are members of the C40 network of the world's megacities committed to addressing climate change. The C40 China Buildings Programme was launched in 2018. The only other C40 country initiative is in South Africa.

8.2.2 Implementation

China is adding about 2 billion m^2 of new construction annually. The 13th Five Year Plan showed that existing residential building energy efficiency upgrades will total 500 million m^2 and 100 million m^2 for commercial building energy efficiency upgrades. The projection is for a 15% decrease in residential heating energy intensity and a 5% improvement in urban-level commercial building overall energy intensity.

Table 8.1 Building Energy Efficiency Requirements in the 13th Five-Year Plan

Indicator	2015	2020	Five Year Change	Type
Urban new building energy efficiency improvement (%)			20%	Control
Urban green buildings percentage in total new building construction (%)	20%	50%	30%	Control
Green materials percentage in urban new building construction (%)			40%	Projection
Existing residential building energy efficiency upgrades (m^2)			500 million m^2	Control
Existing commercial building energy efficiency upgrades (m^2)			100 million m^2	Control

Indicator	2015	2020	Five Year Change	Type
Average residential unit heating energy intensity decrease (%)			-15%	Projection
Urban level commercial building unit overall energy intensity decrease (%)			-5%	Projection
Urban building level renewable energy proportion of overall power (%)	4%	6% (projected)	2%	Projection
Energy efficient residential building in all residential buildings (%)	40	60 (projected)	20%	Projection
Rural buildings that utilize energy efficiency measures in developed areas (%)		10 (projected)	10%	Projection

Source: C40 China Buildings Programme (CBP): Launch Report, Constructing a New, Low-Carbon Future, p. 8.

Recently, China has seen renovations of multi-family dwellings incorporating passive design, which have been financed commercially without subsidies.

There have been some studies on the quality of renovations. One study identifies 18 causes for quality failures. Only one relates to financing, stating that the work is undertaken under high-cost pressure because the budget and funding for renovation projects is insufficient.[71]

8.2.3 Financing

In China, equity financing is available for investments in new building energy efficiency. However, most Chinese investors only take into account their building's financial value in the short-term. They want to sell their buildings as quickly as possible. Energy efficiency is only of interest to them if it is crucial in their clients' purchasing decision, as is the case in the high-end market. For investors in the mass market, energy efficiency is not important as it is barely relevant in their clients' purchasing decisions.

Concerning banking, in China, funding is provided from the central government to the local governments who then lend to project developers or themselves conduct retrofitting measures. Although green loans have recently been available, the financial instruments being used are mainly grants, subsidies or tax reductions.

On-bill financing is not applicable to China at present because the electricity companies would not allow such arrangements. Those financial instruments, which are commonly used in the EU, need to be adopted in China in the near future.

Residential demand for energy-efficient building retrofits is also an important factor influencing the funding channels. Energy efficiency retrofits in existing buildings require a certain level of demand for energy efficiency from occupants or users of public buildings. The primary motivator is the drive to improve indoor temperatures,

71 Yuting Qu, Queena Qian, Frits Meijer and Henk Visscher, Causes of Quality Failures in Building Energy Renovation Projects of Northern China: A Review and Empirical Study, Energies 2020, MDPI, May, 2020.

and specifically to raise the temperature, and the drive to conserve energy is secondary. The main factors affecting this demand are: the ability of the occupants or users to pay; whether the government's energy efficiency retrofitting policy is reasonable in terms of funding options; if the funding options impose more costs on the occupants or users or if the options are unreasonable, this will reduce the demand for energy efficiency retrofitting. On the one hand, the government should control the cost of energy efficiency retrofitting and reduce the cost of retrofitting; on the other hand, it should develop a reasonable and feasible energy efficiency retrofitting plan to meet the needs of households and users in order to reduce resistance to energy efficiency retrofitting.

Taking into account the responsibilities of the property rights unit and individual residents in energy efficiency renovation initiatives, the funding options for energy efficiency renovation of existing buildings can be divided into three options, according to the principle that the government, property rights unit and individuals should benefit from each other. See the following table for the options.

Table 8.2: Funding Options for Energy Efficiency Renovation

	Funding method	Specific operation method
Option 1	Improvement funds = government subsidy + investment by the property owner + personal commitment	Establish a fair principle of who invests and who benefits. First to benefit should be the property rights unit which advances the transformation funds, given that income will come from the accrued savings in energy costs. After a certain number of years, this operation can be terminated when the capital and profit are recovered, and then the energy usage charges can be readjusted. In addition, the charging policy should reflect the benefit of the individual renovation steps, so as to reduce the difficulty of funding. The focus should be on developing a good distribution ratio.
Option 2	Capital for renovation = government subsidy + investment by the property owner	A good proportion of proceeds should be allocated to the property rights unit which advances the transformation funds, given that the proceeds are from energy bill savings. After a certain number of years, this business can be terminated when the capital and profit are recovered, and then the energy usage costs can be readjusted. This option is popular with the public, but it is relatively difficult and stressful for the property owners to fund. The government needs to conduct a rigorous negotiation and review its policies and regulations.
Option 3	Conversion capital = government subsidy + personal commitment	An energy efficiency renovation fund should be established, the main income for which would be the collection of heating fees, with a portion of the heating costs being used to fund the renovation. Once the retrofit is complete, policy regulation through economic leverage will come into play. Policy regulation should make a clear distinction between customers who have invested in energy efficiency retrofitting and those who have not invested in energy efficiency retrofitting and have failed to meet the standards.

