

REAL ESTATE FINANCE AND CLIMATE TRANSITION

Market practices, challenges
and policy considerations

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This report provides an overview of existing green real estate financing products and the state of the market for these products. Even after a decade of growth, green real estate finance markets remain small compared to conventional real estate finance markets. There are a number of challenges in aligning green real estate finance market practices with sustainability goals, including a lack of common definitions, standards and quality data that hinder the ability of market participants and regulators to identify, monitor and manage risks and opportunities. Drawing on a detailed assessment of these markets and products, this report puts forward policy considerations for elaborating principles and good practices that may contribute to supporting the decarbonisation of real estate assets and meeting the climate objectives of the Paris Agreement.

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Foreword

Despite significant progress in recent years, green real estate finance markets remain small in comparison with the size of conventional real estate finance markets globally and are still at an early stage of development in establishing decarbonisation standards and mechanisms. A number of market practices hinder the decarbonisation of real estate assets and an orderly transition to a low-carbon real estate sector that can help to meet the climate objectives of the Paris Agreement.

To better understand the landscape of climate and green real estate finance and debt instruments, this report explores the high-level objectives, qualitative criteria and quantitative metrics to assess underlying methodological practices used in such products. It identifies practices or gaps that could impede the alignment of green building projects with a low-carbon transition. Drawing on a detailed assessment of these markets and products, this report puts forward policy considerations for elaborating principles and good practices that may contribute to supporting the decarbonisation of real estate assets and meeting the climate objectives of the Paris Agreement.

This report has been prepared by Caroline Roulet and Giulio Mazzone under the supervision of Robert Patalano from the Financial Markets Division of the OECD Directorate for Financial and Enterprise Affairs. The report has benefited from comments and suggestions by delegates within the OECD Committee on Financial Markets, where it was discussed in July 2022. This report also contributes to the Phase II of the OECD Horizontal Housing Project and benefited from contributions and comments by OECD experts on housing mortgage finance from the Economics Department.

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This report contributes to the work of the OECD Committee on Financial Markets which seeks to promote the contribution of financial institutions, including institutional investors, and capital markets to facilitate savings and investment, and finance sustainable and inclusive economic growth. It contributes to the enhancement of policy approaches in the financial sector, such as to promote efficient and transparent public and private debt markets. For more information, visit www.oecd.org/finance/financial-markets/.

Executive summary

Green debt markets have expanded significantly in recent years. European markets account for more than half of total green debt issuance in 2021 – with a significant share of green debt proceeds allocated to green buildings, followed by China and the United States. Green debt finance proceeds have increased substantially as a share of total proceeds allocated to buildings, from 22% in 2014 to almost 30% in 2021. This includes through the use of green bond and loan proceeds to develop green buildings – with specific features for design, construction or operation that help to reduce or eliminate negative impacts on climate and natural environment – and also green structured real estate finance products, such as green mortgage-backed securities (MBS). At the same time, real estate investment trusts (REITs) globally have substantially increased their green bond issuance. Dedicated green bond sections have also expanded in stock exchanges in recent years, which may support the development of real estate benchmarks and strengthen investors' confidence. Evidence shows that green real estate debt markets are experiencing faster growth than other green debt markets, as reflected by the significant increase in the share of green real estate bond and MBS issuance in total green debt issuance, from 20% in 2015 to 32% in 2021. Notwithstanding significant progress, green real estate finance markets remain small in comparison with the size of conventional real estate finance markets globally, which suggests that more efforts are needed to promote investments in real estate projects that will serve to achieve a transition to a low-carbon real estate to meet the climate objectives of the Paris Agreement.

Green real estate finance markets are still at an early stage of development in establishing decarbonisation standards and mechanisms within and across jurisdictions. Since the Paris Climate Agreement was adopted in 2015, greater attention has been given to international climate and sustainability objectives, and in turn in real estate finance markets. The real estate sector represents a high share of energy use and carbon dioxide (CO₂) emissions, with the buildings and construction sector accounting for over one-third of global final energy use, and energy and process-related CO₂ emissions, in 2020. Reducing emissions could lead to significant progress towards a transition to a low-carbon real estate sector to meet the climate objectives of the Paris Agreement. Despite significant efforts over the past decade to implement international energy efficiency rating systems in addition to the locally developed rating systems used in many jurisdictions, commitments to industry-wide actions remain limited. These gaps suggest that investment in energy efficiency in real estate lags behind investment in the overall real estate sector. More efforts are therefore needed to decarbonise buildings and promote the construction of green buildings.

To better understand the landscape of climate and green real estate finance and debt instruments, this report explores the high-level objectives, qualitative criteria and quantitative metrics to assess underlying methodological practices used in such products. A number of organisations have developed high-level principles and core metrics to help define eligible green building projects and more accurately assess their impact on achieving environmental and climate transition objectives. In particular, the environmental impact of green debt proceeds used to finance eligible real estate projects can be measured using the frameworks of energy performance certificates (EPCs) and Green Building Rating Systems (GBRSs), which both indicate an adherence to a particular definition of green real estate assets. These certifications aim to indicate a reduction in energy consumption and a building's carbon footprint.

Notwithstanding important progress, there are a number of market practices that hinder decarbonisation of real estate assets and an orderly transition to a low-carbon real estate sector. As such the report also identifies practices or gaps that could impede the alignment of green building projects with a low-carbon transition.

The research identifies a number of major challenges in the alignment of green real estate finance market practices with sustainability goals, notably:

- ***The main focus placed on energy performance for eligible green building projects in the green bond and loan principles, and the lack of a robust methodology aligned with the Paris Climate Agreement objectives***, could limit the effectiveness of these frameworks to achieve climate transition goals. The lack of a comprehensive set of quantitative metrics along with carbon emission reduction targets and pathways may represent a substantial challenge for real estate assets and underlying real estate finance products to support an effective and orderly climate transition.
- ***The focus of most applied GBRs worldwide on energy performance rather than on carbon emission reductions*** could limit their effectiveness to decarbonise buildings and promote the construction of green buildings. Nonetheless, a gradual substitution of renewable and decarbonised energy sources to carbon-intensive energy sources may be needed due to the substantial climate transition costs for homeowners. Although all major GBRs consider strategies towards promoting net-zero carbon emission buildings, the lower weighting assigned to the use of renewable and decarbonised energy sources and low-carbon design could result in a lesser consideration given to zero carbon emission goals and to the decarbonisation of real estate assets.
- ***The wide range of disparate GBRs call for efforts to ensure better clarity and comparability***. The lack of common definitions, standards, quality data and financial products for climate transition and the decarbonisation of real estate assets are hindering the ability of market participants and regulators to identify, monitor and manage risks and opportunities.

These challenges may weigh on the capacity of green real estate finance markets to provide sufficient mechanisms and incentives to decarbonise real estate assets. The varying effectiveness of existing green real estate finance principles, metrics and ratings systems to promote the carbon neutrality of real estate assets could undermine the functioning of green market products, and pricing, which in turn could erode investor confidence. These challenges could ultimately constrain the pace and scale of the capital allocation needed to achieve tangible progress to support a transition to a low-carbon real estate sector. In parallel to green products and GRBSs, some real estate mortgage lenders and investment vehicles - such as banks, asset owners, asset managers and REITs - report directly on climate-related efforts, even though this area is still at the development stage as disclosure of climate-related risks improves. The Task Force on Climate-related Financial Disclosures (TCFD) recommendations aim to improve and increase reporting of climate-related financial information and risks.

Policy measures may be warranted to strengthen the alignment of green real estate assets with the low-carbon transition. In particular, policies could focus on strengthening green real estate bond and mortgage loan frameworks to improve the existing tools, methodologies and products, and support an orderly climate transition. Notably, industry-wide principles and good practices could significantly contribute to the development of a level of playing field for better consistency and integrity of green real estate bond and mortgage markets. Creating and sharing best practices, particularly for the classification, pricing, and securitisation of financial instruments, could help investors identify the benefits of these products for climate transition and enhance their ability to identify, monitor and manage risks and opportunities. Developing such principles and good practices would require collaboration between governments and lenders, energy suppliers, retrofit contractors, homebuilders, and other stakeholders. An ecosystem of providers could finance and implement green home and building improvements at scale, and ensure such implementation is verified and measured. Given the increasing appetite for green real estate finance assets

among international and local investors, such policy guidance and incentives for green real estate bond and MBS issuance could significantly contribute to the liquidity needs of the domestic financial sector. Against this backdrop, green real estate finance could become more liquid and efficient, which in can support resilient intermediation to the real economy.

Overall, greater international co-operation is needed to promote international comparability and the alignment of green real estate assets with the low-carbon transition, enhance market efficiency, reduce market fragmentation, and strengthen investor confidence and market integrity. Addressing challenges related to the lack of clarity and comparability of GBRSs could support efficient and effective risk management frameworks to strengthen the resilience of green real estate financial products and the range of financial intermediaries exposed to these markets. Also, improving sufficient incentives and mechanisms towards needed carbon reduction targets and pathways in existing instruments collectively could help ensure that capital can be effectively allocated to real estate investments that support a low-carbon transition.

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1 Introduction

Since the Paris Climate Agreement was adopted in 2015 under the United Nations Framework Convention on Climate Change, participating countries have agreed to a common goal of maintaining the global temperature increase to well below 2°C, and around 1.5°C under the optimal scenario, by the end of the century. According to the 2021 United Nations Environmental Programme (UNEP) Emissions Gap report, carbon emissions by 2030 are projected to decline by 7.5% compared with previous unconditional nationally determined contributions (NDCs), whereas 30% is needed to limit warming to 2°C and 55% is needed for 1.5°C (UNEP, 2021^[1]).¹ As the buildings and construction sector accounted for 36% of global final energy use and 37% of global energy and process-related carbon dioxide (CO₂) emissions globally in 2020, the sector will play a major part in achieving this vision (UNEP, 2021^[2]). Notably, the buildings sector could contribute in supporting the decarbonisation of the global economy, through improvements in energy efficiency to reduce energy demand, reducing use of materials and reducing their embodied carbon, and supporting adoption of distributed low-carbon and renewable energy generation. Nevertheless, only a small fraction of properties are carbon neutral, and on the current trajectory it will take nearly a century to decarbonise the remaining buildings and individual homes (The Economist, 2022^[3]). As the world urbanises, the real estate building industry is booming. Estimates suggest that cities will need to add 13,000 buildings every day until 2050 just to keep up with global population growth. Therefore, actions are warranted to limit the carbon footprint of the property industry and achieve the decarbonisation of real estate assets in alignment with international climate transition objectives.

A variety of different terms have been used to characterise very-low energy buildings, with the target of “zero” energy or carbon emissions from buildings, whereby any energy consumed within the building is generated by renewable sources at the building site. According to an OECD/IPEEC report (2018^[4]), most countries’ policies are aimed at zero-energy instead of zero-carbon, as building regulators generally have more direct control over building energy consumption. In contrast, the overall carbon content of purchased energy may be difficult to control for building owners as it is often dependent on policies or regulation in other sectors aimed towards decarbonising the energy supply. Importantly, the difference between a zero-energy and zero-carbon approach can be significant in terms of the likely impact on emissions. Based on the OECD/IPEEC report, the Global Alliance of Buildings and Construction (GlobalABC), International Energy Agency (IEA) and UNEP have jointly developed a roadmap for buildings and constructions “towards a zero emission, efficient and resilient buildings and construction sector” over the period from 2020 to 2050 (GlobalABC/IEA/UNEP, 2020^[5]), which uses the following definitions for “zero-carbon emission buildings”:

- *Net-zero operational energy buildings* are buildings by which the energy consumption over the course of the year is offset by renewable energy generation.
- *Net-zero operational carbon buildings* are those in which carbon emissions resulting from electricity consumption and any other fuels consumed on-site are offset through renewable energy generation or other forms of carbon offsetting.

¹ If continued throughout this century, without any substantive progress towards carbon neutrality by 2050, it would result in warming of 2.7°C.

- *Whole-life net-zero carbon emissions buildings* are those in which the carbon emissions from the materials used in their construction, or embodied carbon, are offset, as well as their operational carbon emissions.

Since 2015, greater attention has been given to international climate and sustainability objectives through the adoption of the Paris Climate Agreement and Sustainable Development Goals (SDGs),² and in turn in financial markets (OECD/UNDP, 2020^[6]). In particular, while the SDGs are operationalised through governments, the real estate sector has a role to play in achieving SDG goal eleven to make cities and human settlements inclusive, safe, resilient and sustainable. In parallel other frameworks such as Environmental, Social and Governance (ESG) rating and investing have emerged to better incorporate non-financial and sustainability risks into investment decision-making. Against this backdrop, green bond and mortgage loan markets have expanded globally in the recent years, including for green building project financing.

Nevertheless, a central question remains: how can investors be sure that the proceeds of green financing products are allocated to real estate projects that will serve to mitigate climate change? While there is no single global definition of what precisely constitutes an “environmentally beneficial” and “climate transition aligned” use of proceeds, different standards have gained acceptance among market participants.³ Various organisations, including the International Capital Market Association (ICMA) and the non-profit organisation Climate Bonds Initiative, have developed green bond standards. Also, the Loan Market Association (LMA),⁴ together with the Loan Syndications and Trading Association (LSTA) in the United States and the Asia Pacific Loan Market Association (APLMA), have developed green loan principles. Environmental impacts of green bond or loan principles for green real estate projects are addressed within the frameworks of energy performance certificates (EPCs) and Green Building Rating Systems (GBRSs) that indicate adherence to particular definitions of green real estate assets. In so doing, green debt instruments help align the incentives of borrowers and lenders, and make it easier for asset managers to satisfy increasing investor demand for ESG labelled investment solutions.

This report provides an overview of the various existing green real estate financing products and the state of the market for these products. After a decade of growth, green real estate finance markets remain small compared to conventional real estate finance markets. There are a number of challenges in aligning green real estate finance market practices with sustainability goals, including the lack of common definitions, standards, quality data, and financial products that hinder the ability of market participants and regulators to identify, monitor and manage risks and opportunities. More efforts are needed to promote investments in real estate projects so as to transition to a low-carbon real estate and meet the climate objectives of the Paris Agreement. Drawing on a detailed assessment of these markets and products, this report puts forward policy considerations to elaborate principles and good practices that may contribute to supporting the decarbonisation of real estate assets. The rest of this paper is structured as follows:

- Section 2 explores the expansion of green real estate markets globally over the last decade, through the rising share of bond and loan proceeds allocated to buildings, the development of green mortgage-backed securities (MBS) markets and the role of real estate investment trusts (REITs), benchmarks and stock exchanges to support the expansion of green debt finance in real estate.

² SDGs they have been increasingly accepted to help develop policies and strengthen regulatory frameworks for better aligned private sector incentives with public goals, including incentivizing the private sector to adopt sustainable practices, and foster long-term quality investment.

³ Climate transition often takes a whole economy perspective towards identify decarbonisation. However, in the real estate sector, the focus on climate transition relates primarily to the transformation of existing green products and certifications to better align them with explicit decarbonisation targets and pathways.

⁴ LMA is the authoritative voice of the syndicated loan market in Europe, the Middle East and Africa (EMEA).

- Section 3 describes the various existing green debt instruments with a focus on the effectiveness of environmental objectives, qualitative criteria and quantitative metrics to help transition towards carbon neutral real estate assets.
- Section 4 discusses high-level policy considerations to help strengthening green real estate bond and mortgage loan frameworks, including policies to strengthen the tools, methodologies, and products to further help support an orderly decarbonisation of real estate assets over time.

