Deloitte.

Transforming real estate for a sustainable future

Introduction

Executive summary

The real estate sector continues to evolve against a backdrop of regulatory change, resource constraints, and growing expectations. In 2025, the industry's focus is moving beyond compliance toward embedding sustainability, resilience, and innovation into each stage of the real estate lifecycle.

This year's series explores how leading organizations are responding to three interconnected themes:

Finance and sustainability as strategy:
With new regulations, real estate organizations are weaving sustainability and biodiversity considerations into the heart of their business models. They are doing this for compliance, and also as a driver of long-term value and effective risk management. Innovative financing like green bonds is supporting this strategy shift.

Resource efficiency and innovation:
The adoption of sustainable materials, circular construction methods, and adaptive reuse is transforming how assets are developed and managed. These practices are reducing emissions and waste, boosting efficiency, and enabling the regeneration of urban spaces.

Resilience and community impact:
Technological advances, such as artificial intelligence, are enhancing risk management and portfolio resilience. At the same time, there is a growing emphasis on social outcomes achieved through building adaptation, thoughtful urban development, and innovative financing like green bonds.

Together, these themes reflect an industry that is responding to external expectations, and also proactively shaping a more responsible, resilient, and adaptive future.

This series provides valuable perspectives as you navigate the evolving real estate landscape in 2025.

Kind regards,

Michael Müller
Real Estate & ESG leader,
Deloitte Germany

Katherine Feucht
Global Real Estate Industry leader,
Deloitte Global

Finance and sustainability as strategy

CSRD: An accelerator for biodiversity in the French real estate sector?

In recent years, the European Union has strengthened regulatory frameworks, in conjunction with the Corporate Sustainability Reporting Directive (CSRD), which requires that companies in scope publish sustainability reports compliant with European Sustainability Reporting Standards (ESRS).

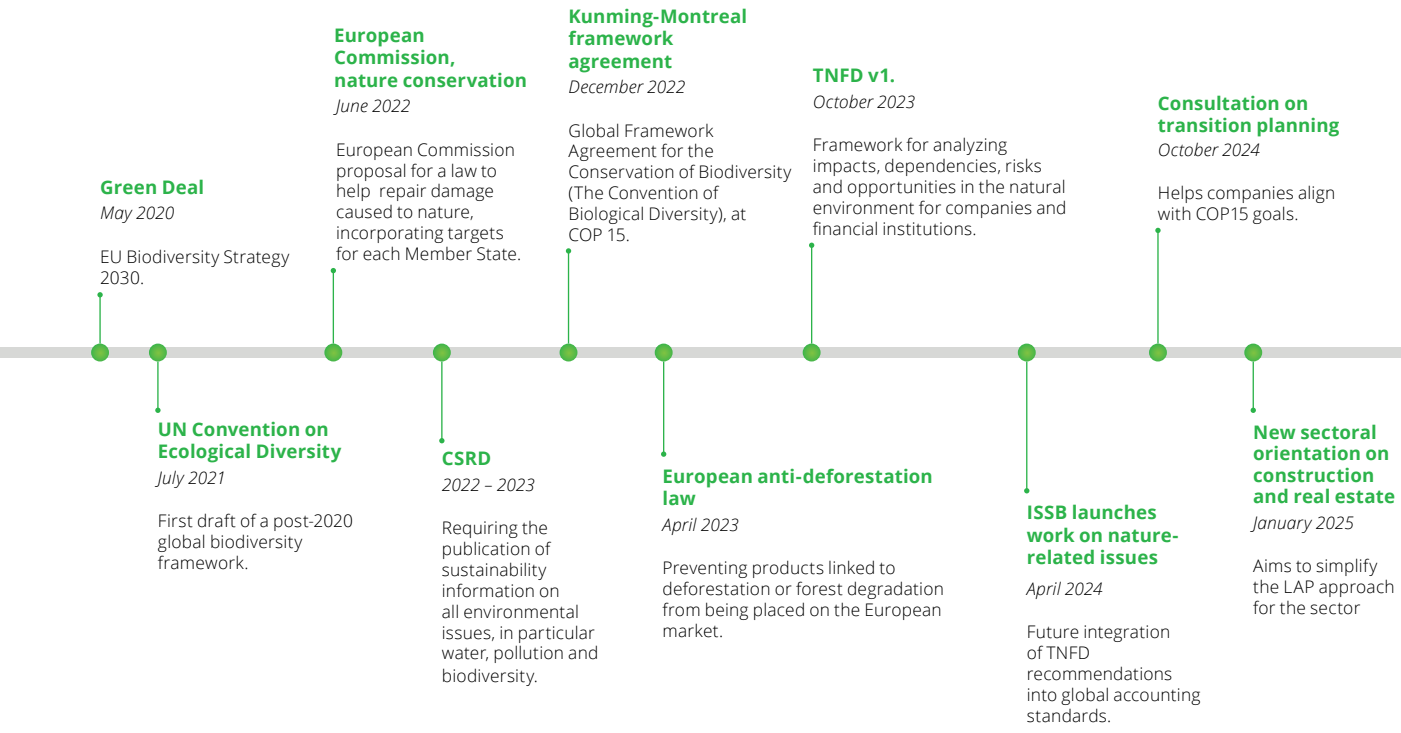
A Deloitte France benchmark on the first application of ESRS reporting by French real estate companies in 2024 reveals that most (eight out of nine) companies included in the review recognized biodiversity as a material matter.[1]

This article:

- Highlights frequent frameworks and tools used by French real estate companies (ENCORE[2], TNFD[3], SBTN[4], etc.).
- Illustrates that disclosure of current financial impacts related to biodiversity risks is still developing, with various assessment methods under exploration.
- Finds that biodiversity transition plans have not yet been developed or implemented, though most French real estate companies intend to publish them in the future.