China could benefit from much stronger economic incentives such as fiscal and tax policies, and has insufficient policy support for building energy efficiency, energy-saving renovation of existing buildings, reform of the heating system, and the use of renewable energy.

8.2.4 ETS as a Powerful Financing Instrument for Building Energy Efficiency

To address the problem of the mismatch between financing terms and the return on investment, the building sector should consider involving the ETS market as a financing instrument. ETS can help track the progress of carbon reduction in building projects through carbon accounting by means of the measuring, reporting and verification (MRV) scheme. Carbon accounting quantifies the carbon emissions at each stage of the building life cycle. This data can be used to develop carbon financial products to match building life cycle financing demand and provide differentiated interest rates for credits to remove financing obstacles. The carbon accounting system can also be used to monitor and assess environmental performance and provide data for investors to evaluate the carbon reduction capabilities of building developers to secure bank loans. Moreover, building developers and ESCOs can trade carbon allowances through the ETS market or mortgage carbon assets for financing purposes. This innovative financing mechanism offers the building industry the possibility of flexible financing for the full project cycle, paving the way for a sustainable future.

8.2.5 Mobilising Stakeholders

Public participation is weak and seen more from an individual perspective than a community perspective. As China is still a developing country, material production has not yet reached great abundance, the standard of living of the residents is still relatively low, and residents in the older urban areas tend to be fairly low and middle-income people. Therefore, residents' participation in the renovation of existing buildings must first and foremost focus on material realities closely related to their own interests (such as housing area, the supporting facilities, compensation for demolition, etc.), while naturally paying much less attention to some aspects of public interest (such as the preservation of the historical and cultural environment, the layout of urban roads, the relationship between community renewal and the city as a whole, etc.). It is worth remembering that residents are often highly motivated to participate in energy efficiency measures, but there are few channels and methods for them to do so.

With the reform of the housing system, China's housing has changed from welfare distribution in kind to commodity distribution in money. The concept that buildings are a special commodity has become commonplace, and consumers buy or rent houses in line with their everyday needs. The level of agreement on the importance of energy efficiency in buildings tends to be higher among residents in cold regions and hot summer and cold winter regions. There is less interest among residents in hot summer and warm winter regions. This is mainly due to climatic factors, as residents of cold regions have a higher demand for thermal insulation in winter, when it is very cold and humid, and in summer, when it is hot and muggy, and they want to improve

the thermal insulation of their buildings to improve the indoor thermal environment and the quality of life. For owners of public buildings, which require heating in winter and cooling in summer, there is a slightly higher level of agreement with the need for building energy efficiency than among residents. However overall, recognition of building energy efficiency products still engages a limited percentage of the population, and awareness of energy efficiency among owners of existing buildings is relatively weak.

8.3 Final Comments

There are challenges for both the EU and China as they contemplate reductions in GHG emissions. Both realise that to achieve long-term objectives, the energy performance of buildings must significantly be improved. There is also a growing realisation that improvements to energy performance bring other benefits, such as better health, improved air quality, lower costs and a higher quality of life.

Both the EU and China use a wide range of financial instruments that are intended to give the market a key role. Undoubtedly, the entire costs cannot be borne by the state. The asset owner must be involved and there have to be market instruments that are appropriate to different situations and different ownership patterns. In the EU effectively there were 27 different ways of doing things since there has been no harmonisation of approach until the last few decades and several Member States have been members for less than 20 years. Also, there are few EU-wide financial institutions. Owners normally deal with financial institutions at the local level. The more understanding there is among financial institutions of the importance of improved energy performance, the better.

Financial institutions are familiar with providing mortgages but less so with combining public support with commercial support (mortgages or normal credit). This lack of familiarity is being addressed and is starting to accelerate in the EU.

International cooperation is vital. As we have noted, China has entered into several projects with US Lawrence Berkeley National Laboratory and more recently with the C40 Cities Climate Leadership Group. This is encouraging.

