REAL ESTATE

The road to net zero

ISFC INTERNATIONAL SUSTAINABLE FINANCE CENTRE

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Content

Executive Summary

The real estate industry is under pressure to align with net-zero goals. This requires ambitious transition and decarbonisation plans, data-driven strategies, and masterly navigation of regulatory and reporting requirements. **Success hinges on building knowledge of policies, enhancing internal capabilities, and fostering collaboration across departments and sectors.** Data-related techniques, including energy modelling, lifecycle assessment, and scenario thinking are crucial for achieving net-zero, with a great need for forward-looking approaches. Standardising information and streamlining data flows are vital for compliance with EU policies such as the Corporate Sustainability Reporting Directive (CSRD) and the EU Taxonomy. Complex modelling approaches offer advantages such as better optimisation and futureproofing of building stock, which allows value retention and higher valuations. **Addressing data challenges can drive innovation, effective carbon reduction, and can enable more effective navigation of the evolving policy landscapes and energy markets.**

Achieving net-zero demands not just technological and structural transformations, but also a f**undamental shift in decision-making processes and board level competencies**. Due to the complexity involved in achieving net-zero emissions in buildings, a comprehensive approach is key: strategies and decision-making processes need to integrate long-term sustainability ambitions combined with measurable shorter to medium term goals. Challenges in decarbonising buildings include the large number of existing buildings still in use, the high cost of renovation compared to new construction, and the complexity of data collection for renovation projects. The diversity and number of stakeholders involved requires a streamlined approach that is tailored to the organisation's overall strategy and reporting needs.

Key factors contributing to the difficulty of decarbonising buildings include:

1. Lifespan of existing buildings
2. Primary energy use and policy interlinkages
3. Operational energy consumption
4. Cost considerations
5. Data and methodology challenges

To address these challenges, a holistic approach is necessary, including re-evaluation of strategies and internal processes (including responsibilities and roles), policy shifts, enhanced reporting practices, improved data management, and investment in technology and skills development. Regulations such as the EU Taxonomy aim to classify sustainable economic activities and used well, can guide the real estate sector towards alignment with net-zero goals. Standardisation, better data capture practices, and technology solutions are essential for informing decision-making processes and supporting sustainable renovation strategies in the real estate industry.

01
Introduction

Introduction

The real estate industry plays a crucial role in the global effort to combat climate change. As the world strives to achieve net-zero emissions, the real estate sector is increasingly focusing on sustainability and adopting strategies to reduce its carbon footprint. This paper explores the emerging trends and approaches in the real estate sector that are driving the transition, and the changes arising from an improved understanding of climate-related risks in the financial sector (banks, asset managers, financial intermediaries, and asset owners).

- Data management
- Life-cycle management
- Complex modelling and long-term strategies
- Technological advancements
- Harmonisation of net-zero frameworks
- Economic trade-offs
- Communication and stakeholder engagement

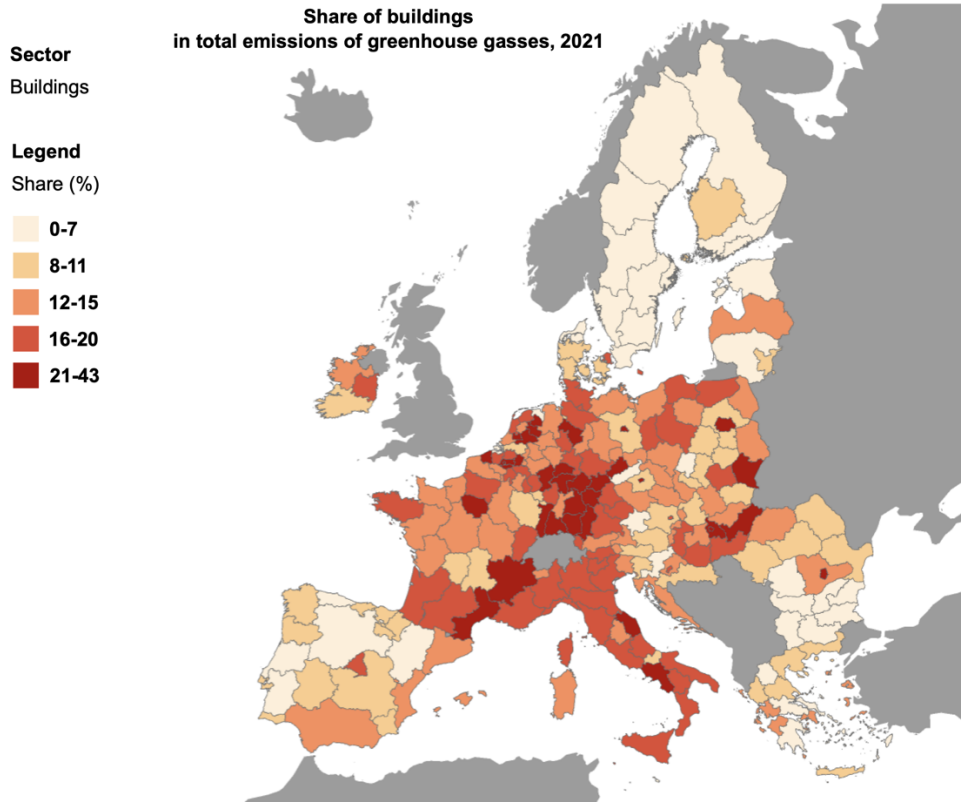
The aim is to provide an overview and analysis of accessible tools and a review of existing approaches, with a focus on data-driven techniques and an examination of the role of offsets.

Definitions

If not otherwise stated, the term 'emissions' refers to greenhouse gas (GHG) emissions. Emissions, GHG, GHG emissions, and CO2e are used interchangeably. However, because of the different sources of emissions, collection and estimation methodologies, the numbers may not correlate. Embodied and embedded emissions/carbon terminology is used interchangeably.

Emissions from buildings and the mitigation potential of buildings

In 2022, buildings globally were responsible for 30% of global final energy consumption and 26% of global energy-related emissions[1] (8% being direct emissions in buildings and 18% indirect emissions from the production of electricity and heat used in buildings).[2] It is important to note that the exact contribution of buildings to GHG emissions can vary depending on various factors like the type of building, its location, the energy sources used, etc. However, while in general, GHG emissions for buildings are much higher in emerging economies than developed markets, there are big differences between national and sub-national levels, as illustrated in the example below for the total GHG emissions in the EU. For this reason, there are challenges in terms of investments and regulations, because they need to account for these differences.