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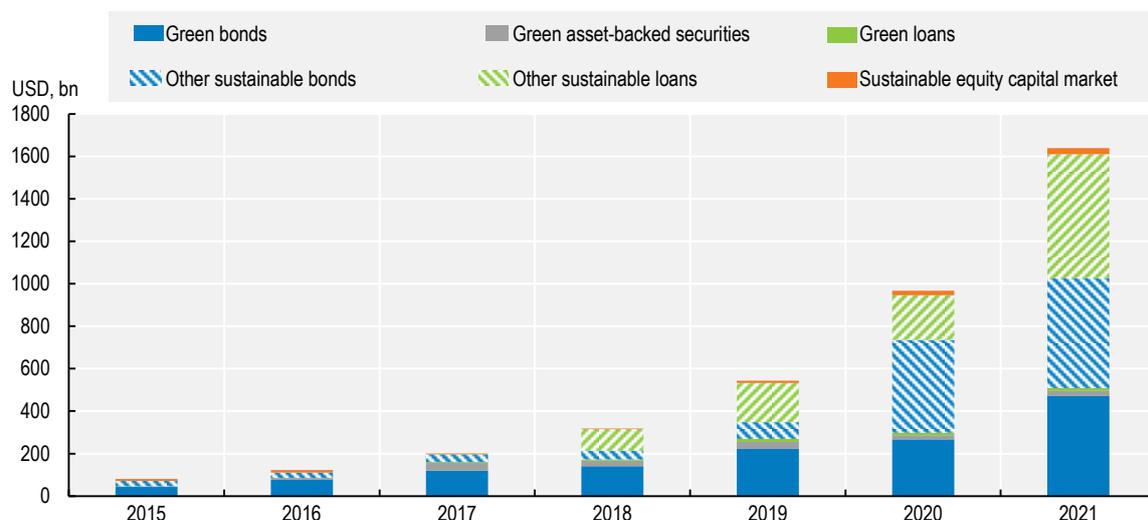
Green real estate debt developments and the prominent role of market-based finance

Sustainable finance has a key role to play in channelling private investment towards the transition to support low-carbon sustainable economic growth. Sustainable finance products and approaches have significantly expanded globally in recent years, such as green bonds and ESG integration. In this respect, green financing and the use of ESG factors have also expanded in real estate finance markets amid the significant scope for the buildings sector to contribute to the decarbonisation of the global economy. This section explores the expansion and the composition of green real estate markets globally over the last decade, through the rising share of bond and loan proceeds allocated to buildings and the development of green MBS markets. It also examines the role of REITs, benchmarks and stock exchanges in supporting the expansion of green debt finance in real estate.

2.1. The development of green debt markets for real estate project financing

Sustainable finance markets have significantly expanded globally in recent years, and sustainable finance products provide alternative financing solutions to address environmental and social challenges. At the end of 2021, issuance in sustainable debt markets reached record levels at USD 1.6 trillion, 3 times the amount recorded in 2019 (Figure 1). A notable development is the significant rise of social and other sustainable financial products in addition to green debt products. While green debt issuance has been the largest source of outright capital until 2019, the sustainability themes have grown significantly since 2020. As a result, total issuance is more evenly spread across a range of sustainability themes, well beyond climate-related aspects, since 2020 compared to prior periods. While sovereign and corporate bond issuance has largely expanded following the COVID-19 crisis, the sustainable bond market has proved to be a flexible source of finance to help with both the immediate impacts and longer-term recovery plans implied by the path to net-zero carbon emissions and implementation of the SDGs.

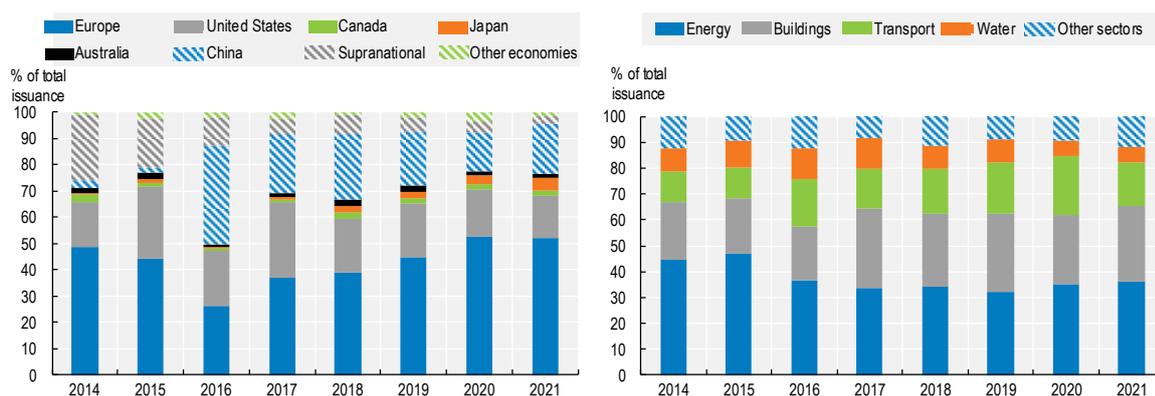
Figure 1. The significant expansion of sustainable finance debt markets over the recent years



Note: Other sustainable debt instruments include elements of social (S) and governance (G) of ESG investment framework.
 Source: Climate Bonds Initiative, Refinitiv, OECD calculations.

Green debt markets are dominated by European markets with a significant share of green debt proceeds allocated to green buildings (Box 1). In particular, issuance of green debt instruments has grown substantially in the recent years. For instance, issuance in 2021 totalled USD 500 billion compared to USD 45 billion in 2015. Green debt markets are dominated by bonds but also include loans and asset-backed securities (ABS) products. The European green debt market accounted for more than 50% of total green debt issuance in 2021, followed by China and the United States (which represent 19% and 16% of total issuance in 2021; Figure 2).

Figure 2. Distribution of green debt instruments issuance by geography and type of proceeds



Note: These figures show the geographical and sectoral distributions of the use of proceeds from issuance of green debt instruments.
 Source: Climate Bonds Initiative, Refinitiv, OECD calculations.

Green debt instruments are increasingly seen as one of the key financial products aimed at financing assets compatible with a low-carbon and climate resilient economy. The share of green debt finance proceeds allocated to buildings in total proceeds stands at almost 30% in 2021, a substantial rise from 22% in 2014. According to the IEA, a building’s entire lifecycle is responsible directly and indirectly for 37%

of global energy-related CO₂ emissions in 2020, more than half of which comes from non-residential properties, construction industries and transportation (IEA, 2021^[7]).⁵ With such a significant contribution, the real estate sector has a key role to play to achieve net-zero emission goals. Therefore, green debt instruments are potentially alternative sources of capital to finance the construction of new green buildings and the retrofitting of existing buildings to improve energy and water efficiency and promote the use and possibly also generation of renewable and decarbonised energy sources.⁶ The relevance of the buildings sector is even higher for cities as up to 70% of a large city's emissions are related to its buildings in 2020 (C40, 2016^[8]; Climate Bonds Initiative, 2020^[9]).

Despite significant efforts over the past decades to implement international energy efficiency rating systems in addition to locally developed rating systems in many jurisdictions, limited commitments to industry-wide actions persist, particularly in emerging markets (World Bank and ICF, 2019^[10]). For instance, green buildings comprise a relatively small share of global construction. Global investments in green buildings accounted for USD 152 billion of the USD 5.8 trillion spent on building construction and renovation in 2019 (IEA/UNEP, 2020^[11]) and represented an even smaller share of the estimated USD 310 trillion in global real estate value (Savills, 2021^[12]). Estimates from the Glasgow Financial Alliance for Net-Zero (GFANZ) and the IEA's Faster Transition Scenario suggest a global investment need of between USD 5.2 and USD 5.4 trillion to decarbonize existing buildings and reach net-zero by 2050 (GFANZ, 2022^[13]; IEA, 2019^[14]).⁷ Almost 60% of investment in the buildings sector is estimated to be in China, India, the European Union, and the United States. The biggest bulk of investment is estimated to be in construction with 67%, followed by heating and cooling with 18% of cumulative investment by 2050. According to IFC estimates (IFC, 2019^[15]), there is a USD 24.7 trillion investment opportunity by 2030 for new green buildings in emerging markets, most opportunities being in East Asia Pacific and South Asia (USD 17.8 trillion).⁸ The investment opportunity in residential construction is expected to represent about 60% of the market (USD 15.7 trillion). Subsequently, these gaps suggest that investment in energy efficiency in real estate lags behind investment in the overall real estate sector, and therefore more efforts are needed to decarbonise buildings and promote the construction of green buildings globally.

⁵ Buildings contribute to greenhouse gas (GHG) emissions throughout their lifecycles through direct emissions from onsite energy generation, indirect emissions from offsite energy generation, and embodied carbon from the materials and the construction process. About 9% of global energy-related CO₂ emissions result from the use of fossil fuels in buildings, another 18% come from the generation of electricity and heat used in buildings, and an additional 10% is related to the manufacturing of construction materials.

⁶ Renewable energy includes bioenergy, geothermal, hydropower, solar photovoltaics (PV), concentrating solar power (CSP), wind and marine (tide and wave) energy for electricity and heat generation.

Decarbonised energy sources mainly refers to low-carbon electricity in the forms of renewable energy technologies, hydrogen-based generation, nuclear power and fossil fuel power plants equipped with carbon capture, utilisation and storage.

⁷ An annual average investment of USD 700 billion is required for existing buildings to reach net-zero by 2050, which is mostly concentrated in retrofitting and heating and makes up 80% of all needed investments, followed by appliances. The annual investment need is projected to quadruple between 2020 (USD 186 billion) to 2040 (USD 714 billion), while 70% of all investment needs for existing buildings are concentrated in developed economies.

⁸ IFC defines green buildings as buildings that are at least 20% more energy efficient than baseline buildings.

Box 1. The strategy adopted in the European Union for the decarbonisation of real estate assets

The climate agenda is particularly prominent in the European Union and the European Commission has adopted a specific strategy for the decarbonisation of real estate assets to help achieve climate-neutral objectives.

In December 2019, the president of the European Commission presented the European Green Deal (EGD) and announced the ambition for Europe to become the first climate-neutral continent in the world by 2050 (European Commission, 2019^[16]). The EGD provides an action plan to boost the efficient use of resources by moving to a clean, circular economy, to restore biodiversity, and cut pollution.

While the energy savings potential remains large in all sectors, there is a particular challenge related to buildings, since 75% of the European Union building stock has a poor energy performance. The Renovation Wave Strategy published in October 2020 aims to improve the energy performance of buildings in the European Union (European Commission, 2020^[17]). The Commission aims to at least double renovation rates by 2030 and ensure that renovations will lead to higher energy and resource efficiency. More precisely, building renovation should speed up the integration of renewables, in particular from local sources, and promote broader use of waste heat. According to the Renewable Energy Directive implemented in December 2018 (European Commission, 2018^[18]), building regulations and codes in European Union member states shall require the use of minimum levels of energy from renewable sources in new buildings and in existing buildings that are subject to major renovation where technically, functionally and economically feasible. Member States shall also permit those minimum levels to be fulfilled for building and renovating industrial, commercial or residential properties, inter alia, through efficient district heating and cooling using a significant share of renewable energy and waste heat and cold.

Following the revision of the Energy Efficiency Directive in July 2021 (European Commission, 2021^[19]), the European commission assessments highlight the need for further efforts to reduce emissions in the buildings sector, which accounts for 40% of energy consumption in the European Union (80% of which is in the heating and cooling sector) and 36% of energy-related emissions. Specific targets at the national level are aimed at stimulating change for:

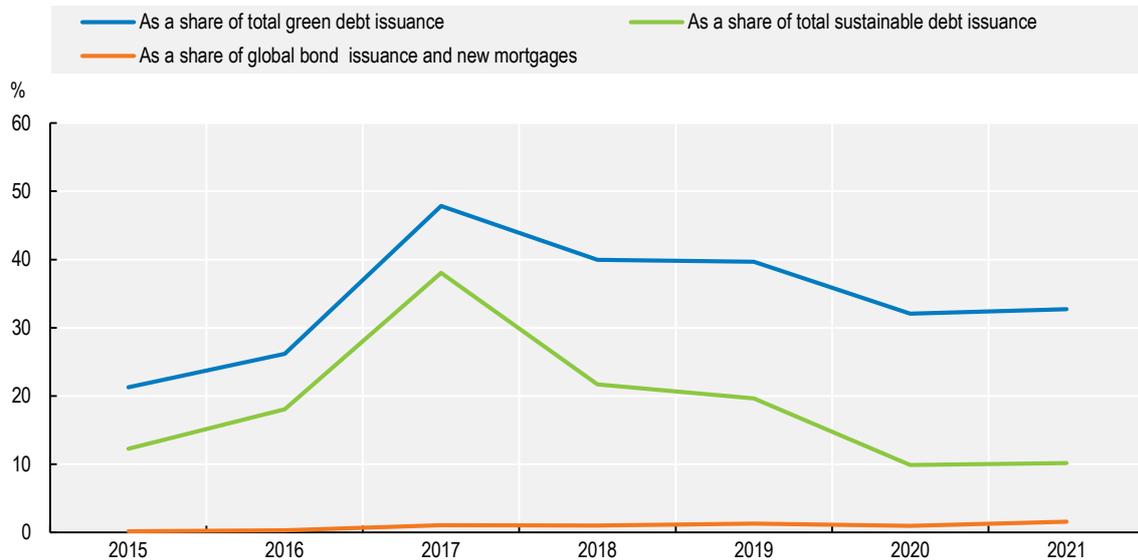
- *Buildings* with a benchmark of 49% renewables use by 2030;
- *Industry* with a benchmark of a 1.1 percentage point annual increase in renewables use;
- *Heating and cooling* with a benchmark of an indicative binding 1.1 percentage point annual increase in all member states including specific indicative national top-ups; and
- *District heating and cooling* with an indicative 2.1 percentage point annual increase in the use of renewables and waste heat and cold (an increase from the current 1.0 percentage point increase).

Overall, the European Union has developed a comprehensive framework for the deployment of renewables for industrial, commercial and residential properties to support the integrated energy system of the future and contribute to its ambition of reducing net greenhouse gas emissions by at least 55% by 2030, and ultimately becoming climate neutral by 2050.

Nominal amounts of green financing are small compared to conventional debt markets, and are growing at a slower pace than issuance of other sustainable debt instruments. Green real estate bond and MBS markets represent about 1.5% of total conventional bond issuance and new mortgage loans granted in 2021 (Figure 3). Also, other segments of sustainable financing are expanding faster than green real estate financing. For instance, the share of green real estate bond and MBS issuance in total sustainable debt issuance has fallen substantially, from more than 38% in 2017 to about 10% in 2021, following the strong

growth of social and other sustainable debt issuance. Nevertheless, green real estate debt markets are experiencing faster growth than other green debt markets. In particular, the share of green real estate bond and MBS issuance in total green debt issuance stands at 32% in 2021, a significant increase from 20% in 2015.

Figure 3. The size of global green real estate bond and mortgage-backed securities markets



Note: This figure shows green real estate bond and MBS issuance as a share of global green debt (including bond and loans) issuance, global sustainable debt issuance (including green debt and other sustainable debt instruments, such as elements of social (S) and governance (G) of ESG investment framework) and global bond (including corporate, financial companies and sovereign) and new bank mortgage loans granted (in jurisdictions where green MBS are issued, i.e. the United States, The United Kingdom, the European Union and China) respectively.
Source: Climate Bonds Initiative, Refinitiv, (S&P Global Ratings, 2022^[20]), OECD calculations.