The strengthening of both regulatory and voluntary frameworks related to biodiversity has been unprecedented in Europe in recent years. (See Figure 1)

Figure 1: Highlights of European biodiversity regulatory announcements

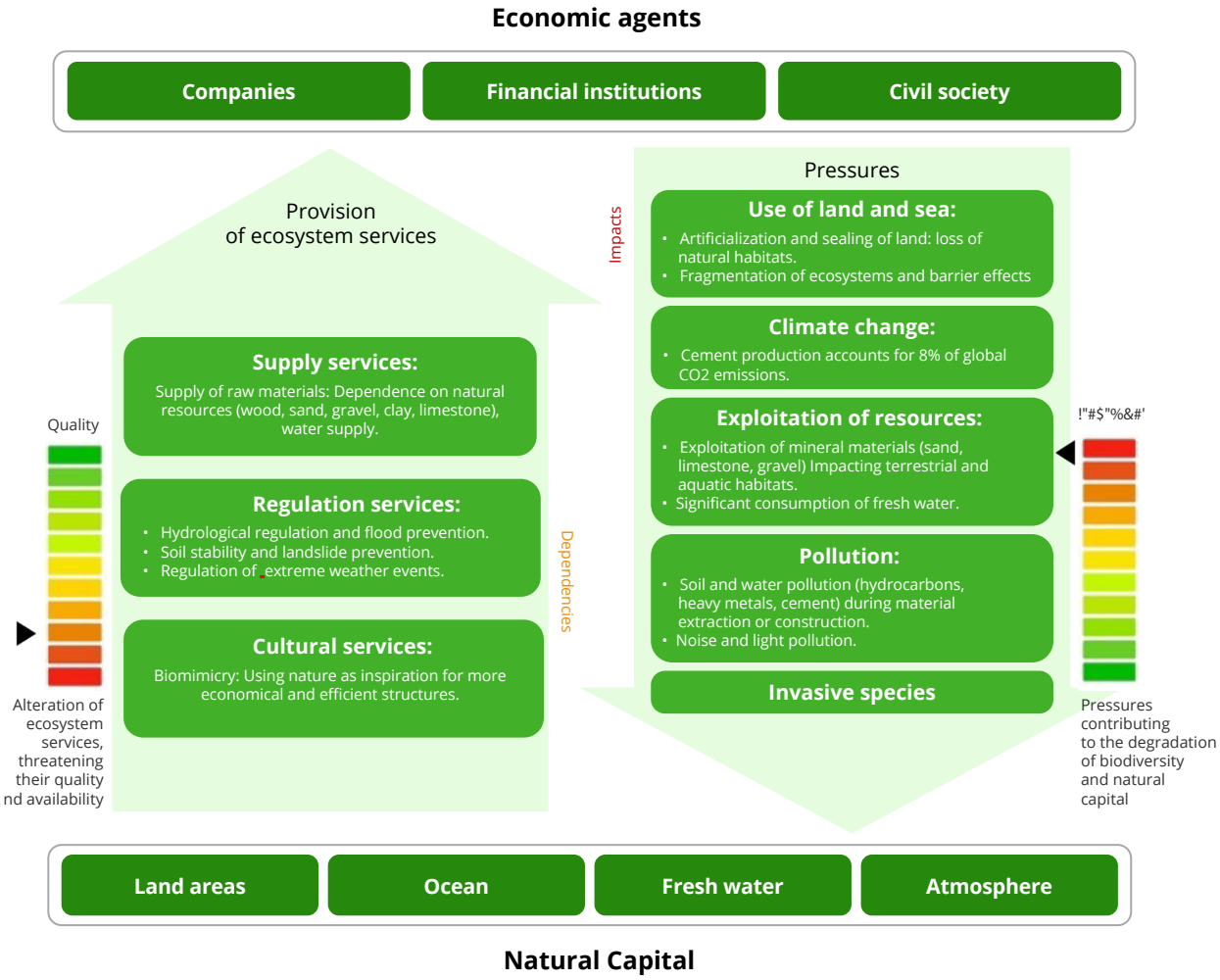


Source: Deloitte France

In this context, companies in the sector have published the first edition of their sustainability reports in a CSRD-compliant format. Below are key findings from the Deloitte France Real Estate benchmark and examples of leading practices.

1. 89% of the companies included in the review consider biodiversity to be material for at least part of their construction or operations scope. Not considering the ESRS E4[5] as material likely exposes companies in the sector to a high reputational risk.
2. Among the companies that declare biodiversity material, all of them use the ENCORE database to identify their dependencies on ecosystem services provided by nature and the pressures they may exert on it. Figure 2 shows a summary of the main examples identified.

Figure 2. Summary of dependencies on ecosystem services and the pressures they may exert on it.



Source: Deloitte France

They complete their analyses by identifying risks and opportunities (R/O). A few examples are listed below:

Physical R/O

- Increased exposure to natural disasters (floods, cyclones, etc.)
- Implementation of Islands of Urban Coolness (IUC) to mitigate heatwaves.

Market R/O

- Material shortages and rising resource costs.
- Insurance companies no longer supporting assets exposed to natural disasters.
- Labelling: HQE building label, Biodivercity, effinature[6], etc.
- Attractiveness of real estate programs that favor biodiversity.

Regulatory and reputational R/O

- Risk of societal and regulatory scrutiny delaying or canceling projects (e.g., destruction of wetlands).
- Sourcing of materials with labels (FSC[7], or PEFC[8].)
- Reinforcement of the employer's brand to attract talent.

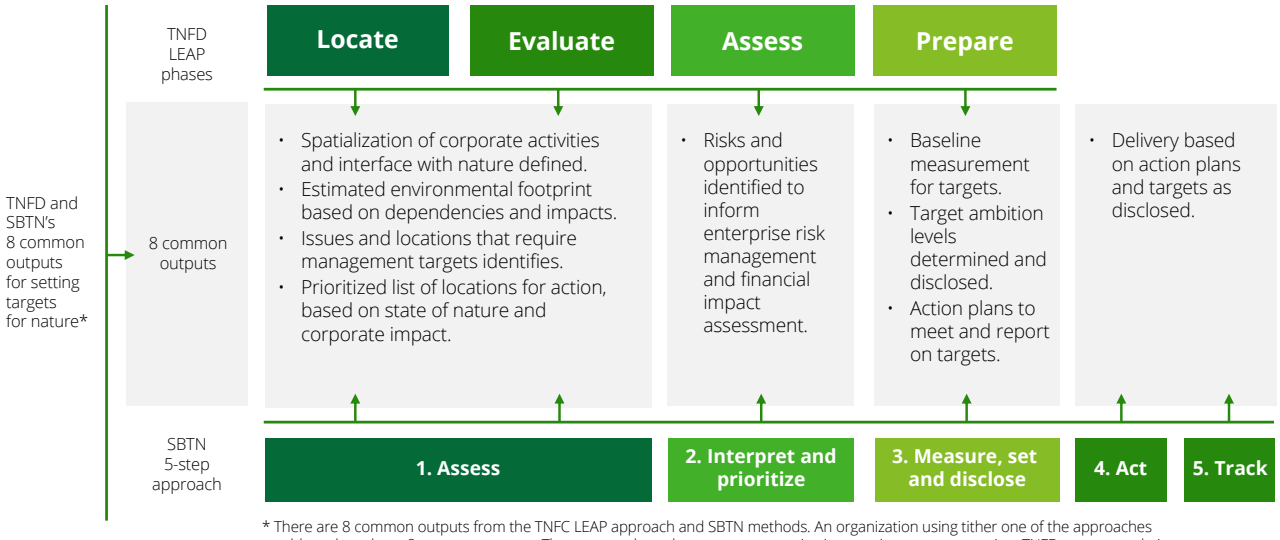
Technological R/O

- New materials: Low-biodiversity footprint concrete (i.e., concrete that causes less biodiversity loss than conventional types; requires structural performance studies), recycled materials.
- New technologies: 3D printing, biomimetics, etc.