Source: EU regional GHG emissions pathways to net-zero Credit: GHG Emissions at sub-national level

[1] Energy sector CO2 emissions include emissions from energy combustion and industrial processes.
[2] IEA: Buildings: https://www.iea.org/energy-system/buildings

In terms of energy and GHG emissions, in the latest statistics available[3], the building sector contributed to 35% of energy related GHG in 2021. These emissions were attributed to the direct use of fossil fuels in buildings (e.g., oil and gas used in boilers for heating) and partly from the production of electricity and heat for use in buildings (e.g., electricity consumed by water heaters, lighting, electrical devices, cooling systems, etc.).[4]

Mitigation potential of buildings

According to the latest IPCC extract for buildings, the global mitigation potential by 2050 (2020 baseline) could amount to a total of 8.2 giga tonnes or 61% of global building emissions in 2050. The prediction for Europe and Eurasia is even higher and amounts to about 66%. However, it is important to note that the highest percentage is attributed to reduction from demand-side energy efficiency. Worldwide, this amounts to 42% and for Europe and Eurasia 38% as shown in the figure below. The biggest mitigation is expected to be in developed countries.[5]

Source: IPCC: Buildings

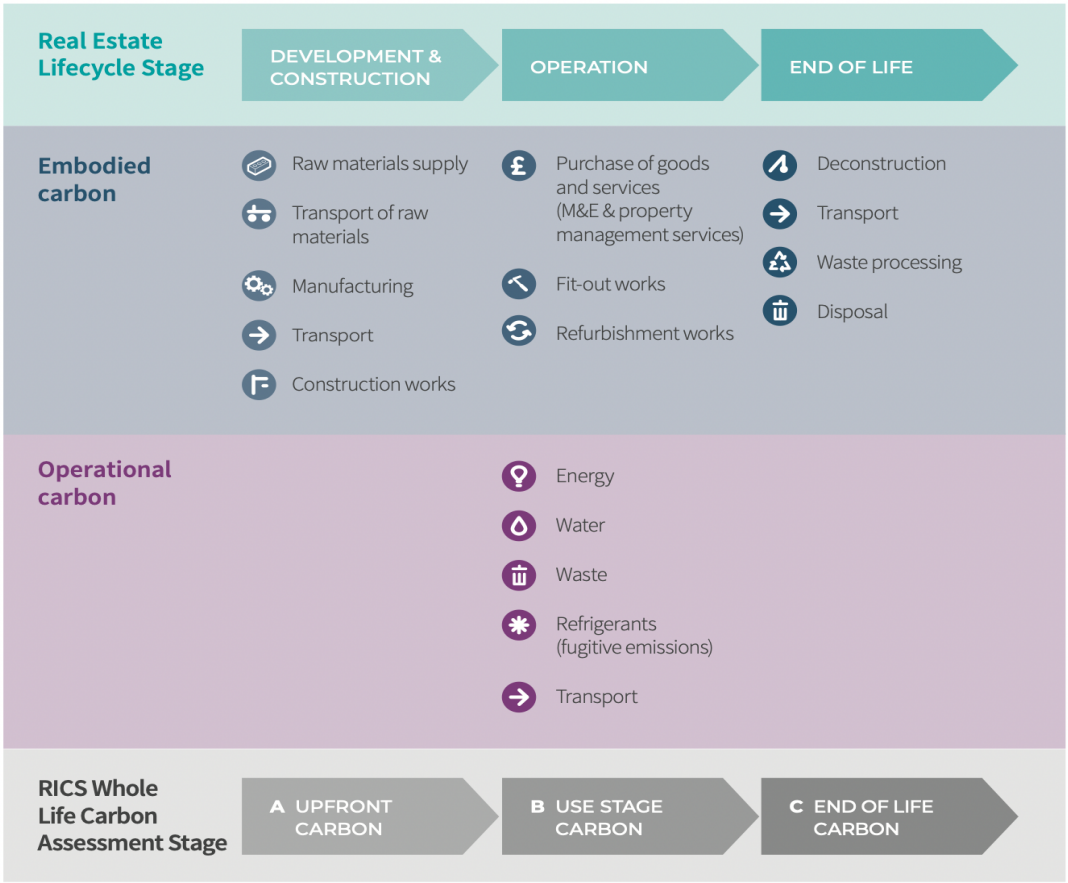
[3] At the time of this report the full 2022-year energy related emissions were not available.
[4] GHG emissions from energy use in buildings in Europe: https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emissions-from-energy
[5] IPCC (2022). Climate Change.https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter09.pdf

Understanding of real estate emissions

There are two categories of emissions, which span the whole lifecycle of buildings and can be broken down into scopes 1-3: operational and embodied/embedded emissions.

Operational emissions as seen below are all emissions, which have been produced during the lifetime of the building, which means emissions related to the operations of the building like heating, cooling, hot water, ventilation, etc. Currently, these emissions account for the most emissions, which buildings produced, but in the future, this should slowly change.[6] More on how the data should be gathered is provided in the section below.

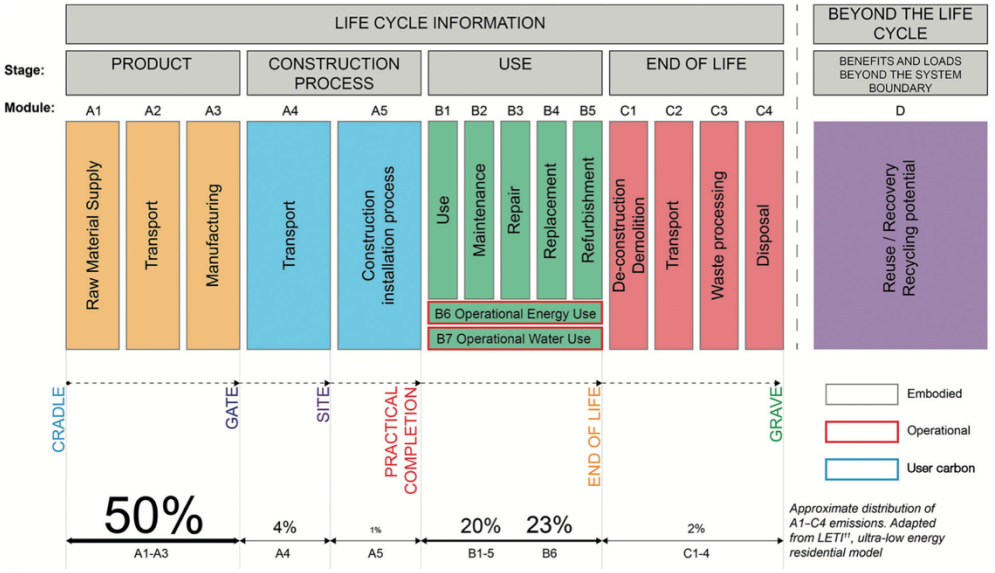
Embodied/embedded emissions are mainly those which are associated with the construction and decommission process. They are split into upfront (development and construction process), in-use (operation), and end of use (end of life) embodied emissions. Considering that these emissions are a result of distinct rather than ongoing processes, this makes them much more difficult to quantify and remove. Further details on challenges and data collection methodologies will be provided in the next section.



Source: Better Buildings Partnership: Net Zero Carbon Pathway Framework

[6] Embodied Carbon vs. Operational Carbon: https://www.oneclicklca.com/embodied-carbon-vs-operational-carbon/

More details on the lifecycle process of emissions and where the scopes fall, including and cradle to gate and cradle to grave approaches is illustrated below:



Source: The Institute of Structural Engineers

IIGCC recently published a report where they looked in detail into the life cycle of emissions and how investors can address them. Some of the points will be further explored in this paper:

Source: Modified from IIGCC: Addressing whole life carbon in real estate portfolios: A step-by-step guide

02

What is needed to achieve net-zero in buildings

What is needed to achieve net-zero in buildings

Achieving net-zero will not only require technological and structural changes, but it will also necessitate a shift in decision-making processes, for example, the integration of long-term sustainability considerations and a holistic approach to the issues that can inform business or investment strategies. Approaches that integrate emission or double materiality considerations are still not mainstream. However, a shift in the cost modelling and decision-making could help to avoid a 'carbon bubble' situation, when the real estate asset valuations do not properly account for the transition risks resulting from late or no-action and large-scale stranding[7]. GRESB estimates that asset stranding year might be the year 2025[8], yet this is not currently priced in by investors.