Real estate is a large and well-established long-term investment asset class for institutional investors and commercial banks. Notably, institutional investors hold USD 100 trillion in assets at the end of 2018, of which about 8% to 10% comprises real estate investments (Institutional Real Estate, Inc, 2018^[21]). The global market for residential mortgage loans from commercial banks was estimated to be more than USD 31 trillion in 2018, which represents about 30% of their total balance sheet (G20 Energy Efficiency Finance Task Group/IEA/UNEP, 2017^[22]). Therefore, strengthening efforts to mobilise commercial banks and institutional investors is essential for scaling up green financing of real estate assets. Institutional investors would provide needed liquidity and enable primary lenders to free up capital to develop new green lending products. Direct loans and equity investments from institutional investors could also be effective in scaling up local currency green financing (CCFLA, 2022^[23]). In addition, commercial banks could significantly accelerate the uptake of green building practices by developers and owners through new green financial products for resource-efficient buildings and green securitisation. In return, institutional investors and banks could expand their client base and product offerings, and benefit from greater opportunities to diversify their investment portfolios. Borrowers could also access new sources of finance through green bonds and green credit facilities.

2.2. The expansion of green mortgage-backed securities in major markets

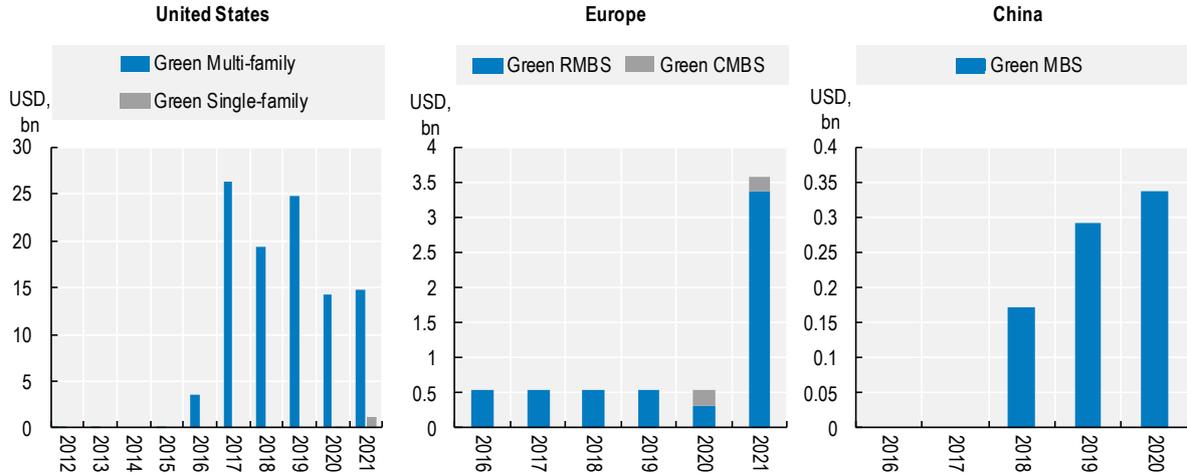
Among the several types of green credit assets, green ABS includes real estate MBS. In the last five years, green MBS markets have significantly expanded, particularly in the United States and to a lesser extent in other major MBS markets including Europe, China and Australia.

Green US MBS markets are dominated by issuance from Government Sponsored Enterprises (GSEs) and US municipalities (falling under either local government or government-backed entities issuer types), yet growing at a slower pace than overall MBS markets, particularly following the COVID-19 crisis (Climate Bonds Initiative, 2021^[24]). Green agency MBS are mainly issued by Fannie Mae and Freddie Mac backed by single or multifamily Green Mortgage Loans (GMLs) (Fannie Mae, 2021^[25]). Fannie Mae issued its first green multifamily MBS in 2012 and Freddie Mac in 2019. Also, both GSEs started to issue green single-family MBS in 2020. Over the period from 2012 to 2021, GSEs have issued about USD 103 billion of green multifamily MBS and USD 1.2 billion of green single-family (Figure 4). Fannie Mae dominates the US green MBS markets, with Fannie Mae issuance accounting for 95% of total US green MBS issuance. Nonetheless, green Residential Mortgage Backed Securities (RMBS) issued by GSEs account for a very small share of the overall US MBS markets over the period 2013-2021 (Figure 5). Indeed, a maximum share was reached in 2017 and culminated at 1.4%. However, this share dropped substantially since 2020 and stands at 0.3% in 2021 following a surge in issuance of conventional MBS by US agencies supported by agency MBS purchasing programs implemented by the Federal Reserve in March 2020.

The size of green MBS markets is also very limited in other large MBS markets, including Europe, China, Australia and Japan (OECD, 2021^[26]). In Europe, green MBS markets have mainly expanded in France and the Netherlands (Petit, C. and Schlosser, P., 2020^[27]). European green MBS markets are dominated by RMBS issuance, yet the first green Commercial Mortgage Backed Security (CMBS) has been issued in 2020.⁹ Consistent with US and European green MBS markets, green MBS markets in the Asia-Pacific region are relatively small. In China, total issuance of green MBS represent less than 2% of total MBS issued in China from 2018 to 2020. The first green CMBS was issued in 2017 (S&P Global Ratings, 2020^[28]), a three-tranche deal issued by Harvest Capital Management and China Energy Conservation and Environmental Protection (CECEP) Group. The underlying asset is an office building owned by CECEP Group. A limited number of green CMBS deals have been concluded in 2018 and 2019 (i.e., two deals in 2018; (Climate Bonds Initiatives, 2019^[29]); (Climate Bonds Initiatives, 2020^[30])). In 2020, two green RMBS were issued for the first time in China (Climate Bonds Initiatives, 2021^[31]). In Australia, four RMBS deals were recorded in 2018 and 2019 (Climate Bonds Initiatives, 2019^[32]); three deals performed by Pepper Group and one by National RMBS Trust, for a total of AUD 870 million.

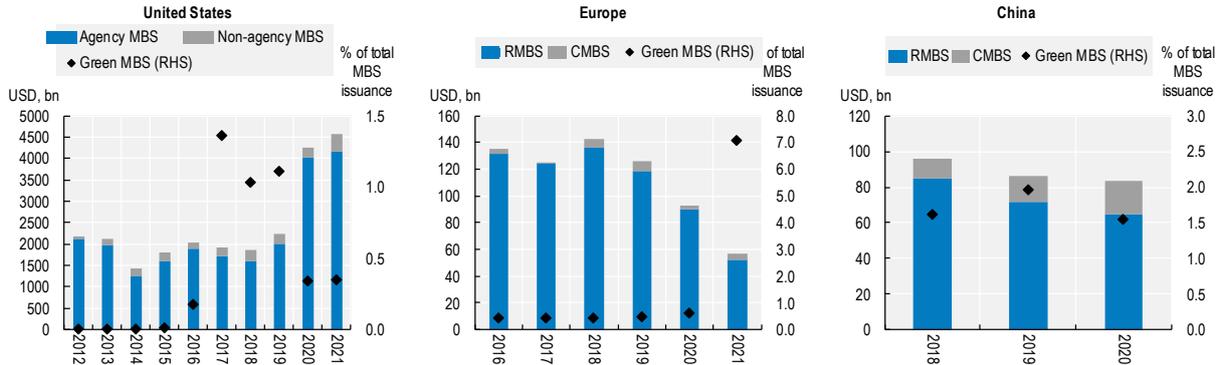
⁹ River Green Finance 2020 DAC is the first green European CMBS issuance that complies with the ICMA green bond principles. The transaction is backed by River Ouest, a single campus-style office property in the western suburbs of Paris.

Figure 4. Green mortgage-backed securities issuance in selected major markets



Note: US green MBS issuance include green multifamily and single-family MBS issued by Fannie Mae and Freddie Mac Issuance of resecuritised pool of multifamily green MBS by Fannie Mae are also included. European data includes UK data. For China, green MBS includes RMBS and CMBS. Collateral types of other green ABS include loans for transport, water, industry, waste, adaptation and renewable energy. Source: Fannie Mae, Climate Bonds Initiative, AFME, OECD calculations.

Figure 5. The size of green versus conventional mortgage-backed securities markets



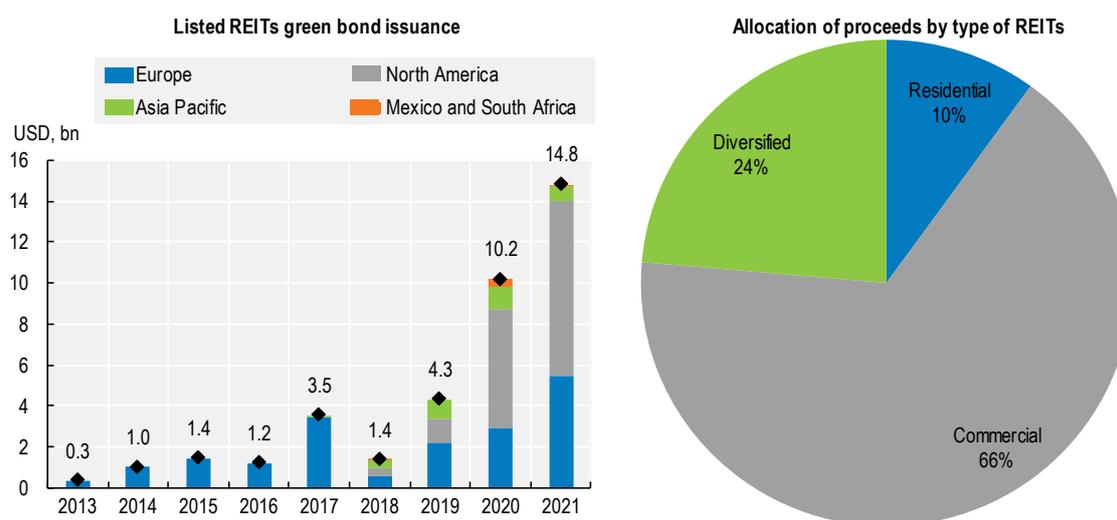
Note: US agency MBS issuance includes residential and multifamily securitisations from Fannie Mae, Freddie Mac and Ginnie Mae excluding risk transfer deals. All other government agency or GSE securitisations or guarantees and GSE risk transfer deals are part of non-agency ABS or MBS. European data includes UK data. Source: Fannie Mae, SIFMA, Climate Bonds Initiative, AFME, CNABS, OECD calculations.

2.3. The role of investment trusts, benchmarks and stock exchanges to support the expansion of green real estate debt finance

Issuance of green bonds by real estate investment trusts (REITs) globally has increased substantially over the recent years. As green building investments are by nature long-term investments, these initiatives are more suitable for long-term real estate investors such as REITs. Also, alternative green investments could enable REITs to diversify their investment portfolios and attract new clients by offering sustainable investment opportunities. For instance, the global REIT green bond has attracted a steady stream of new issuers since 2016. Green bond issuance by REITs was dominated by European REITs until 2018. Since

then, REITs in North America and the Asia Pacific have also started issuing green bonds (Figure 6), and the total annual amount of issuance reveals an increasing trend in the last few years with significant acceleration in 2020 and 2021. Looking at sub-sectors, issuance by commercial REITs dominate, accounting for 66% of total issuance over the period 2013-2021, followed by diversified and residential REITs.

Figure 6. Green bond issuance of real estate investment trusts globally



Note: The left chart shows green bond issuance of 80 listed REITs (including 179 bond deals) available in Refinitiv over the period 2013-2021. The Asia-Pacific region refers to Australia, Japan, New-Zealand and Singapore. Europe refers to all European Union economies and the United Kingdom. North America includes the United States and Canada. The right chart shows the distribution of green bond issuance by type of REITs type.

Source: Refinitiv, OECD calculations.

Dedicated green bond sections have expanded in stock exchanges over recent years. Notably, about 18 stock exchanges have established dedicated green bond sections during the last five years. In addition to the European and Asian exchanges that form the majority, Mexican, Chilean, Argentinian and South African exchanges have such segments.¹⁰ Dedicated sub-segment to real estate green bonds in major markets will play a significant role in improving market access, helping generate liquidity and raising the profile of such green bonds. In addition, since March 2014, a number of ratings agencies and financial institutions have also developed green bond benchmarks, although there is currently no dedicated real estate green bond benchmark. Nonetheless, as standards to promote carbon neutrality of real estate assets improve, and as the market is expanding, benchmarks will play an important role in breaking down some major barriers facing institutional investors. Specifically, these benchmarks will enable investors to better evaluate performance and assess the risk of green real estate financial products and help fund managers to report on the comparative performance of their green bond real estate investments.

Overall, green real estate finance markets remain small in comparison with the size of conventional real estate finance markets globally. In addition to the developments analysed in this section, it could be relevant to also reflect on the substantial climate transition costs for homeowners. An analysis by De Nederlandsche Bank (Zhang et al., 2022^[33]) shows that homeowners often refrain from investing in home retrofitting partly due to financial bottlenecks. Using a panel of 4.3 million homeowners, findings suggest

¹⁰ Climate Bonds Initiative has published a list of stock exchanges that have launched a dedicated green bond and/or sustainable bond section (<https://www.climatebonds.net/green-bond-segments-stock-exchanges>).

that about 20% of homeowners cannot afford such an investment from savings, nor can they borrow the money. Those who do have sufficient means to improve the sustainability of their homes appear to have little incentive to do so. Therefore, climate transition costs and the lack of incentives for homeowners to invest in home retrofitting could hinder the scaling-up of green real estate finance markets.

3 Alignment assessment of debt instruments for real estate project financing with low-carbon transition goals

This section describes the various existing green debt instruments and assesses their effectiveness to reduce the carbon footprint of real estate assets and promote decarbonisation of those assets. In particular, the section focuses on the high-level environmental objectives of eligible green real estate projects and their climate-related benefits. It also explores the various qualitative criteria and quantitative metrics and outlines the underlying methodological practices that could impede their alignment with a low-carbon transition.

3.1. The eligibility of green building projects defined consistently with high-level environmental objectives

Given the wide impact of the real estate on the environment and climate, green bond classification standards¹¹ use several categories to define eligible green real estate projects. Notably, environmental impacts of the real estate industry can be identified throughout the entire economic value chain (i.e., including land use, materials sourcing, supply chain scope and scale, demands on transportation and infrastructure, energy and water pollution and biodiversity, occupant health and well-being, and community impact). Eligible green real estate projects should contribute to one or more of the five high-level environmental objectives: (i) climate change mitigation, (ii) climate change adaptation, (iii) natural resource conservation, (iv) biodiversity conservation, and (v) pollution prevention and control (ICMA, 2021^[34]). Each of the ten categories identified by green bond standards, which are listed in Table 1, represents environmental impacts interlinked with the real estate industry (Global Real Estate Sustainability Benchmark, 2016^[35]). Although the several eligible green real estate projects contribute to achieving environmental objectives, they do so with different levels of intensity.

Only two of the various high-level environmental objectives would provide climate-related benefits, mainly towards mitigating climate change and facilitating adaptation to climate change.

¹¹ The classification standards the most applied worldwide include green bond principles developed by International Capital Market Association, China green bond endorsed project, Climate Bonds Initiative, the joint climate finance tracking group including representatives of Multilateral Development Banks and International Development Finance Club, and the European Commission (i.e., the EU Taxonomy for sustainable activities and the European green bond standards).

- The *Climate change mitigation* objective in real estate is achieved mainly through (i) renewable energy, (ii) energy efficiency, (iii) clean transportation, (iv) green buildings, and (v) adapted products, production technologies and processes.
- The *Climate change adaptation* objective is achieved mainly through (i) strengthened resilience of real estate assets for future climate change adaptation, (ii) environmentally sustainable management of living natural resources and land use, and (iii) sustainable water and wastewater management.

Among these two climate change objectives, only green project categories that includes strategies to promote renewable energy generation at the building site, the purchase of renewable and/or decarbonised energy generated off-site and other forms of carbon offsetting (such as net-zero energy buildings and the use of low-embodied carbon materials) within the climate change mitigation objective would contribute to achieving decarbonisation and carbon neutrality of real estate assets.