Furthermore, on 18 October 2019, on the margins of the International Monetary Fund (IMF)/World Bank annual meetings in Washington DC, the EU launched the International Platform on Sustainable Finance (IPSF), together with relevant authorities of Argentina, Canada, Chile, China, India, Kenya and Morocco[72]. The ultimate objective of the IPSF is to scale up the mobilisation of private capital towards environmentally sustainable investments. The IPSF therefore offers a multilateral forum of dialogue between policymakers who are in charge of developing sustainable finance regulatory measures to help investors identify and seize sustainable investment opportunities that truly contribute to climate and environmental objectives. Through the IPSF, members can exchange and disseminate information to promote best practices, compare their different initiatives and identify barriers and opportunities affecting sustainable finance, while respecting national and regional contexts. Where appropriate, willing members can further strive to align their initiatives and approaches.

72 https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/international-platform-sustainable-finance_en

9. Recommendations

The EU-China Energy Cooperation Platform plays an important role in nurturing cooperation between the two regions. The EU and China have worked together on G20 activities and these have played an important role. However, a bilateral approach is also important, which ECECP aims to facilitate. In order to improve the financial support to building energy efficiency, it would be valuable for the EU and China to share experience, and to explore opportunities individually and together, at both national and local levels.

9.1 Overview

Based on the experience and lessons learned from both China and the EU, the following recommendations for policy researchers and decisions makers in EU and China involved in financing energy renovations of buildings include:

- Monitor long-term targets to ensure that improving the energy performance of buildings has the expected impact to meet the terms of the Paris Agreement and other related climate and energy objectives.

- Ensure that consumers (asset owners) are sufficiently aware of appropriate financial products to help them when improving the energy performance of their buildings, and work with the financial sector to overcome all the identified barriers that restrict the flow of financing.

- Ensure that high energy-performing new and existing buildings (NZEB, passive, other) are monitored for effectiveness and that technical standards remain under regular review.

- Develop and help execute the implementation plans to ensure that the long-term energy performance of buildings strategies are met (e.g. Renovation Wave in EU).

- Facilitate networking and capacity building in the financial sector to ensure they are developing and providing appropriate financial products and effectively underwriting potential projects.

- Empower cities and regions to develop and implement energy performance of buildings strategies within their jurisdictions.

- Support the sharing of best practice examples in financial products and policies/programmes that support the improvement of the energy performance of buildings.

- Review institutional practices to ensure that barriers affecting effective coordination and cooperation amongst ministries, relevant agencies and different levels of government are addressed to ensure good policy development and positive impact.

- As both regions accelerate their renovations, it would be useful to know how the financial community can accelerate the underwriting and approval of financing. Greater use of the EEFIG Underwriting Toolkit[73] and the G20 Energy Efficiency Investment Toolkit[74] should be promoted to financial institutions to improve their capacity in underwriting activities.

- Monitor the evolution of building stock to help evaluate progress and improve the policy and implementation frameworks.

- Incorporate the building sector into the ETS market so that carbon assets can be traded for financing; create carbon financial products to secure long-term bank loans.

9.2 Potential for EU-China Cooperation

Both the EU and China are making it a priority to ensure that the buildings sector contributes to both regions' long-term energy and climate objectives.

A regular exchange of knowledge and experience would be valuable because both are seeing the full range of their approaches evolving in terms of policies, programmes and technical progress. For example, both regions have been developing NZEB and high-efficiency buildings and the standards have been gradually tightening the relevant standards.

Both the EU and its Member States as well as China have developed an array of financial instruments to meet the needs of different consumer categories. While some of these instruments have been used for many years, there are innovative approaches such as green mortgages in both regions that could benefit from sharing experiences and assessing acceptance and impact.

The EU taxonomy regulation has recently been released and in the same week, China released its own updated taxonomy. China's taxonomy update harmonises it more closely with that of the EU. The two economies are actively working to develop a 'common ground' taxonomy to drive global investment in sustainable solutions, under the above-mentioned umbrella of the International Platform on Sustainable Finance. It would be useful to analyse whether there is scope for further harmonisation to facilitate the flow of investments between the two regions.

Both regions are accelerating renovation of buildings in order to meet more ambitious long-term climate and energy objectives. The EU and China would both benefit from sharing experience in order to learn from each other in the acceleration process. As an example, it is valuable to know how China renovates multi-family dwellings to passive building standards at a cost that is financed without subsidies by commercial banks.

It is valuable for the EU to understand how buildings renovation has evolved in China over the years. The development of the renovation of existing buildings in China has gone through the following stages: large-scale demolition and construction, renovation

73 https://valueandrisk.eefig.eu/

74 https://www.unepfi.org/wordpress/wp-content/uploads/2017/05/G20-EE-Toolkit.pdf

of dangerous buildings, renovation of old housing and combining renovation and conservation. While beyond the scope of this report, it is worth nothing that these phases have been evident in major cities such as Beijing, Shanghai and Tianjin. These could be good case studies for further work by ECECP in this area, particularly because there are many European cities with many older buildings and districts that have also been demonstrating how to improve their energy performance.

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