Challenges buildings present and why it is difficult to decarbonise them

Decarbonising buildings presents several challenges, particularly due to the large number of existing buildings that will still be in use in 2050. In advanced economies, where buildings have an average lifespan of about 80 years,[9] this gives pressure to asset owners to renovate these buildings to not only prolong their life, but to make them less emission-heavy and more energy efficient[10], which would help to decrease the operational and embodied emissions of buildings and help to decarbonise them. This would also reduce energy consumption and thus demand, which would address the energy transition goals that have predominantly focused on reduction of fossil fuels on the supply side.

One significant source of risk in the energy transition is related to primary energy use and its interlinkages with national-level policies. Companies aiming to achieve net-zero targets must consider the carbon content of electricity sourced from the grid and develop optimal strategies to react and offset emissions. This analysis involves exploring multiple pathways that change the contribution of onsite energy generation and energy efficiency measures, considering plans from both the private and public sectors. Real estate stakeholders must also be prepared for frequent revisions, as forward-looking data used in the analysis is likely to change.

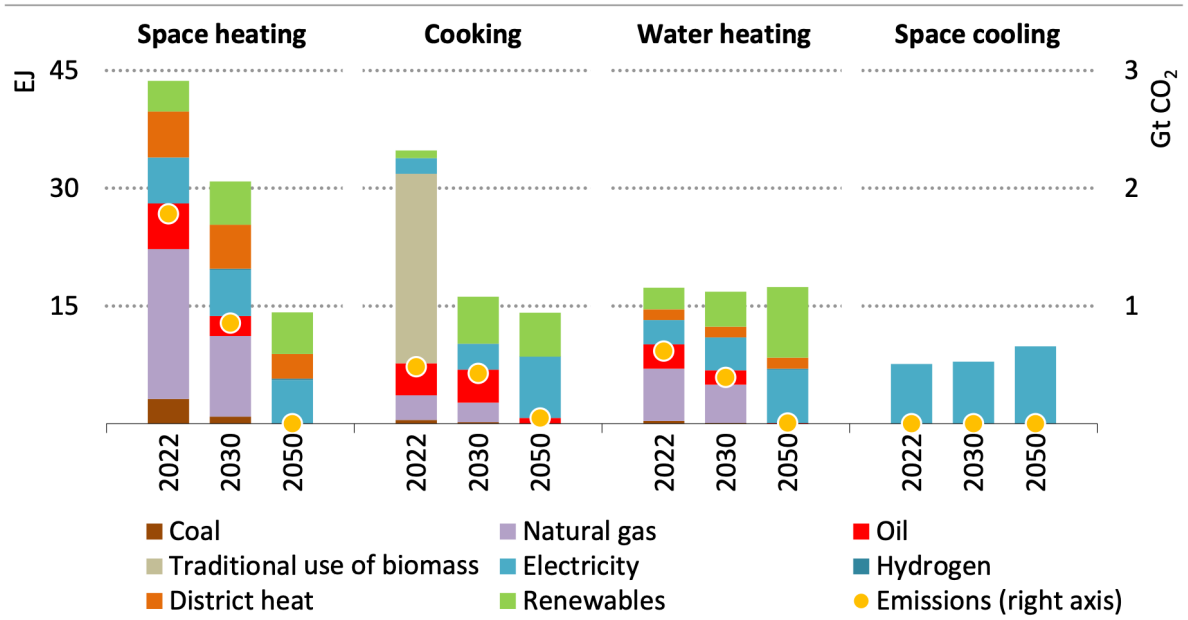
In the Central and Eastern European (CEE) context, operational energy consumption is significant, especially due to higher heating needs. This adds to the operational energy costs and increases the carbon footprint, primarily because of the reliance on coal and gas-generated electricity.

IEA concluded[11] that mandatory zero-carbon-ready building energy codes for all new buildings need to be introduced globally by 2030 latest, and that retrofits need to be carried out in most existing buildings

[7] Urban Land Institute (2022). https://europe.uli.org/uli-sets-out-standard-disclosure-method-to-deflate-carbon-bubble-in-current-real-estate-values-and-prompt-action/
[8] GRESB (2023). https://www.gresb.com/nl-en/2022-real-estate-results/
[9] IEA (2023). Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach
[10] This report has a slight tilt towards emissions from use of energy and how decarbonise them.
[11] IEA (2020). Net Zero by 2050. https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf

by 2050[12]. According to the net-zero (NZE 2023 update) scenario, IEA estimates that the retrofit rate will reach 2.5% per year by 2030 and will remain around this level until 2050. According to the estimates, this should lead to about half of existing buildings being retrofitted and becoming zero-carbon ready[13] by 2040.

Final energy consumption in the buildings sector by selected end-use, 2022-2050



Source: IEA: Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach

However, one of the challenges in decarbonising buildings is the cost. In many cases, it is cheaper to build new buildings rather than renovate existing ones. **Balancing the benefits of extending the lifespan of existing structures with the appeal of new construction involves trade-offs.** Factors such as energy prices, carbon emission costs, and asset inflation play a role in the economic viability of renovation efforts, even though they enhance the value of the assets. Most of the energy efficiency (EE), renewable energy (RE), and other complementary technologies (e.g., heat pumps and batteries) are now available on the market, which increases the retrofitting potential of the older building stock, which could potentially cover also buildings with protected statues, which are aplenty in the EU.

When conducting a thorough assessment of the sector's preparedness to address transition risks and achieve net-zero emissions, it becomes evident that there are substantial gaps[14] that need to be addressed. Many energy-related investments fail to consider crucial factors such as the potential impact of carbon taxes, the importance of enhancing Environmental, Social, and Governance (ESG) ratings, positive social or socio-economic impact, safeguarding corporate reputation, ensuring a stable energy supply, mitigating risks associated future energy price fluctuations. These gaps pose significant challenges that must be overcome in order to successfully transition to net-zero economy.

[12] The Net Zero Asset Managers initiative was created to support investments aligned with the goal of net-zero emissions by 2050 or sooner in line with that.
[13] Refers to CO2 only.
[14] UNEP-FI (2022). Managing Transition Risk in Real Estate: Aligning to the Paris Climate Accord. https://www.unepfi.org/wordpress/wp-content/uploads/2022/03/Managing-transition-risk-in-real-estate.pdf

Financial institutions operating in real estate require more data and flexibility in their approaches to optimise their capital expenditures (CAPEX) for a transition to 2050. This necessity is emphasized in the World Economic Forum's (WEF) Ten Green Building Principles[15], which encourages real estate businesses to prioritise data-driven strategies and more accurate goal setting. **To reach a net-zero operating model, proficiency in environmental sustainability, technology, and data will be just as crucial as real estate and capital-market skills**. Neglecting investment in these areas could hinder the achievement of ESG objectives and create obstacles in securing funding for future projects. **A considerable obstacle that creates risk is the lack of sustainability-related competencies at the board level, which can impede effective decision-making and risk mitigation for the organisation.** Since CSRD requires a board sign off and approval of sustainability performance reports, this can create a risk for the companies that lack adequate board-level expertise in sustainability.

Therefore, to address these challenges, a holistic approach is needed. This includes board level competencies and integration of sustainability into overall strategic frameworks, and considering real estate policies that cover the entire life cycle of buildings and broader energy policies. It is crucial to prioritise data-driven strategies, accurate goal setting, and proficiency in environmental sustainability, technology, and data.