Among other potential additional weaknesses of this framework, the relevant objectives and their relative contributions are project specific. In addition, projects may be deemed to contribute to various objectives but without necessarily prioritising among them. In addition, there is no comprehensive methodology to assess the magnitude of the contribution of each green project category to environmental objectives.

Therefore, a common understanding of what qualifies as a green project and how such green projects contribute positively to climate transition objectives would help investors, issuers and banks seeking opportunities for investing in energy efficient and low-carbon emission real estate projects across multiple jurisdictions. For instance, green bond standards are designed to promote the transparency and integrity needed to enhance green bond market efficiency and redirect capital flows to more sustainable investment opportunities, including financing climate transition projects towards a decarbonised real estate sector.

Table 1. Mapping the contribution of green project categories to environmental objectives interlinked with the real estate industry

Green project categories	Building attributes	Environmental objectives of green bond standards				
		Climate change mitigation	Climate change adaptation	Biodiversity	Natural resource conservation	Pollution and control
Renewable energy	Buildings that demonstrate onsite renewable energy generation and/or distributed to the grid (i.e., solar, wind, geothermal, fuel cell, other) Offsite renewable energy purchase, which help reducing and/or off-setting carbon emissions	***			*	*
Energy efficiency	Buildings that demonstrate energy efficiency metrics at above market performance (i.e. Energy Performance Certificate (EPC), ENERGY STAR, NABERS or Net-Zero Energy Buildings (NZEB) ratings), Peak load demand reduction (i.e. thermal energy storage, demand response systems) Building energy retrofits (i.e., equipment upgrades, energy management systems, deep retrofits)	***				*
Pollution prevention and control	Buildings that demonstrate waste management metrics above prevailing building codes and/or standard market practices (i.e., waste recycling rates, construction/demolition, building operations, ozone depletion, construction activity, storm water quantity/quality, in corporate social and health factors of building occupants and visitors, ventilation controls and strategy, IAQ plan, sophisticated thermal control, sound insulation and indoor ambience)				*	***
Environmentally sustainable management of living natural resource and land use	Real estate investments that demonstrate sustainable land use attributes regarded as conservation and/or preservation (i.e., smart growth development, wetlands preservation, historic rehabilitation, certified forests, organic farmlands)	*	**	***	***	
Terrestrial and aquatic biodiversity	Real estate investments that demonstrate attributes regarded as preserving habitat biodiversity and/or cultural resources (i.e., conservation easements, land banks, carbon sequestration, ecosystem services, ecological connectivity)		*	***	***	
Clean transportation	Real estate investments that demonstrate support to multiple types of transit modes (i.e., accessibility by public transport, carpool/vanpool programs, cyclist facilities, incorporate clean transportation infrastructure, electric vehicle charging stations, fuel cell vehicle charging stations, liquid/gas/battery facilities)	***			*	***
Sustainable water and wastewater management	Real estate investments that demonstrate attributes regarded as minimizing potable water consumption/disposal (i.e., capture/recycle storm water, vegetated/green, roofing, no potable water in landscaping, water metering/monitoring systems, sustainable drainage systems)		**	**	**	***

Green project categories	Building attributes	Environmental objectives of green bond standards				
		Climate change mitigation	Climate change adaptation	Biodiversity	Natural resource conservation	Pollution and control
Climate change adaptation	Real estate investments that demonstrate attributes regarded as strengthening asset resiliency for future adaptation with variations in use/functionality and the implementation of information support system (i.e. climate observation, early warning systems)		***			
Circular economy adapted products, production technologies and processes and/or certified eco-efficient products	Real estate investments that demonstrate attributes to promote reduced and off-set carbon emissions from the materials used in building construction or embodied carbon (i.e., construction technique, material demand, durability, origin, composition, manufacturing processes, reusability or recyclability)	**		*	***	*
Green buildings	Buildings that meet regional, national or internationally recognised standards or certifications for environmental performance	***	*		***	*

Note: Levels of contribution to objective are reported in the table using stars: *** for primary, ** for secondary and * for tertiary. According to ICMA, such attributions are indicative. The relevant objectives and their relative contributions will be project specific, and projects may also be deemed to contribute to various objectives not necessarily with a given priority among them. The assessment is based on the issuers' judgement.

Source: ICMA (2021), GRESB (2016), OECD.

3.2. Criteria and metrics for environmental objectives of green bonds for real estate project financing

High-level environmental objectives should be complemented by a set of relevant qualitative criteria and quantitative metrics to assess the accurate impact of green building projects towards achieving environmental and climate transition objectives. ICMA has developed specific high-level guidance and definitions to capture and illustrate the environmental and sustainability benefits of green building projects according to seven core dimensions that include: (i) new buildings, (ii) retrofitted buildings, (iii) energy use, (iv) primary energy use, (v) final energy use, (vi) gross building areas, and (vii) certification schemes (ICMA, 2020^[36]). As documented in Table 2, regional, national or (optimally) internationally recognised standards or certifications provide important baselines against which the green building project can be benchmarked. Such guidance is aimed to enhance transparency through disclosure, and promote integrity by encouraging issuers to provide qualitative information on a voluntary basis in relation to their green building projects, either for new buildings or the retrofitting of existing buildings. Also, such qualitative information provides for a meaningful understanding of how much progress has been performed against a baseline. Disclosure of additional relevant information, such as the siting of the building and its purpose, could facilitate a better understanding the design of the project, and its benefits in managing resources and protecting the environment.

32. High-level guidance in the *ICMA Handbook for Harmonized Framework for Impact Reporting* capture and illustrate the environmental and sustainability benefits of projects relating to green buildings and address broad considerations such as water usage and waste management in addition to energy-efficiency and low-carbon in buildings. Nevertheless, the wide range of GBRs and existing, published methodologies for building project GHG accounting and carbon emission reductions make complete consistency of reporting metrics challenging. Also, these guidelines and definitions do not cover impact reporting on green building projects focussed specifically on resilience to climate change and climate change adaptation, which could reduce the relevance of such a framework to help supporting an orderly decarbonisation of real estate assets. Although the highest potential to decarbonise existing real estate assets would result from improvements in energy savings performed through the use of renewable and decarbonised energy sources, environmental impacts across all core dimensions should also intend to minimise the impact of building construction and lifecycle use on the environment in line with ambitious climate transition objectives and industry best practice.

Table 2. High-level guidance and definitions for environmental and sustainability benefits of green building projects

Core dimensions for green building	High-level guidance and definitions
New buildings	New construction and the development of buildings must take account of their impact on ecosystems and biodiversity. Where no certification standard is available or where the certification standard referenced does not provide an analysis of location considerations, these should be highlighted in reporting in particular to demonstrate how construction activities have avoided building on land that should be protected, how access to public transportation is incorporated, and any measures taken to offset negative impacts on biodiversity.
Retrofitted buildings	The retrofit, upgrade or renovation of an existing building, building unit, or any building component or system should take into consideration all efforts to improve energy performance (or reduce energy use for comparable quality of enabling environment and for comparable services) in order to meet some minimum energy efficiency criteria whenever this is technically, functionally and economically feasible. Where both the purpose of the building and its use remain unchanged, the improved performance of the building can be reported against that attained prior to the project. Where the purpose and/or use of the building has been altered, the improved performance should be measured against baselines and benchmarks applicable to new buildings.
Energy use	The annual energy input to the building in order to satisfy the energy needs associated with a typical use of the building and

Core dimensions for green building	High-level guidance and definitions
	by the building services that provide an enabling environment in the building. It encompasses the amount of energy needed to meet the energy demand associated with, inter alia, energy used for heating, cooling, air-conditioning, ventilation, hot water and lighting.
Primary energy use	Energy from renewable and non-renewable sources used in buildings and which has not undergone any conversion or transformation process. For further guidance on calculation of Primary Energy Use including renewable energy generated on site, ISO EN standards or applicable national methodologies for energy and carbon performance assessment in buildings.
Final energy use	The total energy consumed by end-users in their building assets. It is the energy which reaches the final user's asset and excludes the energy used by the energy sector itself.
Gross building area (GBA)	Gross Building Area, also named Gross Floor Area ("GFA") corresponds to the total floor area contained in a building measured to the external walls. The physical environmental impact comes from the entire building, and therefore Gross Building Area is more relevant than Gross Letting Area, which is the amount of floor space available to be rented.
Certification schemes	While the importance of international certification schemes as industry benchmarks is highlighted by their prime position in the proposed Core Indicators, the associated costs and processes may be deemed prohibitive for small local players, or large portfolios of very small assets. Locally applicable proxies may therefore provide a relevant baseline when compatible with the major international certification schemes.

Source: (ICMA, 2020^[36]).

To complement high-level guidance and definitions for green building projects, ICMA has developed core metrics and other sustainability indicators. The aim is to ensure that green building projects make a significant contribution to environmental sustainability by achieving meaningful progress towards this goal across all core dimensions. In particular, proposed metrics and additional sustainability indicators provide baselines and benchmarks to facilitate quantitative reporting at a project and/or portfolio level across geographies. As shown in Table 3, core metrics are based on five pillars including (a) energy performance, (b) carbon performance, (c) water efficiency, (d) waste management and (e) certification standard. The core indicators suggest a focus on the construction, development and refurbishment of green buildings, and are thus also relevant for both new and retrofitted buildings. Other sustainability indicators are complementary indicators to core metrics (Table 4), which are relevant to the management of green buildings over time.

Although both core metrics and other sustainability indicators include energy performance of primary energy used and carbon emission reduction metrics (i.e., performance in terms of energy use reduced/avoided, carbon and annual GHG emissions reduced/avoided, use of materials with lower environmental footprint, air quality, light quality and energy efficiency, and transport connectivity and clean transportation infrastructure), the lack of a robust methodology aligned with the Paris Climate Agreement objectives, including a comprehensive set of quantitative metrics along with carbon emission reduction targets and pathways, could undermine the effectiveness of this framework to achieve climate transition goals. This may represent a substantial challenge for real estate assets and underlying real estate finance products to support an effective and orderly climate transition.

Table 3. Core indicators for green building projects

A. Energy performance	B. Carbon performance	C. Water efficiency and savings	D. Waste management	E. Certification standard, if available
Final and/or primary energy use in new buildings or retrofitted buildings	Carbon reductions in new buildings or retrofitted buildings	Water efficiency in new buildings or retrofitted buildings	Waste management in the construction, demolition, refurbishment process in new or retrofitted buildings	Type of scheme, certification level and m ² GBA
<i>Indicators:</i>	<i>Indicators:</i>	<i>Indicators:</i>	<i>Indicators:</i>	<i>Benchmarks:</i>
Gross building area (GBA) per annum	GBA per annum (expressed as kg)	GBA per annum (expressed as m ³ /m ²)		LEED - Leadership in Energy and Environmental Design

(expressed as kWh/m ²)	CO ₂ /m ²)		Amount per annum of waste minimised, reused or recycled expressed in percentage of total waste and/or in absolute (gross) amount in tons per annum	BREEAM - Building Research Establishment Environmental Assessment Method
Percentage of energy use reduced or avoided versus local baseline or building code; and, if relevant	Annual GHG emissions reduced or avoided in tons of CO ₂ equivalent versus local baseline or baseline certification level	Annual absolute (gross) water use before and after the project in m ³ per annum (for retrofitted buildings)		ANSI/ASHRAE/IES/USGBC Standard 189.1 for the design of high-performance green buildings and/or IGCC;
Percentage of renewable energy generated on site (specifying the relevant renewable energy form)	Percentage of carbon emissions reduced or avoided versus local baseline or baseline certification level	Percentage of water reduced or avoided versus local baseline or baseline certification level, International Green Construction Code (IGCC) or International Plumbing Code	Waste removed in tons	Other standards for green buildings widely known and/or used in the industry locally, such as CEEQUAL, DGNB, EDGE, the International Energy Conservation Code (IECC), the US Property Assessed Clean Energy Programs (PACE), Passive House or Swiss Minergie, when compatible with the aforementioned standards
				National Minimum Requirements for Energy Efficiency in Buildings in EU states (based on the EU Energy Efficiency Directive) and Energy Performance Certificates (EPCs), or national certification schemes

Source: ICMA (2020), OECD.

Table 4. Other main metrics for green building projects

A. Use of materials	B. Biodiversity	C. Water efficiency and savings	D. Waste management	E. Air quality	F. Light quality and energy efficiency	G. Transports
Use of materials with lower environmental footprint for both new buildings and retrofitted buildings	Land use and biodiversity for new buildings <i>Indicators:</i>	Water efficiency for both new buildings and retrofitted buildings <i>Indicators:</i>	Waste management in the use of both new buildings or retrofitted buildings <i>Indicators:</i>	Indoor air quality for both new buildings and retrofitted buildings <i>Indicators:</i>	Light quality and energy efficiency for both new buildings and retrofitted buildings <i>Indicators:</i>	Transport connectivity and clean transportation infrastructure for both new buildings and retrofitted buildings <i>Indicators:</i>
<i>Indicators:</i>	Land remediated, decontaminated, regenerated, in ha or m ²	Amount of rainwater harvested and reused in m ³ /a	Recycling, re-use or composting of non-hazardous waste in percentage	Reduction of particulate matter versus local baseline: sulphur oxides (SO _x)	Number of LED or SSL lighting fixtures with lumen/watt (Lm/W)	Land use density including 'transit oriented development' (people and jobs per unit of land area)
Embodied energy (and carbon) over life-cycle ("cradle to grave"), in tons CO ₂	Percentage of unadulterated green spaces before and after the project	Recharge to groundwater in mm/d, mm/a	Waste removed in tons	Nitrogen oxides (NO _x) carbon monoxide (CO)	Energy efficiency from installation of motion detectors (kWh) vs baseline/previous equipment	Number of electric vehicle charging stations as a share of total parking and/or number of bicycle facilities provided
Percentage of embodied energy (and carbon) reduced over life-cycle ("cradle to grave"), versus local benchmark or baseline		Percentage of water reduced or avoided versus local baseline, baseline certification level, IGCC or International Plumbing Code		(PM _{2.5} /PM ₁₀) and non-methane volatile organic compounds (NMVOCs)	Energy efficiency from installation of low-E window glass panels vs baseline/previous equipment	Distance (in Km) to public transportation (thereby reducing the scope 3 emissions of the building)

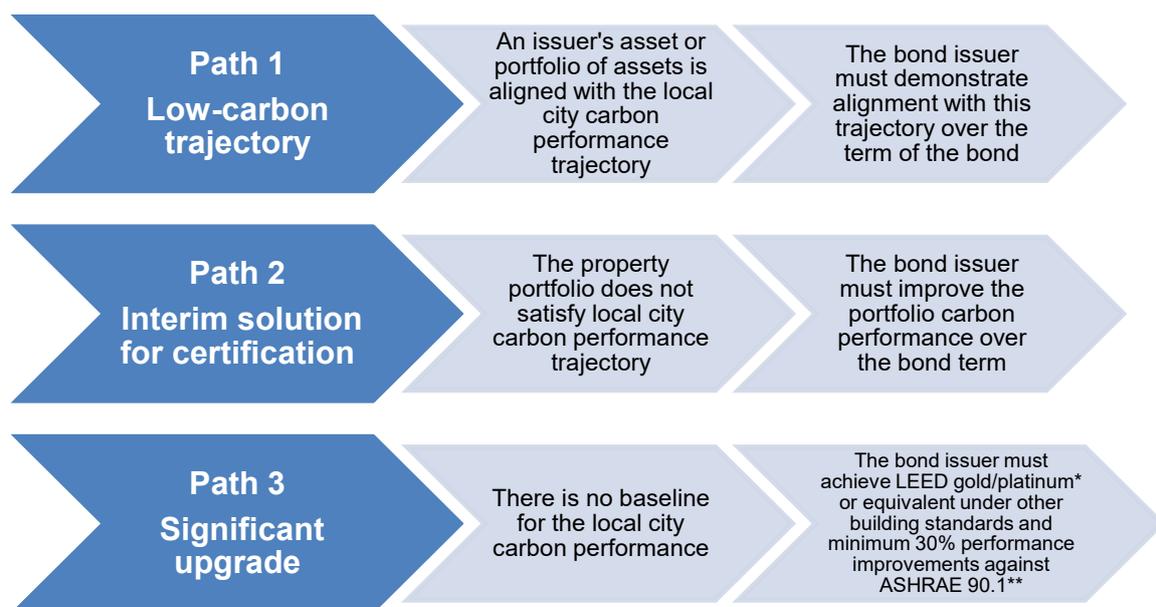
Source: ICMA (2020), OECD.