3. Of the companies that declare biodiversity as material (eight out of nine), a majority use the TNFD[9] LEAP approach (seven out of eight). This methodological framework, designed to analyze nature-related dependencies, impacts, risks and opportunities, supports the response to TNFD publication requirements-the nature equivalent of the TCFD[10] framework for climate. In addition, the LEAP approach provides a rigorous and detailed response to CSRD reporting requirements, whose architecture (governance, strategy, impacts, risks, opportunities (IRO) management, indicators, and objectives) largely mirrors that of the TNFD.

4. Few companies (two out of eight) are using the SBTN framework[11] to set targets for reducing their impact on nature. Although still in the pilot phase, the TNFD encourages the implementation of science-based targets, in line with the recommendations of the SBTN framework[12]. Moreover, the LEAP approach and the SBTN framework are complementary, as they follow a common rationale for understanding and managing nature-related concerns. The SBTN framework is distinguished by its structured methodologies for translating this analysis into science-based targets.

Figure 3. TNFD and SBTN fundamental areas of alignment on target setting



* There are 8 common outputs from the TNFC LEAP approach and SBTN methods. An organization using tither one of the approaches would produce these 8 common outputs. They are not the only outputs an organization requires to report against TNFD recommendations or to use the SBTN methods.

Source: TNFD[13]

5. All companies involved in new construction projects have set a target aimed at limiting land artificialization. However, some divergences can be observed:
    a. In ambition: some developers have committed to a net-zero artificialization (NZA) target by 2030, while others aim for later dates.
    b. In calculation methods: some companies now adjust their NZA calculations based on the ecological value of the biotope (biotope area coefficient or BAC), while others integrate elements related to biodiversity offsetting. It is worth noting that a harmonized biotope area coefficient (HBAC[14]) method has emerged in France, developed by a sector-representative working group.[15] Adopting this harmonized method directly can enhance comparability between stakeholders.

6. Regarding other indicators, since ESRS E4 is not very prescriptive, sustainability report preparers have considerable flexibility in defining indicators based on their specific objectives and actions. It is up to various stakeholders to challenge the often heterogeneous ambitions of different actors. Two initiatives foreshadow the future of biodiversity reporting in France and the related indicators: the Biodiversity Impulsion Group and the Working Group 7 of Cap 2030, an initiative stemming from the French Sustainable Building Plan.

7. In addition, no biodiversity transition plans have been developed and implemented yet, though a majority of companies (five out of eight) have announced plans to publish one in the future, with two companies aiming for as early as next year. This voluntary disclosure aims to adapt the business model and strategy to align with the Kunming-Montreal Global Biodiversity Framework (GBF)[16] and the nine planetary boundaries.[17]

8. To date, companies have also not disclosed expected financial impacts, which is a final component of ESRS E4. Methodologies to assess such impacts are still in development. Nonetheless, several avenues are being explored:
    a. Percentage of assets exposed to nature-related risks;
    b. Percentage of net revenue linked to activities exposed to nature-related risks;
    c. Asset impairments due to exposure to nature-related risks (e.g., sites threatened by coastal erosion or flooding); and
    d. Expected cost savings from adaptation measures.

In conclusion, the CSRD framework[18] has had the merit of compelling companies to adopt a holistic, science-based approach to define their dependencies, impacts, risks, and opportunities. Consequently, it is expected that future strategies will not only focus on an in situ approach—addressing biodiversity impacts that occur directly at the construction site or asset location—but will also be complemented by an ex situ component. Ex situ refers to the biodiversity impacts that take place away from the project site, such as the environmental effects of sourcing materials (for example, the impact of sand extraction for concrete production, which depends on the ecological sensitivity of the extraction site). By considering both in situ (on-site) and ex situ (off-site) impacts, companies can achieve a more comprehensive analysis of the entire biodiversity footprint of each project, thereby constructing robust biodiversity strategies at the company level.

Contacts:

Adrien Boulez
Senior Manager Sustainability Audit and Assurance Team – Real Estate
Deloitte France
aboulez@deloitte.fr

Endnotes:

1. Deloitte France and French Sustainable Real Estate Observatory (OID), "[French Real Estate Benchmark Panel]" (to be published June 2025). Panel includes URW, Covivio, Klépierre, Bouygues, Vinci, Eiffage, Altarea Cogedim, Nexity, and Icade.
2. Natural Capital Finance Alliance, "Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE)," ENCORE (Accessed June 2025).
3. Taskforce on Nature-related Financial Disclosures, "Taskforce on Nature-related Financial Disclosures (TNFD)," TNFD (Accessed June 2025).
4. Science Based Targets Network, "Science Based Targets for Nature (SBTN)," SBTN (Accessed June 2025).
5. European Financial Reporting Advisory Group (EFRAG), "ESRS E4: Biodiversity and Ecosystems," within the broader European Sustainability Reporting Standards (ESRS) framework (Accessed June 2025).
6. BiodiverCity and Effinature, "French Certification Labels for Biodiversity in Real Estate and Construction Projects," BiodiverCity and Effinature (Accessed June 2025).
7. Forest Stewardship Council, "Forest Stewardship Council (FSC)," FSC (Accessed June 2025).
8. Programme for the Endorsement of Forest Certification, "PEFC International," PEFC (Accessed June 2025).
9. Taskforce on Nature-related Financial Disclosures, "Additional Sector Guidance: Engineering, Construction and Real Estate" TNFD, January 2025, p. 4.
10. Task Force on Climate-related Financial Disclosures, "Task Force on Climate-related Financial Disclosures (TCFD)," TCFD (Accessed June 2025).
11. Science Based Targets Network, "Homepage," SBTN (Accessed 26 June 2025).
12. Taskforce on Nature-related Financial Disclosures and Science Based Targets Network, "Guidance for Corporates on Science-Based Targets for Nature," TNFD and SBTN (September 2023): 3.
13. Taskforce on Nature-related Financial Disclosures and Science Based Targets Network, "Guidance for Corporates on Science-Based Targets for Nature," TNFD and SBTN (September 2023): 4.
14. City of Paris, "Harmonized Biotope Area Coefficient (Coefficient de Biotope Surfacique harmonisé, CBSh)," City of Paris (Accessed June 2025).
15. Ministère de l'Aménagement du Territoire et de la Décentralisation, "Cap 2030," Ministère de l'Aménagement du Territoire et de la Décentralisation (Accessed 26 June 2025).
16. Convention on Biological Diversity, "COP 15: Final Text of Kunming-Montreal Global Biodiversity Framework," Convention on Biological Diversity (Accessed 13 June 2025).
17. Stockholm Resilience Centre, "Planetary Boundaries," Stockholm Resilience Centre (Accessed 13 June 2025).
18. European Financial Reporting Advisory Group (EFRAG), "[Omnibus Directives and ESRS Set 1 Revision: Exposure Draft]," EFRAG (to be published July 2025, open for comments until end of August 2025).