Disclosures and Regulations

According to the latest research from IEA, about 80 countries have voluntary or mandatory building codes in place[16]. United Nations (UN) reported that 74 green building certification systems in use as of 2021[17], which presents a lot of challenges, given the limited to no interoperability between the certificates. However, there are also various regulations and especially in the EU, the real estate players face an increasing reporting burden and compliance challenges from policymakers. However, unlike in the Western part of the EU and Europe, the CEE countries focus more on plans and programmes mainly to address the high energy prices. Nevertheless, a few of the countries in the region have published plans and obligations for inclusion and support of more efficient buildings, e.g., Lithuania: National Plan 2021-30: Replacing boilers with more efficient technologies[18], Estonia: 2021-27 Strategic Plan - Promoting energy efficiency and reducing GHG emissions[19], Poland: Central Emission Register of Buildings[20].

In 2023 (pending trialogue approval), the EU adopted a new revision of the Energy Performance of Buildings Directive (EPBD) that stipulates higher Minimum Energy Performance Standards for existing buildings, timelines to achieve them, and earlier deadlines for buildings to become zero-emissions: for all new public buildings from 2026, and for all new buildings from 2028. Additionally, the EU has imposed more stringent energy performance objectives for residential buildings, requiring a minimum energy performance of class E by 2030 and progressing to class D by 2033. For non-residential buildings, the same applies by 2027 and 2030, respectively. On top of that, all new buildings should be net-zero

[15] WEF (2021). Ten Green Building Principles. https://www.weforum.org/agenda/2021/11/10-green-building-principles-real-estate-net-zero
[16] IEA (2022). Technology and innovation pathways for zero-carbon-ready buildings by 2030. https://www.iea.org/reports/all-countries-targeted-for-zero-carbon-ready-codes-for-new-buildings-by-2030-2
[17] UNEP (2022). Global Status Report for Buildings and Construction. https://www.unep.org/resources/publication/2022-global-status-report-buildings-and-construction
[18] National Plan 2021-30: Replacing boilers with more efficient technologies. https://www.iea.org/policies/12474-national-plan-2021-30-replacing-boilers-with-more-efficient-technologies
[19] 2021-27 Strategic Plan- Promoting energy efficiency and reducing GHG emissions. https://www.iea.org/policies/13885-2021-27-strategic-plan-promoting-energy-efficiency-and-reducing-ghg-emissions
[20] Central Emission Register of Buildings. https://www.iea.org/policies/12449-central-emission-register-of-buildings

emissions from 2028.[21] Despite this, it is still challenging to determine the most effective policy shifts needed to improve energy efficiency across this diverse range of buildings.

From other initiatives in the EU, it is important to mention REPowerEU, one of a wide range of measures for clean energy transition, which promotes energy-efficient building retrofits to support rapid reduction of dependence on Russian fossil fuels.

One of the main challenges in the region is the upcoming Corporate Sustainability Reporting Directive (CSRD), which will play a fundamental role in identifying the companies that are required to disclose information, specifying the topics to be covered. Investors, financial intermediaries, civil society organisations, business partners, and other stakeholders can glean insights about sustainable business activities in terms of sustainability as a share of the CAPEX and OPEX.[22] Therefore, companies operating in the sector need to enhance their sustainability performance reporting practices or build them from scratch, while also making efforts to standardise and automatise data activities.

The European Stability Reporting Standards (ESRS) developed by European Financial Reporting Advisory Group (EFRAG) gives further guidance on the specific information to be disclosed for each sustainability issue and the proper reporting methods. The reporting standard covers the full range of environmental, social, and governance issues, including climate change, biodiversity, and social matters.

The EU Taxonomy Regulation supplies a complementary classification framework to the non-financial reporting and supplies specific rules to be able to categorise activities as being "sustainable" from an environmental point of view[23]. This new framework presents new challenges, which have not been part of the national regulations in many EU countries. Most of the challenges fall on the shoulders of the developers who now need to add mandatory Primary Energy Demand, life-cycle Global Warming Potential information for larger buildings, and circularity, pollution, and biodiversity impacts among other things to prove their alignment. Moreover, to be considered in compliance, activities also need to meet the 'Do No Significant Harm' (DNSH) criteria to make sure that none of the enlisted environmental objectives are in jeopardy due to the planned activities.

The EU Taxonomy lists these economic activities that are relevant to real estate:

- Construction of new buildings (primary energy demand at least 10% below the threshold set for low-energy buildings).
- Renovation of existing buildings (energy savings of 30% or in line with the EU Building Directive).
- Acquisition and ownership of buildings (acquired building must have low energy demand- top 15% of national or regional stock).
- Other measures such as building insulation, and photovoltaic systems installation.

The verification process for the EU Taxonomy alignment makes existing data gaps apparent, and it adds extra motivation for developers to find remedies and address those gaps. While currently green bond frameworks are not aligned with the EU Taxonomy's principles, we have reasons to expect that subsequent green bond issuance will converge to the use of the EU Taxonomy. For real estate not to

[21] MEPs back plans for a climate neutral building sector by 2050: https://www.europarl.europa.eu/pdfs/news/expert/2023/3/press_release/20230310IPR77228/20230310IPR77228_en.pdf and Energy Performance of Buildings Directive.
[22] OPEX: Operating expenditure
[23] EU Taxonomy Navigator. Activities definitions. https://ec.europa.eu/sustainable-finance-taxonomy/activities

lose out on the opportunities offered by this kind of finance, the entities operating in the sector need to tackle the data challenges and start aligning long-term capex plans.

Data and methodology challenges of decarbonisation in real estate

The problems of the net-zero transition we face now are dramatically different from those of half a century ago. There are new opportunities, and companies have new resources to tackle complex optimisation problems. As quantification challenges are addressed through integrated analytics, it is important to develop data management practices too. Real estate companies can create a data lineage by capturing available information, enriching indicators and reporting them. Not only does the industry need to make significant strides in enhancing reporting capabilities, but it also needs to create lynchpins of forward-looking frameworks to plan for net-zero.

The starting point of such a framework is data capture. The quantification imperative is clear: To develop a strong ESG and sustainability framework and active real estate portfolio management techniques, companies need to have a data pipeline in place.

KPMG's recent Global Property Tech Surveys[24] found that artificial intelligence, big data, and data analysis held the most potential for the real estate sector, however, significant skill gaps prevent companies from shifting to more into data-driven decision-making. Reportedly, many companies still link different model results manually and incorporate environmental data on an ad-hoc basis, using spreadsheet-based methodologies.

Additionally, the existing net-zero frameworks use distinct sets of key performance indicators, but the absence of consistency poses a significant predicament for two reasons. First, the lack of harmonisation in lifecycle analyses across these national frameworks obstructs the development of a universally applicable method, and this creates ambiguity around data disclosed. Second, and of even greater importance is how the national net-zero frameworks and building codes influence the considerations of embodied environmental impacts, ultimately shaping the level of ambition within carbon reduction strategies. An EU-wide roadmap for the reduction of built environment emissions has not yet been developed, but it is now work in progress[25].

The EU policies are introducing the view of whole life carbon in the building sector. The term "whole life carbon" refers to GHG emissions resulting from materials, construction, and the use of a building over its entire lifespan, including its demolition and disposal. This means that companies need to look beyond their own emissions (Scope 1), as was demonstrated in the chapter above.