3.3. “Low Carbon Buildings Criteria” of green bonds for real estate project financing

As the greenhouse gas emissions of cities are significant, promoting investment in low-carbon or zero emissions buildings would play an essential role in achieving the Paris Climate Agreement goals (Climate Bonds Initiative, 2020^[9]). In view of this, the Low Carbon Buildings Technical Working Group (which is part of the non-profit organisation Climate Bonds Initiative) has developed the “Low Carbon Buildings Criteria” (LCBCs) with low-carbon trajectories defined in alignment with Paris Climate Agreement objectives. The aim of this initiative is to define the eligible use of a bond issuance’s proceeds for real estate assets under the climate bonds standards. LCBCs have been developed for three distinct project types (Climate Bonds Initiative, 2020^[37]):

- *For commercial buildings*, guidance applies solely to office buildings. As shown in Figure , there are three options for certifying a commercial building under the LCBCs. The underlying concept of the criteria is the low-carbon trajectory that has been calculated for each city in alignment with the Paris Climate Agreement and a 2°C warming scenario.¹²

Figure 7. Commercial buildings criteria overview



Note: * Under the LEED certification, green building projects are awarded points according to various sustainability criteria that correspond to a level of certification: Certified (40-49 points), Silver (50-59 points), Gold (60-79 points) and Platinum (80+ points).

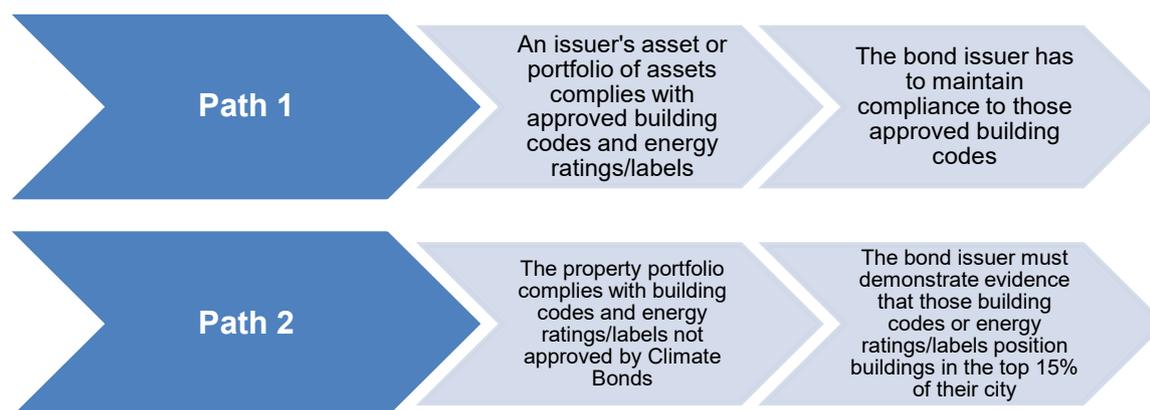
** The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) has developed standards and guidelines for performing energy audits on buildings. ASHRAE 90.1 is a benchmark for commercial building energy codes in the United States and provides the minimum energy-efficient requirements for design and construction of new buildings and their systems, new portions of buildings and their systems, and new systems and equipment in existing buildings, as well as criteria for determining compliance with these requirements.

Source: Climate Bonds Initiative, OECD.

¹² Trajectories calculated for each city have been established by taking a baseline representing the top 15% in terms of carbon intensity (kg CO₂/m sq) and drawing a linear line down to zero carbon in 2050.

- *For residential buildings*, standards apply to buildings used for housing that includes single family, multi-family, and mixed use where more than 50% of the asset is residential. As shown in Figure , local building codes that establish minimum standards for building energy/emissions performance can be used as proxies if it can be shown that they position the buildings in the top 15% of their city. Similarly, energy ratings/labels can be used as proxies if it can be shown that such energy rating/labels position buildings in the top 15% of their city.

Figure 8. Residential buildings criteria overview



Source: Climate Bonds Initiative, OECD.

- *Under upgrade projects*, commercial, residential and some other types of buildings can be eligible for certification if they achieve an emission reduction of 30% for a five-year bond and an emission reduction of 50% for a thirty-year bond from a baseline.¹³

Standards for LCBCs will help to achieve progress towards climate transition objectives and decarbonisation of real estate assets, as targets for carbon emission reductions have been defined in alignment with the Paris Climate Agreement and a 2°C warming scenario. It is worth noting that the adoption of comprehensive zero-carbon-ready building codes,¹⁴ which have been developed by the International Energy Agency, in all countries by 2030 would strengthen the alignment of local building codes with minimum zero-carbon standards (i.e., for structural stability, life-safety, and energy efficiency) that would help transition towards carbon neutral real estate assets (Box 3.1). To date, Climate Bonds have certified more than USD 200 billion in bond issuances. Over 80 climate certified bonds linked to LCBCs have been issued since 2015, representing approximately a quarter of all the bonds so far. Issuers have ranged from private universities and large banks, to central financing authorities and agencies.¹⁵

¹³ For example, if a building currently emits 795 tons of CO₂ per year and a 30-year bond will finance upgrades which are modelled to deliver a 180 tons of CO₂ saving from lighting related emissions and a 220 tons of CO₂ saving from HVAC related emissions, the percentage of reduction in CO₂ emissions is 50%. Therefore, the bond will qualify for Climate Bonds Certification.

¹⁴ A zero-carbon-ready building is highly energy efficient and either uses renewable energy directly, or uses an energy supply that will be fully decarbonised by 2050, such as electricity or district heat. This means that a zero-carbon-ready building will become a zero-carbon building by 2050, without any further changes to the building or its equipment.

¹⁵ Australian ANZ Bank's USD 187 million issuance was the first to be certified using the commercial criteria. Others quickly followed, including the Dutch ABN AMRO bank with two issuances totalling USD 895 million using the residential and commercial criteria. The Indian Axis Bank has issued for USD 25 million of bonds for commercial buildings using the LEED proxy, and the New York State Housing Finance Agency's has issued for USD 233 million

Challenges remain, particularly for commercial real estate assets. Notably, LCBCs standards for commercial buildings do not apply to a wide range of commercial real estate assets, which limits the benefits of this initiative to support decarbonisation widely for these types of real estate assets.

Box 3.1. Zero-carbon-ready building energy codes

In March 2021, the IEA hosted a Net Zero Summit to identify the commitments from countries and companies to reach the goals of the Paris Agreement and further actions needed that should be discussed at the UN Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP 26) in November 2021. A special report has been published, including the Seven Key Principles for Implementing Net Zero that the IEA presented at the Summit (IEA, 2021^[38]).¹⁶ More precisely, the report includes a roadmap for the global energy sector to reach net-zero by 2050 and sets out clear milestones (i.e., more than 400 in total, spanning all sectors and technologies) for what needs to happen, and when, to transform the global economy from one dominated by fossil fuels into one powered predominantly by renewable energy like solar and wind. While the pathway laid out in the roadmap is global in scope, each country will need to design its own strategy, taking into account its specific circumstances.¹⁷

Achieving decarbonisation of energy use in the real estate sector requires almost all existing buildings to undergo a single in-depth retrofit by 2050, and new construction to meet stringent efficiency standards. A zero-carbon-ready building is highly energy efficient and either uses renewable energy directly, or uses an energy supply that will be fully decarbonised by 2050, such as electricity or district heat. Key considerations for zero-carbon-ready building energy codes to set minimum standards for new and existing buildings include:

- **Scope:** codes cover building operations (scope 1 and 2) and emissions from the manufacturing of building construction materials and components (scope 3 or embodied carbon emissions).
- **Energy use:** codes should reflect the important contribution of passive design features, building envelope improvements and high energy performance equipment to lower energy demand and reduce both the operating cost of buildings and the costs of decarbonising the energy supply.
- **Energy supply:** Whenever possible, new and existing zero-carbon-ready buildings should integrate locally available renewable energy resources (i.e., solar thermal, solar photovoltaic, photovoltaic thermal, and geothermal systems) to reduce the need for utility-scale energy supply.
- **Integration with power systems:** Codes could reflect the capacity of a building to become a flexible resource for the energy system (i.e., for example by using connectivity and automation to manage building electricity demand and the operation of energy storage devices).

bonds for multi-family residential projects, using the Energy Star proxy. A number of others have since followed, including Westpac (Australia), Obvion (Netherlands), CDL Properties Limited (Singapore), Treasury Corporation of Victoria (Australia), Investa (Australia), and many others.

¹⁶ Such principles have been backed by 22 among a total of 31 IEA member countries to date.

¹⁷ This means that there is no one-size-fits-all approach to clean energy transitions. Plans need to reflect countries' differing stages of economic development. Therefore, advanced economies are expected to reach net zero before developing economies do.

- **Buildings and construction value chain:** Codes should target net-zero emissions from material use in buildings by encouraging the use of bio-sourced and innovative construction materials.

Building energy codes covering new and existing buildings could help driving the transition to decarbonised real estate assets. For instance, building energy codes currently exist or are under development in only 75 countries, and codes in around 40 of these countries are mandatory for both the residential and services sub-sectors. Under the IEA Net-Zero Emissions Scenario (NZE) by 2050, comprehensive zero-carbon-ready building codes will be implemented in all countries by 2030 at the latest. The adoption of international standards for zero-carbon-ready building energy codes, which also reflect specific country circumstances, would ensure better clarity and comparability without undermining their relevance and effectiveness under the current state of local conditions.

3.4. The effectiveness of single and multi-attribute Green Building Rating Systems towards promoting decarbonisation of real estate assets

Green Building Rating Systems (GBRSs) are typically third-party, voluntary, and market driven standards developed by construction authorities, international organisations, or private consultancy companies with the intention of assessing and verifying the sustainability and “greenness” of buildings. More precisely, GBRSs aim to encourage the adoption of environmentally, socially and economically sustainable practices in design, construction and operation of buildings. GBRSs provide information to real estate investors and bondholders about an existing building or a construction project’s performance from a sustainability and environmental perspective. GBRSs may be either *single-attribute*, focusing solely on water and/or energy, or *multi-attribute*, which address emissions, toxicity, and overall environmental performance in addition to water and energy. While the philosophy, approach, and certification method vary across GBRSs, a common objective is that projects awarded or certified within these programs are designed to reduce the overall impact of the built environment on human health and the natural environment throughout their whole life-cycle.

Over the last three decades, the building sector has witnessed a rapid growth that prompted the need for energy efficiency components of a building to be measured, evaluated and aggregated to an easily interpretable indicator, such as single-attribute GBRSs. Among the several existing single-attribute GBRSs, the ENERGY STAR certification program, introduced in the United States in 1992,¹⁸ and EPCs, introduced in Europe in 2002 (Whole Building Design Guide, 2022^[39]; Farhar, B. C., Collins, N. E and Walsh, R. W., 1997^[40]; Weiss, J., Dunkelberg, E. and Vogelpohl, T., 2012^[41]),¹⁹ are the most widely recognised labels for energy efficient products, including real estate assets. These certifications are benchmarking methodologies to assess energy performance gaps between actual and estimated energy performance for EPCs or against a national building energy consumption benchmark in the case of the

¹⁸ Alaska and California were the first two states to implement policies aimed at improving efficiency and affordability of housing in the United States (Farhar, B. C., Collins, N. E and Walsh, R. W., 1997^[40]) in the early and mid-1980s. In 1995, the non-profit organisation Residential Energy Services Network (RESNET) developed the Home Energy Rating System (HERS) and the governmental Environmental Protection Agency (EPA) introduced the ENERGY STAR certification program for newly constructed single-family homes.

¹⁹ EPCs were introduced for the first time in the Energy Performance of Buildings Directive (EPBD) in 2002, and in 2010 the Energy Performance of Buildings Directive (EPBD) recast added a set of new requirements to improve the quality, usability and public acceptance of EPCs. However, the information inherent in EPCs vary across countries, which could make the comparisons difficult (Weiss, J., Dunkelberg, E. and Vogelpohl, T., 2012^[41]).

ENERGY STAR rating system.²⁰ More specifically, EPC ratings are colour-coded ratings that vary on scale from A to G, A being the most energy-efficient rating, based on the amount of energy used per square meters, the level of carbon dioxide emissions in tonnes per year, and fuel costs. Alternately, an ENERGY STAR rating of 50 indicates that the building, from an energy consumption standpoint, performs better than 50% of all similar buildings nationwide, while a rating of 75 indicates that the building performs better than 75% of all similar buildings nationwide. An EPC rating is valid for a period of 10 years and buildings are ENERGY STAR certified for a period of 12 months. After this period, if a property wants to retain its certification, it must go through the scoring and application process again to demonstrate that it has sustained top performance.

Energy criteria and cut-offs considered in single-attribute GBRs are defined using benchmarking methodologies for energy efficiency performance, yet such criteria are not aligned with international climate transition objectives, which could limit the relevance of existing instruments to provide sufficient mechanisms towards needed carbon reduction targets and pathways to decarbonise buildings, and promote the construction of green buildings. In particular, this approach does not ensure that the highest EPC ratings are necessarily consistent with ratings that could be needed to meet climate change goals under the Paris Climate Agreement. Also, better performance of energy-efficient buildings compared to similar buildings nationwide does not necessarily ensure that improvements in energy efficiency are sufficient to support climate transition in alignment with international climate transition commitments. Although these certifications are effective in helping to reduce energy consumption and buildings' carbon footprint, energy savings do not necessarily result from the use of renewable and decarbonised energy sources, which limits the effectiveness of these single-attribute GBRs in helping to achieve climate transition objectives towards decarbonised real estate assets.

Hundreds of multi-attribute GBRs are now available worldwide, varying in approaches, application processes, and evaluation metrics. BREEAM, CASBEE, Green Star and LEED are among the most applied worldwide (Doan, D., T., Ghaffarianhoseini, A. and Naismith, N., 2017^[42]; Mitchell, L.M., 2010^[43]; Alyami, S.H. and Rezgui, Y., 2012^[44]).²¹ Given the large number of multi-attribute GBRs available, as well as the wide range of methods, terms, models, and indicators they use, there is a consistent body of literature that analyses and compares them (Marchi, L., Antonini, E. and Politi, S., 2021^[45]). For instance, all four of these major GBRs address almost the same core topics despite differences in names and details, confirming that the same concerns are shared at a global level in the real estate sector towards improving sustainability of real estate projects.

- The main assessment categories of BREEAM target low impact design and carbon emissions reduction, durability and resilience, adaption to climate change, ecological value and biodiversity protection.
- LEED covers a comprehensive set of sustainability goals as a means of addressing climate change, enhancing occupants' well-being, and protecting water resources, as well as promoting biodiversity, regenerative material cycles, green economy, community justice, and quality of life.

²⁰ Statistically representative models are used to compare energy performance of a building against similar buildings from a national survey conducted by the Department of Energy's Energy Information Administration. This national survey, known as the Commercial Building Energy Consumption Survey (CBECS), is conducted every four years, and gathers data on building characteristics and energy use from thousands of buildings across the United States.