This article was originally published in July 2025 by Deloitte France.

Beyond compliance: Rethinking sustainability in real estate portfolios

Over the past decade, balancing profitability with the various pressures posed by increasingly frequent and severe weather events has proven to be a challenge. Following years of adaptation and negotiations, countries and markets have attempted to set a common trajectory. The European Union (EU) has found itself at a crossroads and, to strengthen its competitive edge, announced new initiatives in February 2025 —the Simplification Omnibus package and the Clean Industrial Deal—collectively referred to as "the package." These initiatives aim to make the EU environment more business-friendly, giving companies more time to adapt to sustainability obligations while staying aligned with long-term sustainability goals.[1]

Within this evolving regulatory and geopolitical landscape, the real estate sector stands out as an important focus area. As one of the most energy-intensive industries—responsible for 34% of energy-related CO_2 emissions and over 32% of the global energy demand in 2023[2]—real estate plays a central role in the energy transition. Adopting sustainable practices can help mitigate operational costs, protect asset value, and reduce exposure to regulatory and sustainability-related risks. From design and construction to daily operations of assets, real estate stakeholders are now required to future-proof their assets against evolving regulatory frameworks, shifting investor priorities, and rising tenant expectations[3].

As a result, several distinct trends are emerging across the real estate sector: retail stores are being renovated to improve their energy efficiency[4], while residential assets are increasingly refurbished to help reduce reliance on traditional heating systems and enhance insulation[5]. Certifications for office buildings such as Leadership in Energy and Environmental Design (LEED) is a globally recognized building certification system developed by the U.S. Green Building Council[6]. It provides a framework for designing, constructing, operating, and maintaining buildings that are environmentally responsible, resource-efficient, and healthy for occupants. The Building Research Establishment Environmental Assessment Method (BREEAM) is a leading sustainability assessment method for master planning projects, infrastructure, and buildings. BREEAM, developed in the United Kingdom by the Building Research Establishment (BRE), assesses building environmental performance and promotes sustainable design.

Increasingly, such standards are prerequisites for tenants seeking productive workplaces and for investors prioritizing long-term asset value through sustainability[7]. Furthermore, new logistics facilities are being constructed to help meet sustainability building standards, incorporating energy-efficient designs and renewable energy solutions to help align with stricter regulations and tenant demands[8]. Additionally, hotels are being redesigned to help improve insulation, implement waste management systems, and reduce both energy and water consumption without compromising guest experience[9]. Moreover, digital tools across asset classes are enhancing sustainability integration and reporting[10]. Lastly, innovative materials and circular construction can help promote resource efficiency and reduce waste throughout the building lifecycle[11].

At the same time, end-users and tenants (office employees, corporate occupiers, hotel guests, etc.) are placing increasing value on sustainability credentials and the environmental footprint of the buildings they use[12]. In parallel, valuation standards have already integrated sustainability factors, while the certification landscape has evolved into a highly specialized and competitive field[13]. These developments highlight the importance of integrating and implementing sustainability strategies, which are not linear processes with standardized solutions. On the contrary, investors and real estate stakeholders in general should actively engage with their assets, maintain a thorough understanding of emerging trends and regulations, and design tailor-made strategies that help balance resilience with long-term value creation.

These complexities are even more profound for portfolio owners, who can monitor and manage diverse asset types, each with its own regulatory requirements and risk profile. Addressing these challenges requires a forward-looking, structured strategy. The initial steps should include an as-is evaluation of the assets to help create a baseline for analyzing a portfolio's future development. This baseline enables alignment with both national and international regulations, as well as relevant industry standards. Based on this analysis, a broad corporate strategy should be formulated, taking into consideration projected revenues and value creation, including tailored action plans for each property within the portfolio. This strategy should outline specific workstreams, capital expenditure requirements, timelines, KPIs for tracking progress, and clear task responsibilities. In light of the rapidly evolving sustainability landscape, the strategy should be regarded as a dynamic framework—subject to regular reviews and adjustments to help incorporate legislative developments, shifting market expectations, and emerging sustainability trends, thereby helping to ensure regulatory alignment and sustained competitive positioning with the goal of increasing the value of the portfolio and safeguarding it for the future.

Despite recent regulatory delays and relaxed sustainability reporting requirements, Europe remains committed to an extreme weather-resilient economic transformation—driven not by generic solutions, but by future-proof, well-informed, and tailored strategies[14,15]. The real estate sector—under increasing scrutiny for its energy use and carbon emissions—can view sustainability not merely as a compliance obligation, but as a strategic lever for resilience, efficiency, and long-term value creation. Unlocking this potential requires more than a one-size-fits-all approach; it calls for asset-specific strategies that are both informed and future-ready.