Capturing data on energy use and carbon requires the input of experienced energy modelers and engineers. As the focus is shifting towards the longer-term view, including lifecycle assessment, modelling is becoming increasingly complex. Strategies geared towards 2050 need to be able to make use of carbon budgets, reflect on the sectoral pathway forecasts[26] of the International Energy Agency, SBTI, and move along the necessary reduction curve prescribed by those.

The broader implication is that companies in the real estate industry must understand the economic trade-offs involved. To conduct this analysis, indicators related to scopes 1-3 must be collected with a

[24] KPMG (2022). Global Tech Report 2022. https://kpmg.com/xx/en/home/insights/2022/09/kpmg-global-tech-report-2022.html
[25]The public consultation on the development of this roadmap is running until September 15, 2023. https://environment.ec.europa.eu/news/have-your-say-development-new-roadmap-reduce-whole-life-carbon-building-sector-2023-07-17_en
[26]IEA (2020). Net Zero by 2050 and Net Zero by 2050 (2023) pathways serve as a useful benchmark.

reasonable level of confidence. For example, in terms of operational carbon emissions, all energy and emission data must be gathered bottom-up from the underlying assets, using utility bills, energy data from tenants or the building management. Operational emissions are quite well understood, because, for example, GRESB have helped drive standardisation in data collection for operational energy use, comparing it to the embodied ones. The analysis becomes even more challenging and full of uncertainties, when one is trying to calculate emissions which are the main source for scope 3 emissions. Measurement of embodied carbon is still not commonplace, and whilst methodologies exist and such measurements take place in markets like the UK and some parts of the EU, there is no global standard which could be applied. In 2023, the World Green Building Council's (WGBC) requirements[27] came into force. They do not require embedded emissions to be included in the net-zero commitments for existing buildings, only in the new ones. However, there are other initiatives, which are seeking to address these limitations of excluding certain types of emissions and also owners are committing more to reduce embodied carbon to achieve net-zero. It is also necessary to note that for more real estate owners, scope 1-2 emissions are relatively low when compared to the scope 3 emissions, which are mostly falling under the embodied emissions.

CSRD will require real estate companies to disclose several ESG factors across the EU countries. Lacking standardisation and reliable benchmarks, this could prove challenging, as companies have no interpretative, standardised frames to understand their sustainability performance. Often, real-time tracking of changes to the ESG scores, which are often used to start benchmarking, would be desirable for companies to understand incentives for projects, but such data points can be hard to collect and typically, companies are not in the position to tap into granular market data to benchmarking and make projections.

Another complexity lies in the real estate value chains. Integrating ESG factors and information into the supply chain management would be clearly beneficial for the decarbonisation efforts, reporting requirements and risk management aspects of operations. And it is not only the supply chains: wider stakeholder management is needed to enhance the decision-making capabilities.

ESG-centric practices of tenant engagement and data collection can go a long way to optimise ESG performance of the real estate owner companies as well. There is a need to invest into specific knowledge development along the three dimensions, and to improve the understanding of the policies and regulations real estate stakeholders need to navigate now.

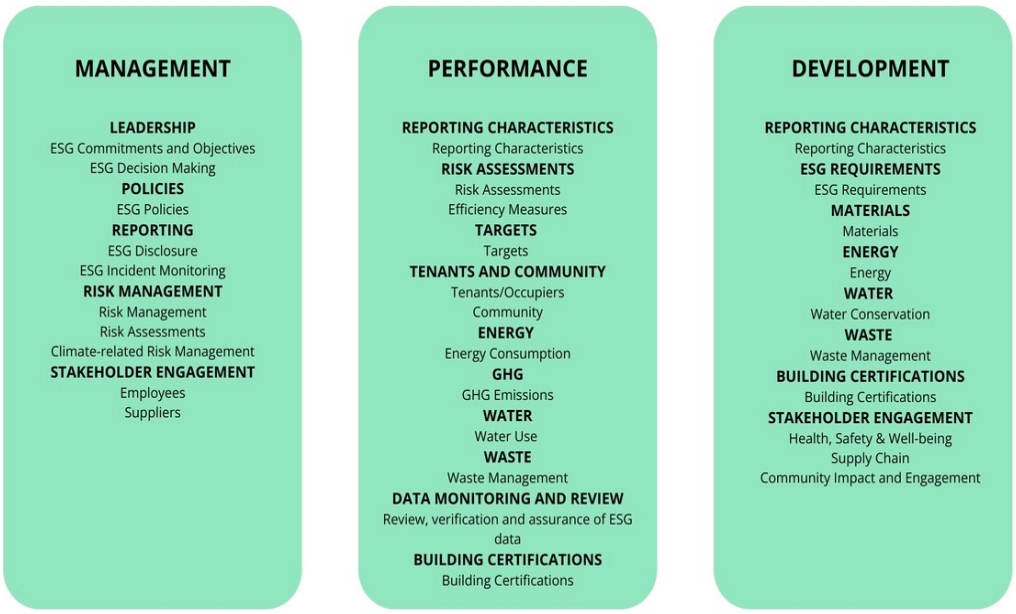
Near to medium term, in-house capabilities and prioritising ESG development areas for business can create a competitive edge. Sustainability expertise at board level is key for effective supervision and guidance on decarbonisation and even data collection or reporting efforts; it can help align the organisation's internal structures and procedures to simplify and streamline the data collection and the use of the competitive advantage this creates for improved financing.

As ESG strategies mature, real estate companies also need to take a closer look at the sub-criteria of the social and governance dimensions. Explorative data analysis and feasibility of collecting performance KPIs are a good start to get a fair view on "E", but "S" and "G" dimensions require companies to scrutinize operating procedures and codes of conduct. Therefore, it is essential for stakeholders to communicate these limitations, uncertainties, and potential assumptions clearly to manage expectations. An attempt to address this gap is undertaken by GRESB, which provides valuable information to real estate stakeholders. GRESB Real Estate Assessment[28] is widely recognized as the

[27] Includes also major renovations, but the point there is more about maximum reduction in embodied carbon: WGBC (2021). Net Zero Carbon Buildings Commitment. https://gbce.es/wp-content/uploads/2021/09/WorldGBC-NZCB-Commitment-Introduction-DG-Lite-2021.pdf

[28] GRESB (2023). Real Estate Standard and Reference Guide.
https://documents.gresb.com/generated_files/real_estate/2023/real_estate/reference_guide/complete.html#overview_of_GRESB_assessments

international benchmarking methodology for evaluating ESG practices in the real estate industry. The Assessment is globally consistent and covers multiple types of entities ranging from listed companies, private funds, developers as well as investors. It covers three key areas: Management, Performance and Development:



Source: Modified from GRESB: Real Estate Standard and Reference Guide

Another significant challenge in the realm of building renovations is the collection of relevant data. Obtaining timely and detailed data for renovation projects can be a complex task, as there is often a lack of consistency across different sources and benchmarks. This inconsistency further complicates the process of data collection and analysis. However, the most daunting issue to address is the variation in definitions used for renovation projects. Different stakeholders may have different criteria for what constitutes a renovation, making it difficult to gather accurate and comparable data. This lack of standardized definitions hampers the ability to collect consistent data and establish a reliable foundation for decision-making.

For example, Oxford Economics reported that extending the economic life of a building by 10-15 years costs between 7% and 30% of its capital value in Europe[29] . The wide range of costs highlights the significant differences across European countries, which limits the usefulness of aggregate-level benchmarks. It is crucial to consider the unique characteristics and requirements of each portfolio and site-specific project, as they play a vital role in determining the feasibility and cost-effectiveness of renovation initiatives.