²¹ The rationale to select these rating systems is based on considering BREEAM, LEED, GREEN STAR and CASBEE as globally well-known leading ones (Doan, D., T., Ghaffarianhoseini, A. and Naismith, N., 2017^[42]). BREEAM is seen as the first green building rating assessment in the world, launched and operated by BRE (Building Research Establishment) in the United Kingdom (Mitchell, L.M., 2010^[43]; Alyami, S.H. and Rezgui, Y., 2012^[44]). It was introduced to the market in 1990 and was first revised to assess offices in 1993. Also, it is widely accepted that almost all later major green rating systems such as LEED, Green Star, and CASBEE are under the influence of BREEAM.

- Green Star assesses the sustainability of projects at all stages of the built environment life cycle and encourages improvements of environmental efficiencies in buildings, and considers users' health and productivity, as well as operational cost savings.
- CASBEE is a method for evaluating and rating the environmental performance of new and existing buildings as well as the overall built environment in Japan, which includes various assessment tools tailored to different scales: construction (houses and buildings), urban (town development) and city management.

Although the major GBRs rate buildings largely based on the overall scores the buildings achieve from the assessment, rating methodologies include minimum requirements and/or credit requirements for the energy aspect.²² This means that applicants must fulfil pre-conditions and/or attain the lowest performance level in order to be certified with the entry-level rating. Therefore, the fulfilment of minimum requirements will not be awarded scores. Instead, applicants will be awarded with different scores upon their fulfilment of different energy-related credits. Such mandatory minimum requirements are particularly relevant to differentiate green buildings from other buildings and provide minimum standards to new investors and building owners who plan to develop green building projects or up-grade the green properties of their existing buildings.

Energy is the major focus in all the major GBRs, which encourage the optimization of energy performance and the reduction in energy used, yet less emphasis is attributed to renewable and decarbonised energy sources. According to the review in Table 5, the energy criterion is used in all major GBRs and is the most important category for all four major multi-attribute GBRs.²³ The energy criterion includes several components, such as the reduction of energy use (particularly the peak load reduction), energy monitoring and reporting, energy efficient appliances, equipment and systems, and the use of renewable energy. Results show that the average weighting of energy (27%) is much higher than the average weighting for all the identified criteria (11%), which suggests that energy plays a crucial role in GBRs. Also, major GBRs allocate the highest weighting to energy compared to the rest of the evaluation criteria (Illankoon, I. M. C. S. et al., 2017^[46]; Shana, M. and Hwangb, B., 2018^[47]).²⁴ This result further indicates that energy is primarily the foremost evaluation criterion for assessing and certifying green buildings. However, all major GBRs allocate the highest weightings to energy components that optimize energy performance and encourage the reduction in energy used and lower weights to renewable and decarbonised energy sources. Also, it is unclear how some of these rating methodologies account for the reduction of carbon emissions from energy savings performed through renewable and decarbonised energy sources.

- In BREEAM for new buildings, 80% of the total number credits allocated to the energy component of the overall rating relate to “reduction of energy use and carbon emissions” and the “energy efficient laboratory”. Only 7% of credits are allocated to “low-carbon design” and “energy efficient transport systems” (i.e., presumably electric vehicles or mass public transport). For existing

²² LEED and Green Star certifications requires pre-requisites. Green Star minimum requirements focuses on greenhouse gases emissions and sustainable sites. LEED pre-requisites applies to the following main credit criteria: sustainable sites, water, material, energy and indoor environment quality. In BREEAM certifications, there are certain minimum overall percentage scores given for each rating level. Apart from that, a credit is assigned to each requirement. However, CASBEE has no pre-requisite to be satisfied before applying for credit points.

²³ This result is consistent with findings in the previous literature (Marchi, L., Antonini, E. and Politi, S., 2021^[45]). In particular, a common finding in the literature is that energy is the most important category for all four major multi-attribute GBRs, followed by materials, and health and well-being. Transport, land use and ecology are usually weighted less.

²⁴ These results are consistent with previous studies performed by including a larger number of GBRs.

residential and commercial buildings, only a small percentage of credits (under 7%) are assigned to solar photovoltaic panels, energy efficient transport systems and solar thermal panels.

- In LEED for new buildings, 55% of credits are allocated to “optimize energy performance” and only 15% of credits are assigned to “renewable energy”. For existing buildings, there is no “renewable energy” component in the overall energy rating category.
- Green Star aims to reward new building and retrofitting projects that reduce overall greenhouse gas emissions by energy demand reduction, use efficiency, and power generation from alternative sources. While 90% of credits or more are assigned to greenhouse gas emission reductions for new or existing buildings, there is no detailed information about the share of greenhouse gas emission reductions lowered through energy savings from the use of renewable and decarbonised energy sources (Green Star, 2019^[48]). Among the criteria considered in the simulation model to assess the associated energy consumption and greenhouse gas emissions, only the “on-site energy generation” component refers to the use of renewable energy sources.²⁵
- CASBEE encourages “natural energy utilisation” for both new and existing buildings. Nevertheless, the contribution to energy savings from renewable and decarbonised energy sources cannot be assessed due to the complex weighting system.

²⁵ The simulation model to assess the associated energy consumption and greenhouse gas emissions includes the following components: thermal calculation method, location, adjacent structures and features, environmental conditions, orientation, geometric model, building envelope, external surfaces solar absorptance, infiltration rate, project operation, heating/ventilation/air-conditioning, artificial internal/external lighting, domestic hot-water systems, on-site energy generation, lifts, other energy consumption, small power and process loads, appliances and swimming pools.

Table 5. Description and weighting of the energy criteria in the major green building rating systems

Green building rating system	Description and energy focus areas	Certification stage	Maximum contribution of the several environmental criteria to the overall rating (%)	Distribution of credits allocated to the various energy components
<p>BREEAM Building Research Establishment Environmental Assessment Method</p> <p>Country:</p> <p>United Kingdom</p> <p>Managing organisation:</p> <p>BRE Group</p>	<p>BREEAM is a voluntary international standard that is operated and applied through a network of international operators, assessors and industry professionals. It provides social and economic benefits while mitigating the environmental impacts of the built environment.</p> <p>BREEAM encourages energy-efficient building design, systems and equipment that support the sustainable use of energy in buildings and sustainable management of the building's operation. Credits are assigned to aspects that contribute improve the inherent energy efficiency of the building, encourage carbon emission reduction, and support efficient management throughout the operational phase of the building.</p>	<p>New buildings (BREEAM International New Construction 2016)</p>	<p>Energy: 20 Health and well-being: 19 Materials: 13 Management: 11 Pollution: 10 Innovation: 10 Land use and ecology: 8 Water: 7 Transport: 6 Waste: 6</p>	<p>Reduction of energy use and carbon emissions (18/29 credits) Energy efficient laboratory (5/29) Energy monitoring (3/29) External lighting (1/29) Low-carbon design (1/29) Energy efficient transport systems (1/29)</p>
		<p>Existing buildings (BREEAM In-Use International v6)</p>	<p>Asset performance</p> <p>Residential</p> <p>Energy: 28.5 Health and well-being: 17 Resilience: 14.5 Resources: 10.5 Water: 9 Pollution: 9 Transport: 7 Land use and ecology: 4.5 Management: 0</p> <p>Commercial</p> <p>Energy: 25 Health and well-being: 20 Resources: 13 Resilience: 13 Water: 11</p>	<p>Residential</p> <p>Asset energy calculator (40/68 credits) Demand side management capabilities for electricity (4/68) Installed controls (4/68) Solar photovoltaic panels (4/68) Monitoring energy uses (4/68) External lighting (4/68) Local energy performance asset rating (3/68) Monitoring of separate units (2/68) Energy efficient transport systems (2/68) Solar thermal panels (1/68)</p> <p>Commercial</p> <p>Asset energy calculator (40/70 credits) Demand side management capabilities for electricity (4/70) Installed controls (4/70) Solar photovoltaic panels (4/70) Monitoring energy uses (4/70) Monitoring tenanted areas (4/70)</p>

Green building rating system	Description and energy focus areas	Certification stage	Maximum contribution of the several environmental criteria to the overall rating (%)	Distribution of credits allocated to the various energy components
			Pollution: 9 Transport: 5 Land use and ecology: 4 Management: 0 Building management Residential Energy: 29.5 Health and well-being: 16.5 Resources: 12 Resilience: 11 Management: 10 Land use and ecology: 8.5 Water: 8.5 Pollution: 4 Transport: 0 Commercial Energy: 27 Health and well-being: 17 Management: 11 Resources: 11 Resilience: 11 Water: 9 Land use and ecology: 7 Pollution: 7 Transport: 0	External lighting (4/70) Local energy performance asset rating (3/70) Energy efficient transport systems (2/70) Solar thermal panels (1/70) Residential and Commercial Operational energy calculator (50/61 credits) Energy audit (4/61) Energy consumption data use (4/61) Reduction of carbon emissions (3/61)
LEED Leadership in Energy	LEED is a voluntary, market-driven,	New buildings (LEED)	Energy and atmosphere: 30	Optimize energy performance (18/33 credits)

Green building rating system	Description and energy focus areas	Certification stage	Maximum contribution of the several environmental criteria to the overall rating (%)	Distribution of credits allocated to the various energy components
<p>and Environmental Design</p> <p>Country:</p> <p>North America (United States, Canada)</p> <p>Managing organisation:</p> <p>Green Building Council</p>	<p>consensus-based tool that serves as a guideline and assessment mechanism for the design, construction, and operation of high-performance green buildings and neighbourhoods.</p> <p>LEED aims to reduce the environmental and economic harm associated with excessive energy use. For both new and existing buildings, the requirements on building energy performance are stated in the prerequisite minimum (energy performance) and the credit (optimise energy performance). The former requires a minimum level of energy efficiency for a building and its system. The latter intends to achieve increasing levels of energy performance beyond the prerequisite standard.</p>	Building Design and Construction v4.1)	<p>Location and transportation: 15</p> <p>Indoor environmental quality: 15</p> <p>Materials and resources: 12</p> <p>Water efficiency: 10</p> <p>Sustainable sites: 9</p> <p>Innovation: 6</p> <p>Regional priority: 4</p>	<p>Enhanced commissioning (6/33)</p> <p>Renewable energy (5/33)</p> <p>Grid harmonization (2/33)</p> <p>Advanced energy metering (1/33)</p> <p>Enhanced refrigerant management (1/33)</p>
		Existing buildings (LEED Existing Buildings v4.1)	<p>Energy and atmosphere: 35</p> <p>Indoor environmental quality: 22</p> <p>Water efficiency: 15</p> <p>Location and transportation: 14</p> <p>Materials and resources: 9</p> <p>Sustainable sites: 4</p> <p>Innovation: 1</p>	<p>Energy performance (33/35 credits)</p> <p>Enhanced refrigerant management (1/35)</p> <p>Grid harmonization (1/35)</p>
<p>Green Star</p> <p>Country:</p> <p>Australia</p> <p>Managing organisation:</p> <p>Green Building Council of Australia</p>	<p>Green Star is a voluntary local sustainability rating system for buildings and communities. It assesses the sustainability of projects at all stages of the built environment life cycle. It also encourages improvements of environmental efficiencies in buildings and considers users' health and productivity, and operational cost savings.</p> <p>Green Star aims to reward projects that are designed and constructed to reduce overall greenhouse gas emissions by energy demand reduction, use efficiency, and power generation from alternative sources.</p>	New buildings	<p>Energy: 20</p> <p>Indoor environment quality: 15</p> <p>Management: 13</p> <p>Materials: 13</p> <p>Water: 11</p> <p>Transport: 9</p> <p>Innovation: 9</p> <p>Land Use and Ecology: 5</p> <p>Emissions: 5</p>	<p>Greenhouse gas emissions (20/22 credits)</p> <p>Peak electricity demand reduction (2/ 22 credits)</p>
		Existing buildings	<p>Energy: 22</p> <p>Indoor environment quality: 16</p> <p>Management: 15</p> <p>Water: 11</p> <p>Materials: 9</p> <p>Innovation: 9</p> <p>Transport: 6</p>	<p>Greenhouse gas emissions (23/24 credits)</p> <p>Peak electricity demand (1/24 credit)</p>

Green building rating system	Description and energy focus areas	Certification stage	Maximum contribution of the several environmental criteria to the overall rating (%)	Distribution of credits allocated to the various energy components
			Land Use and Ecology: 5 Emissions: 5	
<p>CASBEE Comprehensive Assessment System for Built Environment Efficiency</p> <p>Country: Japan</p> <p>Managing organisation: Japan Sustainable Building Consortium</p>	<p>CASBEE is a method for evaluating and rating the environmental performance of new and existing buildings as well as the overall built environment in Japan. CASBEE is comprised of assessment tools tailored to different scales: construction (houses and buildings), urban (town development) and city management.</p> <p>The requirements on building (and individual home) energy performance are stated in the standards for the environmental load reduction (LR) of the building, in addition to standards for the environmental quality of the buildings (Q).</p>	<p>Buildings (New Construction 2014 edition)</p> <p>Individual homes (Detached Houses 2007 edition)</p>	Complex weighting system applied at every level	<p>Building thermal load Natural energy utilisation Efficiency in building service system Efficient operation</p> <p>Energy saving through building innovation (i.e., control of thermal load of building, natural energy use)</p> <p>Energy saving through equipment performance (i.e., air-conditioning and ventilation systems, hot-water equipment, lighting and highly energy efficient equipment)</p> <p>Well informed maintenance and operation schemes (i.e., management and control of energy)</p>

Source: Technical manuals released by BREEAM, LEED, Green Star and CASBEE, OECD.

Although multi-attribute GBRs consider strategies towards promoting net-zero carbon emission buildings in alignment with international objectives for climate transition, the main focus of current rating schemes on energy performance rather than on the use of renewable and decarbonised energy sources could weaken the benefits of these initiatives. Nonetheless, substantial climate transition costs for homeowners could necessitate a gradual substitution of renewable and decarbonised energy sources to carbon-intensive energy sources that would contribute supporting the transition to a decarbonised real estate sector. All major GBRs are developing roadmaps and high-level principles for climate positive solutions to decarbonisation in the built environment, real estate, and associated investments in an effort to mitigate the impacts of global warming of 1.5°C to 2°C above pre-industrial levels and to help achieve net-zero globally by 2050 in alignment with the Paris Climate Agreement objectives. According to the review in Table 6, zero carbon emission goals strategies of all major GBRs consist of achieving carbon neutrality by 2030-2050 with a significant share of carbon emission reductions through on- and off-site renewable energy, the implementation of carbon mitigation projects, and the construction of buildings with lower embodied carbon and lower whole life carbon. Nevertheless, the lower weighting assigned to the use of renewable and decarbonised energy sources and low-carbon design in all major GBRs could result in a lesser consideration given to zero carbon emission goals in overall rating schemes.