Contacts:

Eleftheria Riga, MRICS
Principal, Strategy & Transactions, Infrastructure & Real Estate, Deloitte Business Solutions S.A.
eriga@deloitte.gr

Stefania Gkiouzelli
Senior Manager, Strategy & Transactions, Infrastructure & Real Estate, Deloitte Business Solutions S.A.
sgkiouzelli@deloitte.gr

Michail Kyrillopoulos, MSc
Consultant, Strategy & Transactions, Infrastructure & Real Estate, Deloitte Business Solutions S.A.
mkyrillopoulos@deloitte.gr

Endnotes:

1. Ségur-Cabanac, E.-M., Stuart, G. J., Thoms, A., Jones, C., Ehrle, A., Galdino-Glaeser, G., Herrera Barrios, N., & Weydemann, M., "European Union: Commission proposes Simplification Omnibus package and Clean Industrial Deal," Global Compliance News (2025, March 15).
2. United Nations Environment Programme, "Global Status Report for Buildings and Construction 2024/2025," United Nations Environment Programme (2025).
3. Knight Frank, "ESG Property Investor Survey 2025," Knight Frank LLP (2025): London.
4. Knight Frank, "Retail and ESG in 2025: Bigger Fish to Fry," Knight Frank (2024).
5. EUROCONSTRUCT, "99th EUROCONSTRUCT Conference – Warsaw, June 2024," EUROCONSTRUCT (2024).
6. European Commission, "LEED certification to deepen alignment with Level(s) and EU Taxonomy for European market," European Commission (2025).
7. World Green Building Council, "New report links office design with staff health and productivity," World Green Building Council (2022).
8. GLP Europe, "Logistics 2.0: New logistics parks are becoming green, smart and environmentally friendly," GLP Insights (2024).
9. Kwatra, M., "Eco friendly hospitality trends: What's next for green hotels?," ET HospitalityWorld (2025).
10. Savills, "Technology is transforming the global office market," Savills Blog (2024).
11. Interreg Central Europe, "Good practice examples of EU projects on re-use of construction waste in Central Europe," Interreg Central Europe News (2024).
12. MIPIM World Blog, "The role of ESG factors in real estate investing," MIPIM World Blog (n.d.).
13. RICS, "RICS Valuation – Global Standards (Red Book Global Edition)," Royal Institution of Chartered Surveyors (2024): London.
14. Feingold, S., "What's next for corporate sustainability rules in Europe?," World Economic Forum (2025): 21 February
15. European Environment Agency (EEA), "Sustainability solutions," European Environment Agency (n.d.).

This article was originally published in July 2025 by Deloitte Greece.

Finance sustainability and green finance

As key geographies, such as Europe and China, continue to strive toward climate neutrality, real estate continues to stand at the heart of global energy transition efforts. The sector is under pressure to modernize its asset base, reduce emissions, and align with sustainability targets—all while facing rising capital costs and lender scrutiny.

Green bonds are emerging as an important instrument in financing this transformation. This article explores how sustainable debt, particularly green bonds, is reshaping the way in which the real estate sector mobilizes capital and meets its climate obligations.

Climate targets and real estate's central role

The European Union has committed to achieving climate neutrality by 2050 with an interim target of at least a 55% reduction in greenhouse gas emissions by 2030[1]. China's target of net-zero emissions by 2060 is equally ambitious as it consumes more non-renewable energy sources than any other country[2]. Real estate is at the center of these challenges as buildings and construction account for a third of global energy consumption and CO2 emissions according to the United Nations Environment Program (UNEP)[3].

The environmental footprint of real estate is matched by an investment gap. UNEP estimates that annual energy-efficiency investment in buildings globally should rise from US$270 billion in 2023 to over US$520 billion by 2030 to stay on track with climate goals[4].

Navigating real estate financing in line with climate goals

Public funding alone is unlikely to meet the scale of investment required. Private capital should be mobilized to help close the gap.

Debt financing is particularly well suited to real estate's green transition as buildings can deliver predictable and stable cash flows, measurable energy performance indicators, and can act as strong, tangible collateral with long asset lives.

Banks are responding by embedding sustainability metrics into lending criteria, requiring certifications such as Building Research Establishment Environmental Assessment Method (BREEAM) or Leadership in Energy and Environmental Design (LEED), and tying loan pricing to sustainability performance via margin ratchets or key performance indicators. Examples include maintaining a specific Global Real Estate Sustainability Benchmark (GRESB) score for a portfolio of commercial real estate or achieving energy performance certificate rating improvements for residential mortgages.

Green bonds: A tool for reducing emissions in real estate

In addition to the efforts from traditional banks, several alternative sustainable finance instruments have arisen to help fill the significant capital requirements. Among these, green bonds have emerged as a powerful tool to channel capital into sustainable real estate projects, thereby facilitating the reduction in emissions of the real estate sector.

Investor demand for this asset class has been strong as green bonds have benefited from a steady inflow of sustainability-focused investors, attracted by the greater transparency that green bonds offer. This is clearly evidenced as global green bond issuances increased to €515 billion in 2024, a 7% increase from 2023[5].

Benefits and pricing

The "greenium"—or yield discount for green assets—is a key topic in sustainable finance. According to the European Public Real Estate Association, EPRA members and constituents of the FTSE EPRA Nareit Developed Europe index issued €48 billion in green bonds from 2013 to 2023, with a greenium of between 4.5 and 8.3 basis points[6].

While modest in percentage terms, these discounts can yield multi-million-euro savings on large, long-term deals. Greeniums tend to be higher for projects with strong environmental certifications and low transition risk.

Even as greeniums have narrowed in some markets, investor demand remains robust. The European Investment Bank's €3 billion green bond issued in April 2025 under the EU Green Bond Standard was 13.3 times oversubscribed[7]—a strong signal of appetite.

By using such financing structures, issuers can also broaden their investor base, send a positive signal to the market, and help build their reputation as sustainability-focused borrowers.

Regulatory momentum and market alignment

The effectiveness of green bonds can depend on adherence to recognized frameworks, which aim to safeguard transparency and environmental integrity. The most widely recognized include the International Capital Markets Association (ICMA) Green Bond Principles and the EU Green Bond Standard (EuGBS), the newest and most rigorous of the standards.

The ICMA Green Bond Principles were launched in 2014 as a voluntary framework. It is estimated that more than €600 billion has been issued across over 5,000 bonds classified under the green buildings category of these principles[8].

From a market access perspective, the Luxembourg Green Exchange (LGX) was launched in 2016 as the first dedicated platform for sustainable securities and in 2024 more than 40% of sustainable bonds worldwide were listed on its platform[9].

Sustainable financing opportunities

To conclude, as investors, developers, and regulators align around credible green financing structures, green bonds are set to play an even more pivotal role in shaping the built environment's energy transition. For real estate players, there is an opportunity to capitalize on investor appetite and regulatory alignment.