By improving data capture practices for building renovations, real estate companies can gain a better understanding of the costs, benefits, and environmental impacts associated with renovation projects. This, in turn, can inform decision-making processes and support the development of sustainable and cost-effective renovation strategies in the real estate industry.

[29] Oxford Economics (2022). The renovation race to net-zero. Research Briefing. https://www.oxfordeconomics.com/resource/europes-renovation-race-to-net-zero/

In conclusion, data capture for building renovations presents unique challenges in the real estate industry. Overcoming these challenges requires standardized definitions, improved data collection methods, and the use of technology solutions. By addressing these challenges, real estate companies can make more informed decisions about building renovations and contribute to the overall sustainability of the industry.

Box1: Most important data techniques to measure and manage net-zero

GIS (Geographic Information System) Tools: GIS tools integrate geographical data to provide insights into factors such as transportation accessibility, land use, and environmental features. This information can guide sustainable urban planning and development.

Energy performance simulations: Building Information Modelling (BIM software) can be leveraged to simulate energy performance and perform energy efficiency optimization during design. Off-the-shelf tools on the market can simulate and predict building energy performance based on parameters of choice. The simulations can aid real estate companies with a granular understanding of the impact of retrofitting on energy efficiency.

Life Cycle Assessment (LCA): Environmental impacts need to be considered throughout the whole life cycle. That means that during design factors like materials, energy consumption estimates, and emissions need to be quantified. The LCA process is standardized to a large extent and the rules are given by ISO 14040, ISO 21930, EN 15804 and EN 15978.

Carbon Footprinting: Carbon footprint calculators help estimate the carbon emissions associated with a building's energy consumption, materials used, and other factors. They assist in setting reduction goals and tracking progress.

Third-Party Certification Tools: Real estate companies can use tools that align with third-party certification programs like LEED, BREEAM, or ENERGY STAR. These programs provide standardized criteria for measuring and certifying the sustainability of buildings.

Technical Indices and Benchmarks: To overcome data gaps, normalized and benchmark data are used. An example of that is using location specific Heating Degree Days (HDD) and Cooling Degree Days (CDD) indices which are based on long-term weather observations and can help approximate heating energy and air-conditioning requirements of buildings, respectively. Eurostat provides metadata related to those30. Historical project performance sourced from standardized sources such as the International Construction Measurement Standards (ICMS) can go a long way to better gauge the life cycle costs and environmental impacts.

Cost-estimating databases: A common way to bridge existing data gaps is using the cost-estimating databases (Ecoinvest) which consist of standardized cost indicators on production factors. They can support more advanced methodologies to link lifecycle assessment with budgeting and cost estimation techniques. Thanks to the ease of computation, more sophisticated decision support systems (DSS) are available which can help to add the economic dimension to the sustainability issues and explore the correlation between building costs and environmental impacts.

Predictive Analytics and Machine Learning: Advanced analytics and machine learning techniques can identify energy demand patterns and automate adjustments in real-time to optimize resource consumption which then can help reduce life-cycle impacts. They also play an important role in better understanding of the time-series properties of actual measured energy use and latent factors that relate to tenants' behaviour.

[30] Eurostat: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Heating_and_cooling_degree_days_-_statistics

Case Study

Case study below illustrates the data collection methodologies used by Legal & General Investment Management (LGIM) Real Assets.

LGIM Real Assets is the UK's largest owner-operators of commercial real assets. The company prepared a net-zero carbon roadmap[31] in 2020 to provide more granular insights accompanying their science-based targets covering Scope 1 and 2 levels. They detail their strategy by enlisting the reporting metrics to measure the success of implementation. Broadly, they segment the underlying indicators to the following key areas of their operation:

- Operational metrics
- Carbon associated with capital goods, services, and capital works.
- On-site energy generation
- Renewable energy procurement
- Carbon-offsetting
- Third party verification
- Climate related physical risk & resilience: Value-at-risk

The operational metrics considered by LGIM reveal that the asset manager is currently gathering data and can report on a point-in-time basis on the Scope 1 and 2 carbon metrics while Scope 3 data capture is still a work in progress informing the process of Scope 3 target setting. To that we can add that a key challenge still is to capture tenant behaviour related indicators on a best-effort basis. Tenant data are envisaged to be collected over a three-to-four-year period to guide the process of the decarbonization.

- Energy use (kWh), carbon emissions (kgCO2e), Energy and carbon intensity (kWh/m2 / kgCO2e/m2).
- Data completeness for Scope 3 granularity. Number of occupants sharing data (m2, number, % of portfolio).
- Absolute and intensity (kgCO2e, kgCO2e) per passenger mile for business travel
- Gas use (kWh), carbon emissions from gas use (kgCO2e), gas intensity kWh/m2.
- Water use (absolute and intensity) M3 / occupier / m2 (FTE).
- % recycling, tonnes of waste, % diverted from landfill.
- %, numbers, Net Lettable Area (NLA) m2 of occupiers engaging.
- % of refrigerant data coverage for relevant assets. Kg of refrigerant gas losses, kgCO2e emissions (from refrigerant losses).
- % assets and funds with net-zero roadmap plans in place
- New acquisitions: % of new developments and refurbishments incorporating new net-zero brief and guides, % of acquisitions with net-zero carbon audits completed.
- % of transactions and major investments with net-zero implications reports
- Decisions made to review into carbon pricing (coverage of £/tonne of CO2)

[31] LGIM Real Assets (2020). Net Zero Carbon roadmap. https://www.betterbuildingspartnership.co.uk/sites/default/files/LGIM%20Real-estate-net-zero-carbon-roadmap-report.pdf

03

Tools and data collection methods

Tools and data collection methods

This section will highlight a few of the methods pertaining to data collection, which is one of the main challenges, and their strengths and weaknesses.

Building Information and Energy modelling

Construction activities heavily rely on data and are primarily driven by design simulations. Building Information Modelling (BIM) is an advanced modelling approach extensively utilized in the Architecture, Engineering, and Construction sectors. It is commonly employed to guide the planning, designing, and construction phases of a project. Carbon calculations are factored into optimization and simulations.

Rightsizing renovation efforts and energy efficiency measurement are vital but quite challenging domains. The reliability of measured or predicted energy consumption will have a significant impact on whether the net-zero goal can be accomplished. Energy simulation can guide decision-making; therefore, it is useful to understand the different types of scientific methods behind it.

Most frequently, theoretical knowledge-based, data-driven, and hybrid models are used for energy modelling and demand forecasting. The knowledge-based models rely on principles of physics, while other empirical techniques can account for behaviour and irregularities. Undoubtedly, stakeholders can adjust to performance-based building codes that are expected to be implemented in the near to medium term by incorporating use-side metrics and implementing more behavioural energy models and rigorous POE (post occupancy evaluation).

With the advances in smart metering, sub meter usages forecast can go a long way in optimization. Machine learning algorithms prove particularly useful for indoor temperature forecasting and energy usage of complex buildings when granular sensory data can be collected.