Table 6. Strategy towards achieving zero carbon emission goals of major green building rating systems

Green building rating system	Description of the strategy towards achieving Zero carbon emission goals
BREEAM Building Research Establishment Environmental Assessment Method	<p>BREEAM supports solutions to decarbonisation of new and existing buildings and associated investments in an effort to help achieving net-zero globally by 2050 and avoiding 1.5 degrees warming.</p> <p>Net-zero carbon emission goals strategy of BREEAM includes four main objectives:</p> <p>Minimise carbon emissions in the new development, refurbishment, and operation of assets. BREEAM standards cover a range of asset-related carbon emissions including operational energy, embodied carbon, operational water, construction activities, which are designed to focus on decarbonisation and carbon emissions.</p> <p>Provide assessment methodologies for carbon emissions, including embodied carbon. BREEAM assesses embodied carbon and encourages the construction of assets with lower embodied carbon and lower whole life carbon. Also, BREEAM intends to combine operational and embodied carbon credits into a dedicated carbon category. The aim is to demonstrate to stakeholders that BREEAM certifications will fully account for embodied carbon alongside with operational carbon to help achieving an optimum outcome overall. These principles are still under development by the BREEAM net-zero carbon technical working group.</p> <p>Encourage the use of onsite renewables and providing credits for energy and carbon reduction. BREEAM includes onsite/near-site renewables. In addition, BREEAM certifications assign some credits for carbon reductions resulting from any renewable electricity that is exported to the grid by the asset. This could help assets to become carbon positive if they generate more electricity than they use.</p> <p>Provide third-party verification of carbon emission assessment. BREEAM can support the real estate and construction sector by strengthening certifications' compliance with international net-zero carbon initiatives and definitions. It may also use asset core performance data from certification assessments. This could help determine whether an asset fulfils the requirements of each net-zero carbon initiative.</p>
LEED Leadership in Energy and Environmental Design	<p>The US Green Building Council has developed the LEED Zero certification, as a complement to the LEED certification, to help verifying the achievement of net-zero goals in existing buildings.</p> <p>The LEED Zero certification includes the following four main components:</p> <p>LEED Zero Carbon certification recognizes buildings operating with net-zero carbon emissions over the course of the past year. This certification provides an assessment of carbon caused from energy consumption and occupant transportation to carbon emissions avoided or offset. Going forward, this certification will incorporate carbon caused from water consumption, waste generation, and the embodied carbon of materials used into the carbon balance.</p> <p>LEED Zero Energy certification recognizes buildings that achieve a source energy use balance of zero for the past year.</p> <p>LEED Zero Water certification recognizes buildings that achieve a potable water use balance of zero for the past year.</p> <p>LEED Zero Waste certification recognizes buildings that achieve true Zero Waste certification of the Green Building Certification Institute at the most stringent level of requirements (i.e., platinum level).</p>

Green building rating system	Description of the strategy towards achieving Zero carbon emission goals
	<p>To mitigate the impacts of global warming of 1.5°C to 2°C above pre-industrial levels by reducing carbon emissions and supporting the decarbonisation of real estate assets, LEED Zero Carbon and LEED Zero Energy are the most effective certifications.</p> <p>To obtain LEED Zero Carbon certification, total carbon emitted should be off-set by total carbon avoided.</p> <p>Carbon emitted is calculated from delivered energy and occupant transportation.</p> <p>Carbon avoided includes on-site renewable energy generated and exported to the grid, off-site renewable energy procurement, and the purchase of carbon offsets.</p> <p>Renewable energy generated and used on site reduces the amount of energy delivered.</p> <p>Under the LEED Zero Energy certification, the net-zero energy balance is based on the quantity of source energy delivered and the quantity of renewable energy that displaces non-renewable energy on the grid.</p> <p>Renewable energy generated and used on site reduces the amount of energy delivered.</p>
Green Star	<p>The Green Building Council in Australia has developed a “climate positive roadmap” and high-level principles for climate positive solutions in the planning, design and construction of precincts to help reducing, eliminating and compensating for all emissions.</p> <p>The following five actions intend to achieve climate positive precincts:</p> <p>Embed climate positive pathways into all stages of planning,</p> <p>Commit to fossil fuel-free precincts (i.e., expected to be zero carbon in operations by 2030 for new or in-development precincts and by 2040 for existing precincts) and ensure policy and planning processes support this ambition,</p> <p>Remove the barriers to low-carbon precinct energy solutions,</p> <p>Drive lower upfront carbon in materials and construction activity, and</p> <p>Commit to delivering low-carbon buildings in all precincts.</p> <p>Precincts should be developed and operated to eliminate emissions in alignment with a 1.5°C target as outlined in the Paris Climate Change Agreement. This means precincts must meet the following targets:</p> <p>New precincts must have no operational carbon emissions and have lower upfront and other carbon emissions by 2030,</p> <p>All existing precincts must be well on their way to decarbonising by 2040,</p> <p>All precincts (new and existing) must have net-zero greenhouse gas emissions by 2050,</p> <p>Precincts are built using materials with significantly lower embodied carbon and emissions are minimised during construction,</p> <p>All buildings and infrastructure are energy efficient to reduce stress on the broader grid,</p> <p>Transport emissions are reduced by good planning and urban design, promotion of active transport and low-carbon transport options,</p> <p>The precinct does not use fossil fuels for stationary energy,</p> <p>All energy is sourced from 100% onsite or off-site renewables, and</p> <p>The balance of emissions is neutralised through an offsets approach that leads to positive biodiversity outcomes.</p>
CASBEE Comprehensive Assessment System for Built Environment Efficiency	<p>CASBEE certifications for buildings and individual homes encourage efforts towards a higher level of energy savings, eco-friendly materials and longer life service.</p> <p>Certifications include assessments for buildings with a higher level of carbon performance, such as the Zero Energy Buildings (ZEB), Zero Energy Homes (ZEH) and Life Cycle Carbon Minus (LCCM) Houses.</p> <p>In Japan, Zero Energy Building (ZEB) and Zero Energy (detached) House (ZEH) are defined based on the Primary Energy Consumption (PEC).</p> <p>ZEB or ZEH is a building with PEC which is 100% less than standards.</p> <p>Nearly ZEB/ZEH (nZEB/nZEH) is achievable when PEC will be 75% less than standards.</p> <p>ZEB/ZEH Ready is a building which PEC is 50% less than standards.</p> <p>Objectives of ZEB or ZEH certifications are twofold:</p> <p>Decreasing building energy consumption by improving the energy efficiency of the building and also devices, and</p> <p>On-site energy (power) production, using renewable energy sources.</p> <p>Japan’s Strategic Energy Plan (adopted at the Cabinet Council in April 2014) has set the following goals to realize and promote ZEB or ZEH certifications:</p> <p>Achieve zero emission in standard newly constructed buildings or houses by 2020, and</p> <p>Achieve average zero emission in newly constructed buildings or houses by 2030.</p>

Source: Documents, technical manuals, dedicated web-portals of BREEAM, LEED, Green Star and CASBEE, OECD.

The wide range of GBRs call for efforts to ensure better clarity and comparability, which could help investors identify the benefits of these products for climate transition, and improve their ability to identify, monitor and manage risks and opportunities. In practice, green bond issuers provide evidence about the certification of their bonds by considering energy efficiency certifications or pursue third-party certifications to provide additional transparency on the environmental quality and performance of bonds for financing green real estate projects to an external audience. Also, in the absence of a common definition of green real estate projects, most issuers commission independent reviews of their green bond investment frameworks and/or specific issuances for the benefit of investors. Notably, the ICMA green bond principles and climate bond standards developed by Climate Bonds Initiative encourage a high degree of transparency and recommend an external review to supplement the issuer's project evaluation and selection process. These assessments are known as second party opinions.²⁶ It is crucial for issuers to be able to demonstrate the quality of their business to strengthen investors' confidence by having the opportunity to make informed decisions. The objective is to supply investors with the information and data about the environmental value of green real estate projects to be financed, the issuer's ability and governance in terms of the projects it selects, and how the issuer manages the proceeds and executes reporting.

3.5. Assessment of green mortgage loans and mortgage-backed securities towards supporting the decarbonisation of real estate assets

Green Mortgage Loans (GMLs) are any type of mortgage loan instrument made available exclusively to finance or re-finance, in whole or in part, new and/or existing eligible green real estate projects. GMLs have been issued consistent with the green loans principles that include similar key components as the green bond principles and climate bond standards developed by ICMA and Climate Bonds Initiative (LMA, 2020^[49]; APLMA/LSTA/LMA, 2021^[50]). As for green bonds, the green loans principles are voluntary recommended guidelines, to be applied by market participants on a deal-by-deal basis depending on the underlying characteristics of the transaction. The green loans principles seek to promote integrity in the development of the green loan market by clarifying the instances in which a loan may be categorised as "green". The green loans principles are intended for broad use by the market, providing a framework within which the flexibility of the loan product can be maintained, and will be reviewed on a regular basis in light of the development and growth of green loans. The aim is to promote the development and integrity of green loan products to facilitate and support environmentally sustainable economic activity, including in the real estate sector.

Standards for lenders to offer GMLs have been developed mainly in Europe, the United States and the United Kingdom (World Green Building Council Europe, 2018^[51]; Green Finance Institute, 2021^[52]; Green Finance Institute, 2021^[52]; Fannie Mae, 2021^[25]). As mortgage loans in 2020 are equivalent to 58%, 56% and 41% of GDP in the United States, the United Kingdom and the Euro Area respectively,²⁷ the mortgage loan industry's efforts to improve energy efficiency through funding criteria of the home construction and renovation programmes is important to help decarbonise real estate. Key steps in developing GML standards are as follows in Europe, the United States and the United Kingdom:

²⁶ An SPO provides investors with assurance that the bond framework is aligned to accepted market principles (i.e., green bond or loan principles) and that the proceeds of the green bond or loan, as set out in the framework, are aligned to market practices and expectations from the investment community. For example, CICERO and Sustainability are among the most applied worldwide.

²⁷ These figures have been calculated using loans to household for house purchase and GDP data from Federal Reserve, ECB and OECD Main Economic Indicators databases.

- Since its inception in 2015, the EU Horizon 2020 funded the Energy Efficient Mortgages Initiative (EEMI) that has been the catalyst for the growth of a new, integrated, multi-stakeholder energy efficient mortgage ecosystem. The EEMI seeks to incentivise borrowers, through reduced interest rates and increased loan amounts, for improving the energy efficiency of their buildings or acquire highly energy-efficient properties.
- In the United States, the multifamily green financing business began in 2010 following the launch of the multifamily green initiative by the GSE Fannie Mae, laying the groundwork to introduce the concept of green financing to the multifamily mortgage market. The first green loan product was launched in 2011 in partnership with the US Department of Housing and Urban Development. In 2012, Fannie Mae issued its first multifamily green MBS. In 2016, Freddie Mac launched the multifamily green advantage loan program, which is designed to support water and/or energy efficiency improvements in housing. In 2019, Freddie Mac issued its first multifamily green MBS. In 2019, Freddie Mac created the single-family GreenCHOICE mortgage loan program to finance energy- and water- efficient home improvements in efforts to help more families attain and maintain cost savings and reduce environmental impacts. In 2020, Fannie Mae took another important step by issuing its first single-family green MBS, and in 2021, Freddie Mac issued its first single-family green MBS.
- In the United Kingdom, green mortgage loans have been offered for the first time in 2006 by the Ecology Building Society, when it introduced its C-Change discount mortgage loans.²⁸ Ecology was the UK's only green mortgage lender until 2018, when Barclays launched its Green Home Mortgage lending program.²⁹ Since 2019, a number of government policies³⁰ and competition from other lenders³¹ have supported the expansion of the UK green mortgage loan market.

GMLs are made available to borrowers for financing property improvements (i.e., retrofitting of existing buildings) or the construction of green buildings. There are two main types of GMLs, each with only mild effects towards achieving climate transition and decarbonisation of real estate assets. :

- *Energy efficient mortgage loans* provide incentives for borrowers with projects that target specific reductions in energy and water use and/or generation of renewable energy. Box 2 includes examples of energy efficient mortgage loans in major GML markets. Criteria for eligible energy efficient mortgage loans mainly focus on high levels of energy efficiency achieved through the reduction of energy consumption instead of lowering carbon emissions, which is the most relevant means of supporting climate transition.

²⁸ Through this product, Ecology offers discounted mortgage loan rates to homeowners building or converting sustainable homes, or undertaking retrofits and energy improvements.

²⁹ Through this product, Barclays offers mortgage loans to buyers of new homes with EPC ratings of A or B a discounted interest rate on two-year and five-year fixed rate mortgage loans.

³⁰ In July 2019, the UK government launched its Green Home Finance Innovation Fund competition, which awarded grants to three new green finance projects that incentivised energy efficiency retrofits in homes. The short-lived Green Home Grants Scheme was launched in September 2020, providing grants for homeowners who made certain energy improvements to their homes. In November 2020, the UK government announced that companies would be mandated to report their climate risks, in alignment with the Task Force on Climate-related Financial Disclosures (TCFDs), by 2025. The Bank of England has announced that it will begin climate-related stress tests on UK banks and insurers in June this year and in February 2021, the UK government's Department of Business, Energy and Industrial Strategy finished its consultation period on the proposed policy that UK lenders disclose the energy efficiency of their mortgage loan portfolios.

³¹ Including Nationwide Building Society, Newbury Building Society, Just Group, Saffron Building Society, NatWest, Monmouthshire Building Society, Paragon Bank, Foundation Home Loans, Kensington Mortgages, Santander and Halifax.

Box 2. Description of energy efficiency criteria for eligible energy efficient mortgage loans

Table 7 includes detailed description of energy efficiency criteria for eligible energy efficient mortgage loans mainly in the European Union and the United States.

Nonetheless, this table does not include details for energy efficient mortgage loans in the United Kingdom as there is no common definition of GMLs and UK lenders are broadly divided between those that offer discount mortgage loan rates to customers building or buying homes that are highly energy efficient, and those that offer extra lines of credit, discounted mortgage loan rates or cash back on existing loans to homeowners that improve the energy efficiency of their homes.

Also, it is worth noting that Freddie Mac certifies single family green mortgage loans for existing homes with renewable energy. The borrower should use refinance proceeds to finance energy efficient home improvements. Specifically, the proceeds or portion thereof from each refinanced mortgage paid off existing debt that was used to finance the purchase and installation of a renewable energy source such as solar panels and geothermal. Mortgage loans backed by newly constructed homes with a renewable energy source are also eligible.

Table 7. Description of energy efficiency criteria for eligible energy efficient mortgage loans

Green mortgage loan	Certification stage	Description of energy efficiency criteria
Energy efficient mortgages initiative (EEMI)	New buildings	Property showing a Nearly Zero Energy Building (NZEB) ³² compliant, or alternately, a 20% better than current national building regulations (but information varies across countries).
Fannie Mae single family green mortgage loan	Newly constructed properties with one to four single-family residential units	Properties with ENERGY STAR certifications that meet or exceed the national program requirements for ENERGY STAR Certified Homes, Version 3.0, which are, on average, 20% more efficient than single-family homes built to code.
Fannie Mae multifamily green rewards mortgage loan	Existing multifamily properties	The borrower commit to efficiency improvements projected to reduce the property's energy and water consumption by a combined minimum of 30%, with a minimum of 15% savings from reduced energy consumption or renewable energy generation. ³³
Freddie Mac single family Green Up mortgage loan	Newly constructed homes	Properties showing a Home Energy Rating System (HERS) ³⁴ Index Score of 60 or less.
Freddie Mac multifamily Green Up mortgage loan	Existing multifamily properties	The borrower commits for a minimum projected consumption reduction of 30% of energy or water/sewer consumption for the whole property, with a minimum of 15% from energy, based on Green Assessment. The Green Assessment report details proposed property-level improvements to promote utility consumption efficiency at the property. It uses the ASHRAE Level 1 standard ³⁵ plus additional specific and rigorous inspection and consumption data requirements. The report describes projected savings in terms of utility consumption and dollars saved per improvement item.
Freddie Mac multifamily Green Up plus mortgage loan	Existing multifamily properties	The borrower commits for a minimum projected consumption reduction of 30% of energy or water/sewer consumption for the whole property, with a minimum of 15% from energy, based on Green Assessment Plus. The Green Assessment Plus is a highly detailed property analysis based on an ASHRAE level 2 ³⁶ energy audit.

Source: Energy Efficient Mortgages Initiative, Fannie Mae, Freddie Mac, Green Finance Institute, OECD.