Contacts:

Elena Petrova
Partner
Deloitte Luxembourg
elpetrova@deloitte.lu

Jared Goedhals
Director
Deloitte Luxembourg
jgoedhals@deloitte.lu

Endnotes:

1. "European Green Deal : Delivering On Our Targets", European Commission, 2021, p. 4.
2. "China poised to achieve carbon neutrality before 2060 goal", Harvard Business School, 2025.
3. "Not just another brick in the wall", United Nations Environment Programme, 2025, p. 13.
4. "Not just another brick in the wall",United Nations Environment Programme, 2025, P. 18.
5. "Global sustainable bond issuances hit €878bn in 2024", Delano, 2025.
6. "Estimating a green premium in listed real estate bonds", EPRA, 2024, p 9.
7. "European Investment Bank sets example with EU Green Bond issuance", IEEFA, 2025.
8. Luxembourg Green Exchange.
9. "Partnerships in sustainable finance: Luxembourg's Green Exchange", OECD, 2024.

This article was originally published in September 2025 by Deloitte Luxembourg.

Resource efficiency and innovation

Sustainable building materials and the circular economy

The real estate and construction sector is undergoing significant transformation as sustainability becomes a central priority. This includes replacing high-emission materials like traditional cement and steel with lower-impact alternatives and modern methods of construction. Embracing a circular economy approach can help reduce carbon emissions, cut waste, and enhance efficiency. These tactics can improve building performance, attracting investment, and increasing long-term real estate value.

The construction industry plays a central role in global environmental impact, both in terms of resource consumption and waste generation. One of the main contributors to this impact is the selection and use of building materials. Traditional materials such as concrete and steel are widely used due to their strength and availability, but they come with a heavy environmental cost. Cement production alone is responsible for approximately 8% of global CO_2 emissions, largely due to the chemical process of calcination and the fossil fuels used in production[1]. Steel, although recyclable, is highly energy-intensive to produce and in 2020 it accounted for between 7% and 9% of global human-derived CO_2 emissions[2].

These alternatives are increasingly regarded in the industry as contributors to lower greenhouse gas emissions, more renewable resource cycles, and improved building efficiency, including better thermal insulation and indoor air quality. The challenge is compounded by the fact that construction and demolition waste represent at least 30% of solid waste generated in the world[3]. It is often observed that materials are not typically recovered at the end of a building's life, resulting in processes that are both carbon-intensive and wasteful. This linear model—extract, use, and discard—has long been characteristic of the construction sector.

By contrast, a growing number of sustainable building materials are being developed with circularity in mind. Examples include cross-laminated timber, recycled steel, low-carbon concrete, recycled concrete aggregates, and engineered wood panels made from recycled fibers, which are designed to enhance environmental performance throughout their life cycle. These alternatives can reduce greenhouse gas emissions (i.e., each tonne of recycled steel avoids 1.5 tonnes of CO2 compared to steel produced from iron ore[4]), support renewable resource cycles, and can enhance building efficiency by providing better thermal insulation and indoor air quality.

The adoption of these materials is closely linked to the principles of the circular economy. Instead of viewing buildings as static and disposable, the circular model encourages designing for adaptability, disassembly, and material reuse. For example, there is increasing discussion around using structural elements made with recycled concrete in new construction. Similarly, agglomerated wood panels produced from post-consumer waste are often mentioned as a potential way to extend the lifecycle of timber resources.

Although traditional construction practices are still dominant, there is a gradual shift toward methods that support more efficient use of materials. Industrialized construction methods—such as prefabrication and modular design—are often referenced in industry discussions as approaches that may help with material efficiency and waste reduction. When used alongside sustainable materials, these methods are viewed as having the potential to lessen environmental impact. Digital tools, including building information modeling (BIM), are also frequently noted for their role in supporting more detailed planning, life cycle assessments, and material traceability, which can be relevant for future reuse or recycling.

Increasingly, sustainable materials are seen as a relevant consideration in project valuation from an investment perspective, developers and asset managers are increasingly considering the carbon footprint and life cycle of building materials. Incorporating certified sustainable materials is often viewed as beneficial for meeting green building certification requirements, such as Leadership in Energy and Environmental Design (LEED) or Building Research Establishment Environmental Assessment Method (BREEAM), and for enhancing appeal to tenants and investors. Recent trends indicate that this shift is especially relevant in European countries, where the real estate and construction sectors are beginning to accelerate the transition toward more sustainable practices. For example, 56% of European real estate and infrastructure companies confirm that lower-emission concrete is part of their carbon reduction strategy for addressing scope 3 emissions[5]. However, despite growing interest, there is still a gap between pilot projects and widespread adoption—particularly when it comes to integrating circular material strategies in public tenders and mid-scale developments.

Financial instruments such as bonds or sustainability-linked loans are often tied to measurable sustainability outcomes, including the use of low-carbon materials. Developers who prioritize circular material strategies may access preferential financing and align more easily with institutional investors seeking sustainability-aligned assets. Moreover, tools such as digital material passports can offer transparency in sourcing and help facilitate responsible resource management, further enhancing investor confidence.[6]

In conclusion, shifting away from high-emission, linear material use in construction toward a model based on sustainability and circularity is important and possible with today's technologies and materials. By choosing low-impact alternatives and embracing the principles of reuse and regeneration, the construction sector can reduce its environmental footprint and help build a more resilient future.

Building the future responsibly begins with the materials chosen today.

Contacts:

Agustín Manzano
Senior Manager, ESG Real Estate,
Deloitte Spain
amanzano@deloitte.es

Jose Javier Durán
Manager, ESG Real Estate,
Deloitte Spain
jduranheras@deloitte.es

Endnotes:

1. "Cement is a big problem for the environment. Here's how to make it more sustainable", World Economic Forum, 13 September 2024.
2. "Climate change and the production of iron and steel", World Steel Association, 2025.
3. "The circular economy in the construction and demolition waste management: A comparative analysis in emerging and developed countries", ScienceDirect, 1 November 2023. "24 Construction Waste Statistics & Tips to Reduce Landfill Debris", BigRentz, 26 February 2024.
4. "Climate Change and the production of iron and steel", World Steel Association, 2020.
5. "Survey for Real Estate, Infrastructure, Manufacturing and Energy sectors", Climate Group and Ramboll, 2024.
6. "What are material passports and the benefits of using them?", UK Green Building Council, 7 June 2024.