The Design for Performance (DfP) initiative was launched by the **UK's leading commercial property owners** to strengthen net-zero aligned design by providing an approach, based on measurable performance outcomes, to ensure new office developments deliver on their intent[32]. Transparent and consistent data collection in the post-construction plays a key role in this scheme: The initiative builds a strong case for performance monitoring and provides metering to separate base building and tenancy energy use. Key input parameters considered by DfP are:

- Net Lettable Area (NLA)
- Hours of use by the occupants
- Climate zone is determined by postcode. Locations are characterized by heating degree days and cooling degree days.
- Energy. Energy is measured based on energy bills for one year ("the rating period"). Data from non-utility sub-meters might be necessary.

[32] Better Building Partnership (2021). https://www.betterbuildingspartnership.co.uk/our-priorities/design-performance

Box2: Denmark's national strategy for sustainable construction

In 2019, the Danish government established climate partnerships across fourteen economic sectors to identify the pathways for their ambition of cutting carbon by 70% by 2030. One of the main policy measures implemented was the requirement for mandatory life cycle assessment (LCA) calculations in the new national building code, starting from January 2023. The assessment period for buildings, such as residential and public buildings, was set at 100 years. This means that materials and solutions with longer lifespans will have a lesser impact on the LCA accounts.

Lifecycle and embodied carbon assessment

The cost of assessing the embodied carbon of projects in Europe has decreased by about ten times in the past decade[33] thanks to better automation and increased availability of data. This is met with a growing demand for granular carbon data and assessments, which has allowed for cost optimization.

There are different types of embodied carbon assessments used in the market today reflecting on building complexities and the life-cycle assessments followed. The variability of data and methodology used are important: those create issues for procurement in the building sector and can hamper decision-making abilities of real estate asset managers. Additionally, stakeholders on the demand side of real estate encounter significant limitations in accessing data, as only a partial amount of information from the buildings' life cycle is passed on to them.

Some key considerations for data collection:

- Commercially available construction products and materials; specific EPDs from the manufacturer
- Good quality metadata for all information considered.

Standardization of the data capture, access, and pipeline from building logbooks to materials labelling remains a key area. And significant differences persist across the European market. In Western European markets, generic LCA data representative of different dwelling types is available from governmental sources. But in Eastern Europe, data are more limited to those coming from commercial buildings subject to certification. The ongoing roadmap setting activities of the EU Commission suggests that regulators will develop open-access databases to cover energy performance and carbon data of the European building stock in the short term.

BREEAM (Building Research Establishment Environmental Assessment Method)

Developed by the Building Research Establishment, BREEAM (Building Research Establishment Environmental Assessment Method) is a widely used method of assessing, rating, and certifying the sustainability of buildings. The standards have been developed 30 years ago and the certified assessment of all buildings are available through their open-source data tool[34].

[33] One Click LCA (2022). Embodied Carbon Benchmarks. https://www.oneclicklca.com/eu-embodied-carbon-benchmarks/
[34] BREEAM Tool. https://tools.breeam.com/projects/index.jsp

The upcoming upgrade to BREEAM also dubbed as Version 7[35] will also address whole life carbon measures and capture embodied carbon.

Scenarios and risk management

Climate scenarios and risk management strategies are essential tools for real estate stakeholders to navigate the challenges and opportunities presented by climate change. By incorporating climate scenarios into decision-making processes and implementing robust risk management strategies, the real estate industry can enhance resilience, protect asset values, and contribute to a sustainable and low-carbon future.

It is often said that all models are wrong, but some of them are useful. This sentiment also applies to transition scenarios. While they are based on imagination and predictions of future changes and behaviour, they may prove to be inaccurate in hindsight. However, despite their imperfections, transition scenarios provide a valuable framework for business planning, measuring progress, and adjusting strategies as new evidence emerges.

An often-overlooked benefit of scenario thinking is related to transparency and the resource pooling this could encourage. Sharing scenarios and disclosing the results of analysis can foster collaboration between real estate stakeholders, governments, and local communities.

Currently, benchmark scenarios are available for Europe through the EUCalc modelling tool. Developed by the 2050 Calculators, this tool promotes transparency in reducing carbon emissions. The modular model examines energy, resources, production, and food systems of the EU27 members, the U.K., and Switzerland based on predetermined levels of ambition regarding technological deployment and energy use.

The model can be easily accessed through its web-based interface, the Transition Pathways Explorer[36]. web-based interface, allows users to simulate scenarios, visualize model outputs, identify inter-sectoral synergies, and compare decarbonization options. Alternatively, the model can be downloaded from its online repository[37].

The Moderate Policy Scenario and the Responsible Policy Scenario in the tool envisages a decrease in final energy consumption of the buildings enabled by an increasing share of renewable energy and energy efficiency gains. The two scenarios reflect on the policy targets expressed as part of the Renovation Wave communication, setting 60% emission reductions by 2030 compared to 2015 for the building sector.

Understanding climate risk management can help identify vulnerabilities and evaluate the potential impact of climate-related hazards on real estate assets. It involves evaluating both physical risks (e.g., flooding, hurricanes, heatwaves) and transition risks (e.g., policy changes, technological advancements) that may affect property values, rental income, and operational resilience. This assessment helps prioritize adaptation measures and inform investment decisions like portfolio diversification and transfer of potential risks through insurance coverage or special instruments such as catastrophe bonds.

One systematic framework that sets guidelines on how to implement rigorous risk management and forward-looking analysis was set up by the Taskforce on Climate-related Financial Disclosures (TCFD),

[35] The Building Research Establishment just concluded a public consultation end of June underpinning this update.
[36] Transition Pathways Explorer: http://tool.european-calculator.eu/intro
[37] Online repository. https://bitbucket.org/eucalcmodel/_interactions/src/master/

which was recently taken over by IFRS. Beyond reporting, the TCFD equips the financial sector and real asset investors with a consistent approach to addressing materiality issues and identifying key risks and opportunities associated with climate change.[38] Until now TCFD has been one of the very few disclosure initiatives which encouraged forward-looking reporting. However, with the CSRD coming into force, this is due to change.

CRREM Risk Assessment Tool incl. decarbonisation pathways

Carbon Risk Real Estate Monitor (CRREM)[39] is a research project to define science-based decarbonisation scenarios for real estate, in order to help manage transition risks associated with net-zero. In early 2023, new decarbonisation pathways were rolled out. The scenario analysis for the building sector will also inform the Science Based Target initiative's sectoral guidance, due to be released in Q4 2023. The CRREM framework was also further developed thanks to a GRESB-PCAF-CREEM[40] collaboration to improve the carbon accounting methodologies underpinning the operational and embodied carbon measurements for buildings and bring them in line with the usual Scope 1 to 3 emissions.

The CRREM tool is currently available in all EU member states, the UK, and will come online in the U.S. late 2024. But the tool also provides guidelines for the application of the methodology outside of those.

- The CRREM tool can pinpoint asset stranding and transition risk due to falling behind the carbon curve.
- CRREM enables users to estimate financing needs for retrofit upgrade properties and relate that internal cash flow estimates.

The role of offsets in decarbonisation

The real estate market has the potential to play a significant role in addressing residual emissions and meeting the goals of the Paris Agreement. One approach that can be taken is carbon offsetting. However, it is important to note that this should not be the sole focus, and stakeholders in the real estate industry should prioritize reducing carbon emissions before considering offsetting. Failing to do so may lead to the risk of greenwashing.