- *Green building certification mortgage loans* offer incentives for borrowers that possess an eligible, nationally recognized green building certification. Nevertheless, as discussed in section 3.4, although multi-attribute GBRs are considering strategies towards promoting net-zero carbon emission buildings in alignment with international climate transition objectives, the focus of major rating schemes is mainly on energy performance rather than on the use of renewable and decarbonised energy sources. Thus, this could weaken the benefits of GBRs and the effectiveness of green building certification mortgage loans to help supporting an orderly decarbonisation of real estate assets. For instance, Fannie Mae's green building certification mortgage loan program incentivizes new construction property owners and owners contemplating a retrofit of an existing property to design for high standards of efficiency and pursue a third-party certification. Multi-family properties eligible must have one of the 40 different green building certifications from 13 different issuing GBRs that meet rigorous impact criteria. The borrower must provide evidence of the certification to Fannie Mae. Nevertheless, according to Fannie Mae classification, only a limited number of multi-attribute GBRs certifications are designed to achieve climate transition objectives towards zero carbon emission buildings (Fannie Mae, 2019^[53]; Fannie Mae, 2022^[54]).³⁷ Among the 40 GBRs from 13 green building certification providers, only eight are classified as Towards Zero certifications, which have the highest level of environmental impact and would contribute to achieve carbon neutrality objectives as net-zero energy standards are reached through a combination of innovative highly efficient construction techniques and renewable energy generation. Current empirical evidence shows that while multifamily properties with these certifications are rare, an increasing number of multifamily pioneers are embracing this challenge.

³² The EU Energy Performance of Buildings Directive requires all new buildings to be NZEB compliant, where NZEB performance levels are defined by each member state based on cost optimal levels.

³³ Investments can include energy-efficient heating, ventilation, and air conditioning (HVAC) systems; energy-efficient lighting and appliances; water-efficient fixtures, such as low-flow toilets and faucets; and on-site solar PV systems. Fannie Mae requires that all products, fixtures, and appliances be ENERGY-STAR.

³⁴ The Home Energy Rating System (HERS) Index was created and is maintained by the Residential Energy Services Network (RESNET) to measure a home's energy efficiency. The process for obtaining a HERS Index Score includes a certified RESNET HERS Rate assessing the energy efficiency of a home and assigning it a relative performance score. The lower the number, the more energy efficient the home. The US Department of Energy has determined that a typical resale home scores 130 on the HERS Index while a home built to the 2006 International Energy Conservation Code is awarded a rating of 100. A home with a HERS Index Score of 60 is roughly 40% more energy efficient than the reference home.

³⁵ The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) has developed standards and guidelines for performing energy audits on buildings. ASHRAE has three levels of energy audit that increase in terms of the depth, scope, and detail of the audit. The Level 1 audit is a simple audit that involves a basic walk-through assessment, review of utility bills and other applicable operating data, and interviews with operations staff. This basic evaluation is designed to identify glaring energy problems. With the detail of this audit, low-cost upgrades are proposed, energy efficiency projects can be prioritized, and it is determined if a more detailed audit is necessary.

³⁶ The Level 2 audit builds on the level 1 analysis with more detailed energy calculations and added financial analysis of proposed energy measures. This level of audit uses utility data over a longer period of time so that the auditor can better understand the building's energy use. The financial analysis at this level of audit is used to build the business case for implementing energy measures.

³⁷ Four categories can be identified in the Fannie Mae's classification of multi-attribute GBRs: Towards Zero, group 1, group 2, and group 3.

GMLs are the underlying assets of green MBS, which provide issuers and investors a number of benefits (Box 3), yet their effectiveness to support climate transition towards low-carbon emission real estate assets would depend on the GBRs of those underlying green GMLs, which would have to be mainly Towards Zero ratings. For instance, Fannie Mae's multi-family green building certification mortgage loans with Towards Zero GBRs would be the most efficient underlying products for green GMLs (and subsequently green MBS) to achieve carbon neutrality objectives for real estate assets.

Box 3. The benefits of green mortgage backed securities for various types of investors

GMLs are underlying assets of green MBS, which provide issuers and investors a range of additional risk management tools and alternative options to increase investment portfolio diversification.

For mortgage lenders and at the bank level, green securitisation provides a range of additional risk management tools as securitisation allows significant risk transfer to limit exposures to GMLs. Subsequent capital relief could enhance bank lending capacities and their ability to expand green mortgage lending activities (Petit, C. and Schlosser, P., 2020^[27]). For non-bank mortgage lenders, green MBS may lead to lower funding costs than balance sheet funding from banks (Climate Bonds Initiative, 2016^[55]). By aggregating loans, which can be refinanced through a bond, the underlying investment can access a broad range of fixed income investors.

For asset managers and institutional investors, green securitisation provides alternative investment solutions that would contribute to increase portfolio diversification by adding a sustainability dimension through green MBS (Fitch Ratings, 2020^[56]). Credit tranching could also help expand the pool of investors in green MBS by offering investors bonds with differing risk-return profiles. Also, green MBS could help match investors' liabilities with asset tenors (Climate Bonds Initiative, 2019^[57]). For instance, liabilities of pension and insurance companies have long-dated tenors and prepayment of loans is a significant risk. Therefore, green MBS may be well-suited for GML financing by allowing banks to offer longer-dated loans.

For non-financial corporates and households, green MBS would provide access to mortgage markets to small-scale actors excluded otherwise (Climate Bonds Initiative, 2016^[55]). For instance, green MBS would support better market integration by aggregating micro projects into instruments of a critical size to qualify for acquisition by large investors. Importantly, green CMBS could also help address low credit ratings and funding access as the rating of green MBS is determined by the GML risk, which is independent from the borrower's balance sheet and its credit rating.

While evidence shows a positive correlation between building energy efficiency and mortgage loan performance (Billio, M. et al., 2020^[58]; Guin and Korhonen, 2020^[59]), insufficient data (i.e., the low volume of GMLs granted to set a benchmark, scarce credit performance data, cost for banks to identify GMLs), financially material metrics and analytical tools to measure and manage climate transition risks in the real estate sector remain a critical constraint for borrowers and financial institutions, which calls for greater attention to the role of policy (OECD, 2021^[60]). Notably, the lack of common definitions, standards, quality data and financial products for climate transition and the decarbonisation of real estate assets are hindering the ability of market participants and regulators to identify, monitor and manage risks and opportunities. For example, the wide range of rating systems limits the comparison of local green building assets globally, and thus impedes efforts to mobilise private investments, both local and international, for the financing of domestic green real estate projects, especially in developing G20 member countries (Yilmaz et al., 2020^[61]).

The absence of clear and appropriate policies to support a transition to low-carbon real estate sector is at a minimum stalling progress, and should implementation of such policies be delayed this could create a cliff edge scenario followed by a disorderly adjustment of prices. In this respect, the major role of

policyholders would be to promote alternative criteria based on carbon emission reductions defined in alignment with international climate transition commitments, and improve specific green real estate bond and GML data disclosure and environmental performance metrics to implement clear and homogeneous frameworks for green projects that will achieve climate transition and carbon neutrality of the real estate sector. International co-operation between market regulators, international organisations, central banks and market participants would further strengthen efficient and solid disclosure practices to achieve the right level of granularity and reliability of metrics with respect to climate-related opportunities and risks in the real estate sector and beyond.

4 High-level policy considerations

Over the last three decades, the real estate sector has witnessed a rapid growth in the implementation of environmental and sustainability objectives. Significant progress has been achieved towards improving water usage and waste management practices in addition to energy-efficiency and low-carbon considerations in buildings. In order to help define eligible green building projects and more accurately assess their impact on achieving environmental and climate transition objectives, a number of organisations have developed high-level principles, core metrics and a range of GBRs. Another significant development is the substantial increase in the use of green debt finance in recent years, including through the proceeds of bonds and loans to develop green buildings and the issuance of green mortgage-backed securities.

Notwithstanding important progress, there are a number of market practices that hinder decarbonisation of real estate assets and an orderly transition to a low-carbon real estate sector. From the review performed in the previous sections, green real estate finance markets remain small in comparison with the size of conventional real estate finance markets globally, which suggests that more efforts are needed to promote investments in real estate projects that will serve to achieve a transition to a low-carbon real estate to meet the climate objectives of the Paris Agreement. Also, major challenges have been identified in alignment of the assessment of debt instruments for real estate project financing with low-carbon transition goals, including:

- ***The main focus placed on energy performance for eligible green building projects in the green bond and loan principles, and the lack of a robust methodology aligned with the Paris Climate Agreement objectives***, could limit the effectiveness of these frameworks to achieve climate transition goals. The lack of a comprehensive set of quantitative metrics along with carbon emission reduction targets and pathways may represent a substantial challenge for real estate assets and underlying real estate finance products to support an effective and orderly climate transition.
- ***The focus of most applied GBRs worldwide is mainly on energy performance rather than on carbon emission reductions from the use of renewable and decarbonised energy sources*** that could limit the relevance of existing instruments collectively to provide sufficient mechanisms to decarbonise buildings and promote the construction of green buildings. Nonetheless, a gradual substitution of renewable and decarbonised energy sources to carbon-intensive energy sources may be needed due to the substantial climate transition costs for homeowners. Although all major GBRs consider strategies towards promoting net-zero carbon emission buildings, the lower weighting assigned to the use of renewable and decarbonised energy sources and low-carbon design could result in lesser consideration given to zero carbon emission goals and to the decarbonisation of real estate assets.
- ***The wide range of disparate GBRs*** call for efforts to ensure better clarity and comparability. The lack of a common definitions, standards, quality data and financial products for climate transition and the decarbonisation of real estate assets are hindering the ability of market participants and regulators to identify, monitor and manage risks and opportunities.

Many measures have been introduced to support banks, mortgage lenders and REITs' efforts to invest in green real estate financial products, yet they are at very different stages of development

and adoption. Notably, the implementation of a national loan guarantee scheme, an interest rate offsetting scheme, or favourable capital treatments for green real estate bond, mortgages and MBS, could all incentivise banks, mortgage lenders and REITs to offer more attractive interests rates to customers and boost financing volumes (Green Finance Institute, 2021^[52]). While contributing to emission reductions, existing and announced policies are insufficient to reach the target of net-zero carbon emission by 2050.³⁸ The additional measures required to meet the net-zero objective involve large funding needs, meaning that well-functioning markets for green mortgages are essential to housing decarbonisation. Therefore measures that would support banking versus market-oriented financing could help incentivise financial intermediaries to invest in green real estate financial assets.

Policy measures may be warranted to strengthen the alignment of green real estate assets with the low-carbon transition. In particular, policies could focus on strengthening green real estate bond, mortgage loan and MBS frameworks to improve the existing tools, methodologies and products, and further support an orderly decarbonisation of real estate assets over time. The identified challenges associated with the relevance of high-level principles, metrics and ratings systems, including single and multi-attribute GBRs, to provide sufficient incentives and mechanisms towards the decarbonisation of real estate assets could erode investor confidence and mask the extent of environmental and climate-related impacts of investment decisions. Ultimately, challenges could constrain the pace and scale of the capital allocation needed to achieve tangible progress to support a transition to low-carbon real estate assets and real estate construction and services sectors. In parallel to green products and GRBs, some real estate mortgage lenders and investment vehicles are reporting directly on climate transition, yet such reporting is in a state of development as the disclosure of climate-related risks improves. For instance, the Task Force on Climate-Related Financial Disclosures (TCFD) has provided guidelines since 2017 to support corporates and financial firms to develop sound climate transition plans and forward looking metrics for more accurate carbon reduction assessment toward zero-emission goal (TCFD, 2017^[62]). In 2021, TCFD has developed recommendations on climate-related financial disclosures applicable to organisations across sectors and industries, including banks, asset owners, asset managers and REITs (TCFD, 2021^[63]).

Beyond such supportive policy and regulation, industry-wide principles and good practices for the green real estate bond and mortgage markets could help strengthen its consistency and integrity towards supporting the decarbonisation of real estate assets. For instance, bridging local energy efficiency standards for real estate assets with global standards consistent with Paris Climate Agreement objectives could significantly contribute to the development of a level of playing field for green real estate assets that would ensure greater clarity and comparability across the wide range of GBRs. Creating and sharing best practices could support the development of green real estate finance instruments, particularly for the classification, pricing, and securitisation of financial instruments, to help investors identify the benefits of these products for climate transition, and enhance their ability to identify, monitor and manage risks and opportunities. Developing such principles and good practices would require collaboration between government and lenders, energy suppliers, retrofit contractors, homebuilders, and other stakeholders to develop an ecosystem of providers that can finance and implement green home and building improvements at scale, and ensure this implementation is verified and measured. In this respect, the European Commission proposed a new standard in July 2021 for European green bonds by requiring close alignment with the 2015 Paris Climate Agreement and sectoral criteria of the EU Taxonomy for sustainable activities, and by creating a regime for registering and supervising external reviewers (EPRA, 2021^[64]). For instance, European Public Real Estate Association (EPRA) members are working closely to align real estate projects' eligibility with the technical screening criteria set by EU Climate Taxonomy for

³⁸ The forthcoming report about "Housing Decarbonisation" from the OECD Economics Department for the Working Party No. 1 on Structural and Macroeconomic Policy Analysis of the Economic Policy Committee. The report will describes the magnitude of the required CO₂ emission reduction efforts and discusses the merits and limits of the policy instruments that are available to reach housing decarbonisation objectives.

the construction of new buildings, renovation of existing buildings, acquisition and ownership of buildings, and individual energy efficiency and renewable energy intervention.

Given the increasing appetite for green real estate finance assets among international and local investors (e.g., pension funds, sovereign wealth funds, REITs, Exchange Traded Funds), **such policy guidance and incentives for green real estate bond and MBS issuance could significantly contribute to the liquidity needs of the domestic financial sector and support the expansion of green real estate finance markets.** Furthermore, they could provide the right incentives to investors and facilitate market access, which could significantly contribute to the development of green real estate finance markets. Against this backdrop, green real estate finance could become more liquid and efficient, strengthening investors' trust. For instance, funding providers would see significant growth potential for this small market over the next few years, including a wide variety of lenders, large and small, supporting a diverse range of products. Ultimately, funding providers willing to invest in product innovation, underwriting and the expansion of their green real estate bond and mortgages will play a key role in shaping what this nascent, exciting and critically important market will look like in years to come, and ultimately, the influence it will have on the decarbonisation of real estate assets. In this respect, the European Banking Authority has developed a dedicated framework for sustainable securitisation, which could be also applied to green real estate MBS (European Banking Authority, 2022^[65]). The main idea consists of applying European green bond standards to green securitisation products to ensure a level playing field across all types of green bond instruments. European green bond requirements (including the use of proceeds, disclosures and sanctions) would be applied at the originator level, which is an entity with broader economic substance than a securitisation special purpose entity. The aim of establishing a dedicated framework in addition to the European green bond standards is twofold: i) to help to signal to the market institutions that are already transitioning³⁹ and ii) to further promote standardisation and consistency in the use of the 'green securitisation' designation. However, such a dedicated framework for sustainable securitisation is only a proposal at this stage.

Overall, greater international co-operation is needed to promote international comparability and the alignment of green real estate assets with the low-carbon transition, enhance market efficiency, reduce market fragmentation, and strengthen investor confidence and market integrity. Addressing challenges related to the lack of clarity and comparability of GBRSs could support efficient and effective risk management frameworks to strengthen the resilience of green real estate financial products and the range of financial intermediaries exposed to these markets. Also, improving sufficient incentives and mechanisms towards needed carbon reduction targets and pathways in existing instruments collectively could help ensure that capital can be effectively allocated to real estate investments that support a low-carbon transition.

³⁹ Hence that are already capable of including green assets in the underlying portfolio of a securitisation transaction and, as a result would have additional/complementary green credentials in addition to the green use of proceeds.

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