This article was originally published in August 2025 by Deloitte Spain.

Embracing the circular economy: Sustainable fit-outs through materials reuse

Significant focus has been placed on helping to reduce the operational emissions of office fit-outs through energy-efficiency and emission removal, with many companies establishing SBTi validated net zero targets. While these efforts are beneficial, it is important not to overlook other aspects of sustainability. Exploring circular economy strategies in real estate fit-out projects can offer additional environmental advantages and financial gains. One effective circular economy strategy is the reuse of materials.

The role of fit-out materials in the circular economy

Materials associated with interior building fit-outs account for approximately 10% of global emissions[1]. These emissions are generated from the extraction of raw materials, processing, manufacturing, and transportation of products, and are often referred to as 'embodied carbon' or 'upfront carbon'. During office decommissioning, retrofits, and upgrades, many building materials are removed from sites and disposed of in landfill prematurely. This results in a linear economy that contributes to the loss of material resources and the carbon embodied in these products.

Benefits of a materials reuse strategy

Materials reuse involves designers and architects creatively incorporating recovered, reused, or repurposed products into office spaces. Common materials can include furniture, demountable partitions, kitchen equipment, flooring, ceilings, etc. Investing time and effort in this closed-loop approach can offer several benefits:

- Reduced embodied carbon: Avoids embodied emissions associated with manufacturing new materials and transporting them to the site.
- Decreased raw material extraction: Lowers the demand for new raw materials, minimizing the environmental and potential human impact associated with mining, logging, and other extraction processes.
- Landfill waste avoidance: Prevents resources from ending up in landfills, reducing waste and the associated environmental hazards.
- Cost savings: Cuts costs by reducing the need to purchase new products, decreasing reliance on volatile global markets, and reducing disposal expenses.

Challenges of a material reuse strategy and potential ways to overcome

Common challenges or potential barriers that may be encountered when incorporating recovered, reused, and repurposed products in an office fit-out include:

- **Design flexibility:** Reusing materials may limit design options. As aesthetic, performance, and efficiencies in designs change, it may be difficult to repurpose materials with outdated specifications. A potential solution to addressing this challenge is to engage a design team specializing in adaptive reuse. They can provide innovative solutions that incorporate reused materials without compromising on aesthetic or functional goals.
- **Scheduling coordination:** Coordinating the storage and timing of materials reuse can be complex. This can be addressed by planning ahead to allow additional leeway, helping to ensure that relevant business functions involved have sufficient time and adequate opportunities to find appropriate solutions.
- **Additional cost and effort:** Accommodating materials reuse can be time-consuming, adding additional stages (i.e., materials inventory, pre-refurbishment audits, on-site validation, staging, warranty checks, repairs etc.) to the process and could result in real or perceived costs. In some cases, the perceived cost of embedding circularity is due to lack of foresight and planning; utilizing existing technologies that help streamline the inventory process and recommend optimal material pathways, such as materials

passports and renovation passports[2], can help mitigate these challenges and make the process more efficient.

- **Price competition:** Secondary materials can struggle to compete with more affordable primary raw materials, particularly where external costs like CO2 emissions are not included in prices. This can make it more difficult to establish circular business models. A potential solution to address this is to go beyond upfront costs when making the business case, clearly assessing life cycle costing and quantifying externalities (e.g., model the avoided environmental costs) and communicating to stakeholders early to build support for circular approaches. Research can also be done early in the project stages to help determine the availability of local and national programs that provide funding for circular construction projects, or sustainable financing loans with favorable terms for sustainable projects.
- **Transparency and digital traceability:** Effective control of complex material flows can require reliable data, and a lack of digital systems is slowing down the development of intelligent traceability and monitoring solutions. While retroactively addressing traceability is challenging, a proactive approach is to implement material passports—digital records that capture key information about building materials, such as their origin, composition, and quality. These passports help verify the quality and provenance of secondary materials.

Takeaway

Embracing materials reuse can yield significant environmental and financial benefits. While the building industry strives to meet ambitious SBTi-validated net-zero goals, which emphasize operational carbon reduction, it is equally important to adopt a circular economy approach that considers material efficiency. While it is easier to reuse materials if the spaces were initially designed with disassembly or circularity in mind, there are opportunities to reuse, repurpose, or recycle.

By addressing the challenges associated with materials reuse and embracing innovative solutions, companies can create office spaces that are not only functional and aesthetically pleasing but also environmentally responsible. Circular practices can play a pivotal role in shaping the future of office fit-outs, and reuse of materials is an important strategy in achieving sustainable transformation.

Case study: Materials reuse in the Ottawa office refresh

Background

Deloitte Canada's Ottawa office, originally refurbished in 2013, has been a testament to forward-thinking design and non-obsolescence, contributing to Deloitte Canada's decision to remain in the existing location with plans for expansion and a refresh to align with evolving design standards and specifications. This decision was driven by its focus on sustainability, cost-effectiveness, and maintaining a modern and functional workspace.

Objective

The primary goal of the refresh was to update the office space to support new ways of working, reflect current brand standards, and incorporate inclusive design trends while ensuring that the aesthetics and functionality would remain relevant for years to come. The project aimed to leverage the durability and timelessness of the original materials, minimizing waste, and maximizing resource efficiency.

Approach

1. **Assessment of existing materials:** The first step involved a thorough evaluation of the materials used in the 2013 refurbishment. This included assessing the condition and potential for reuse of flooring, fixtures, furniture, and other architectural elements. The original investment prioritized quality and longevity, which facilitated the reuse strategy.
2. **Design integration:** The design team worked to integrate existing materials into the new aesthetic framework. By focusing on neutral palettes and versatile designs, the refresh aimed to incorporate elements that would not become dated quickly. This approach ensured that the office would maintain a modern look while preserving the integrity of the original materials.