Carbon offsetting involves buying a representation of a metric ton of avoided emissions, which can then be used to support projects such as the construction of new energy power plants in various parts of the world.[41] While offsetting can be a valuable tool, it is challenging to accurately measure and calculate the embodied carbon in the real estate and construction industry for offsetting purposes. Therefore, it is crucial for the industry to focus on mitigating the impacts of building, operation, and waste processing.[42]
To achieve Net Zero greenhouse gas targets, companies in the real estate sector should prioritize taking appropriate measures in the construction process and supply chain throughout the entire life cycle of a building. Carbon offsetting should only be considered as a last resort to mitigate residual emissions.[43] This means that offsetting should be viewed as a supplementary measure, as it can only be used after

[38] UNPRI (2021). TCFD for real assets investors. https://www.unpri.org/infrastructure-and-other-real-assets/tcfd-for-real-assets-investors/7495.article
[39] CRREM Guidelines (2022). https://www.crrem.eu/wp-content/uploads/2022/09/CRREM_Guidelines_2022.pdf
[40] For more information on GRESB's work please visit https://documents.gresb.com/
[41] MetLife (2021). Carbon Neutrality in Real Estate: Strategies for Success. https://investments.metlife.com/content/dam/metlifecom/us/investments/insights/research-topics/real-estate/images-new/Article/Carbon-Neutrality-in-Real-Estate/MIM-Carbon-Neutrality-in-Real-Estate-Strategies-for-Success.pdf.
[42] Schroders (2022). How to get to net zero in real estate investment. https://www.schroders.com/en-ca/ca/professional/insights/how-to-get-to-net-zero-in-real-estate-investment/
[43] Workman (2022). Is carbon offsetting in buildings greenwashing? https://www.workman.co.uk/carbon-offsetting-real-estate/

all other efforts to reduce emissions have been exhausted. The Science Based Target initiative (SBTi) sets a limit of using offsets for a maximum of 10% of residual emissions and only for long-term targets.[44]

In addition to carbon offsetting, there are other ways for companies with larger estates to contribute to emissions reduction by using insets like power purchase agreements (PPAs) to buy remote renewable energy. This allows companies to support renewable energy projects and reduce their carbon footprint.[45]

Examples of good offsets or when to consider offsetting

Offsets complement residual emission neutralization with carbon removal and represent an important facilitator in advancing net zero. When set up accordingly, offsetting might also be a long-term solution used in the form of sector-based compensation offsets. Investments in carbon storing offsets can even have further environmental and/or social benefits in line with the Sustainable Development Goals (SDGs).[46]

Immediate offsets, or so-called short-lived storage, represent nature-based methods of a carbon neutralization, such as afforestation, reforestation, rewilding, etc. With the nature-based methods the carbon storage depends on the life cycle of natural organisms. The offset carbon is stored throughout the whole life cycle of an organism, e.g., a tree. Once the tree dies and decomposes, the sequestered carbon is released back into the atmosphere. If managed properly, immediate offsets are an efficient and ready solution for current emission issues but are not sufficient to achieve a net zero target.[47] There are several credit certification programmes, which aim to provide only high-quality offsets. The most known and the biggest ones are Verified Carbon Standard (VCS) by Verra, Gold Standard (GS), and American Carbon Standard (ACR).

Permanent offsets provide a long-lived storage of carbon, for example through Direct Air Capture (DAC) or Bioenergy with Carbon Capture and Storage (BECCS). The current issue with permanent offsets lies in low commercial availability due to the interim expensiveness of technologies and the solution depends on further innovation.[48]

[44] Verco (2022). How do offsets fit into a real estate net zero strategy? https://www.vercoglobal.com/latest/15-minute-expert-how-do-offsets-fit-into-a-real-estate-net-zero-strategy
[45] CBRE. Decarbonizing Commercial Real Estate. https://www.cbre.com/insights/reports/decarbonizing-commercial-real-estate
[46] WGBC (2021). Advancing Net Zero Whole Life Carbon: Offsetting Residual Emissions from the Building and Construction Sector. https://worldgbc.s3.eu-west-2.amazonaws.com/wp-content/uploads/2022/10/18110149/WorldGBC-Advancing-Net-Zero-Whole-Life-Carbon_PUBLICATION.pdf
[47] Ibid
[48] Ibid

Case study

The case study below illustrates how Schroders approached reduction of CO2 emissions in one of its mandates situated in and exposed to German real estate (principally office) with an income target of between 4.5-5%.

In the "baseline" year, total operational carbon emissions were c.7,000 tonnes (t) per year. Green electricity contracts had not been achieved and this figure excludes specific tenant consumption to focus purely on the building output. Initial energy audits have been carried out for the majority of the assets, allowing us to set realistic targets and project costs.

- An initial reduction of 500t – in the short-term – is achievable through asset efficiency measurements

- The procurement of green electricity drops emissions by 3,800t

- From there, we can secure district heating, of which c. 40% can be renewable energy sourced

- Remaining emissions could further be addressed - by around 5-10% - by introducing on-site renewable energy, to leave a residual footprint of an estimated 2,000t.

The forecast investment (CAPEX) to affect these reductions amount to c.€12m. Interestingly, we have established that this investment to reduce actual emissions in the portfolio - by more than 70% from 7,000t to 2,000t - is similar to the costs of buying carbon credits for 70% of the actual carbon emissions on the voluntary carbon market. Moreover, the energy costs of the building reduce ultimately benefitting the operational costs of the tenants and together with a better carbon footprint, constitutes material value that a tenant is willing to pay for.[49]

[49] Schroders (2022). How to get to net zero in real estate investment. https://www.schroders.com/en-ca/ca/professional/insights/how-to-get-to-net-zero-in-real-estate-investment/

04

Way forward

Way forward

The real estate industry is facing a clear imperative to take immediate action and align with net-zero goals. This requires adopting ambitious transition and decarbonisation plans, ensuring appropriate governance competencies and responsibilities, embracing data-driven strategies, and navigating complex regulatory reporting expectations. To succeed, stakeholders in the real estate sector must invest in building up necessary knowledge and competencies about policies and regulations, while also building internal capabilities to address complex and interlinked challenges that require cross-departmental and even cross-sectoral collaboration.

This paper has emphasized the importance of data-related techniques and the need to create synergies and links between existing methodologies. A key theme is the shift towards more forward-looking approaches, such as **energy modelling, lifecycle assessment, embodied carbon assessment, and scenario thinking,** which are essential tools for achieving net-zero.

Standardisation of information and streamlining of data flows is another crucial takeaway. This applies to supply chains, internal business units of real estate companies, and in the context of tenant-landlord relationships. EU policies like the CSRD and the EU Taxonomy require the flow of information and advancements in internal data pipelines to ensure that raw data are cleaned, verified, stored, and integrated for reporting purposes, as well as for business intelligence and analysis.

While the modelling approaches outlined in this paper may be complex, they offer manifold advantages. Strong data foundations, as demanded by regulators, can lead to better optimisation and futureproofing of the building stock. They enable more granular and frequent modelling exercises, providing insights into the connections between design, embedded carbon, and costs.

In the pursuit of feasible decarbonisation pathways, companies may encounter data and empirical challenges. However, addressing these challenges will lead to the emergence of new skills and expertise within the sector, driving innovation and enabling effective carbon reduction. A holistic approach is essential for future success, as broader policy changes will influence energy markets and the pace at which net-zero can be achieved.

DISCLAIMER

The views expressed in this work represent those of the authors only and do not necessarily reflect any other institution's or funder's perspective nor any of the experts consulted.

AUTHOR

International Sustainable Finance Centre: www.isfc.org
LinkedIn