Outcomes from the proposed design

- **Materials recovered[3]:** Quantity of products reused includes:
  - Over 1,100 furniture pieces
  - Over 250 square meters (over 2,690 square feet) of demountable wall panels
  - Over 6,900 carpet tiles, measuring over 1,700 square meters (over 18,300 square feet)
- **Waste diverted:** Over 38,000 kg (over 83,775 lbs) of materials diverted from landfill
- **Cost avoided:** The estimated cost avoided from not purchasing new materials is over CAD 1,000,000 (approximately USD 730,000).[4]
- **Emissions mitigated[5]:** Almost 200,000 kg of Carbon Dioxide Equivalent (CO_2e) (approximately 441,000 lbs), equivalent to:[6]

Emissions from **60 cars** driven for one year, or

Emissions from the electricity used to power **130 homes** for one year, or

Emissions from **16 million smartphones** charged, or

Carbon sequestered by **3,300 tree seedlings** grown for 10 years

Contacts:

Ying Gu
Sustainability Manager
CoRe Procurement,
Real Estate & Office Services,
Deloitte Global
yigu@deloitte.ca

Sally Pickering
Senior Design Specialist,
Corporate Real Estate,
Deloitte Canada
sapickering@deloitte.ca

Endnotes:

1. The RESET Standard, Embodied Carbon and Circularity in Office Interiors: Part 1, April 2022, page 4.
2. Please see UKGBC's article on Material Passports, and Build Up's article on Renovation Passports for additional information.
3. Only furniture and demountable walls/partitions and carpet were included in this assessment. Additional materials reused include ceiling tiles, flooring, millwork, partitions, appliances and equipment, lighting and plumbing fixture, and more, but were not included in assessment as volumes are difficult to determine. The inclusion of those materials would result in even higher avoidance of above noted outcomes.
4. Cost avoidance calculated based on current price of products if available. Where not available, original cost of products were used, factoring in inflation. Inflation was calculated as 15%, based on Canadian Inflation Tracker for "Household operations / furnishings and equipment" between Jan 2013 to Dec 2024.
5. Impact category used for this assessment is Global Warming Potential, excluding biogenic carbon, under the Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts (TRACI) methodology. Product-level environmental product declarations (EPDs) were used where available. Where exact data was not available, comparable products with similar materials compositions were used as proxies.
6. Car and home equivalencies calculated from Natural Resource Canada's Greenhouse Gas equivalencies Calculator, based on Canadian averages. Smart phone and tree seedling equivalencies calculated from EPA's Greenhouse Gas Equivalencies Calculator.

This article was originally published in August 2025 by Deloitte Canada.

Aged urban building adaptation, reuse, and regeneration

The building and construction sector accounts for more than 20% of global emissions and more than a third of global energy demand[1]. Large-scale retrofitting and refurbishment of aging building stock can retain existing structural frames and foundations, which can significantly reduce embodied carbon (the total emissions generated to produce a building, including materials, construction, and related processes), which, on average, is half that of a new build project[2]. There are other benefits, including heritage preservation, improved aesthetics, shorter construction duration, and reduced risk, which are additional reasons why developers may opt for refurbishment over new construction. Below, three case studies are presented from the dense urban landscape of Hong Kong, where Deloitte Hong Kong architecture and planning specialists are collaborating with building owners on renovation and conversion projects.

Adaptive reuse of a convent building

This existing brick-veneered building is part of a cluster of school buildings erected in 1937, which was declared a monument in 2008. The key objective of the project was to drive both social and environmental improvements through upgrading outdated building services systems, improving energy efficiency, and functional replanning to meet current-day requirements.

- Double-glazed windows: Replacing single-glazed windows reduced heat transfer by 22.4% and decreased cooling energy consumption by 10%-15%.[3]
- Operational efficiency: The renovation significantly improved thermal comfort and energy performance during the 50-year operational phase.

Renovation strategy

The renovation strategy prioritized retaining 90% of the existing structure, minimizing material waste and reducing lifecycle carbon emissions. A 27.37% reduction in lifecycle carbon emissions was achieved compared to constructing a new building, with total emissions of 793.19 metric tons of CO2 (tCO2) (renovation) versus 1092.14 tCO2 (reconstruction)[4].

The social and community aspects of the project were equally important. Through a series of subtle architectural interventions, the modernized building was designed to be accessible in accordance with Hong Kong's 'Barrier Free Access' building code (1997), including those with disabilities, by incorporating features such as ramps and wide doorways, while preserving the building's historical elements. Additionally, a new exterior forecourt was formed, acting as a social connector to the rest of the campus, providing valuable outdoor space that extends the functional footprint beyond the walls of the small building.[5]

In addition to its social, community, and sustainability benefits, the project's cost considerations were also significant. While the building is currently at the main contractor tender stage, and final renovation costs are yet to be determined, preliminary analysis suggests that renovation projects often have a lower embodied carbon footprint and, on average, can cost up to half as much as a new build project. However, it is important to note that actual costs may be subject to change due to potential variation orders during construction, and a precise comparison between renovation and new build costs will only be available upon project completion.

This case study highlights the importance of sustainable design, lifecycle thinking, and heritage preservation in urban development. By prioritizing adaptive reuse, the project demonstrates how aged buildings can be transformed into models of environmental and social performance, fostering community engagement and cultural preservation.

Conversion of an industrial building into a lifestyle hub

One of the first projects to be approved under the Hong Kong Government's policy to revitalize older industrial districts in the territory, this 16-storey industrial building

was gutted and reconfigured into a lifestyle building comprising offices, shops, and food and beverage outlets. By surgically removing existing floor plates, double-height spaces were strategically located around the building to compensate for suboptimal floor-to-floor heights.

The lobby serves as a publicly accessible art gallery and cultural beacon for the district, which has gained a reputation as an artist enclave in recent years. Multi-level roof terraces connect to restaurant spaces throughout the building, supporting a variety of usage scenarios both day and night.

Natural terracotta cladding makes reference to the colors and character of the original neighborhood, while high-performance insulated glass units provide enhanced energy performance.

The project is targeting Building Environmental Assessment Method (BEAM) Plus Silver certification, which is the local Hong Kong green building accreditation system, demonstrating achievement in areas such as material usage, effective waste management, and indoor air quality.

Retrofitting of a secondary school

Located in the eastern part of Hong Kong Island, this secondary school occupied a 14,000-square-meter building that was over 20 years old. Energy consumption was a significant challenge for the operations of the school, with HVAC (Heating, Ventilation, and Air Conditioning) systems accounting for 65% of annual electricity consumption.[6] Other resource usage, such as water consumption, waste management, and transportation, also required optimization, providing a foundation for targeted renovation plans.

Innovative adaptive reuse approaches

The renovation project uniquely combined technological innovation with community engagement.

- **Energy efficiency and renewable energy integration**
  A 750-square-meter photovoltaic system, which uses solar panels to convert sunlight into electricity, was installed on the roof and surrounding areas. Based on solar radiation analysis and standard calculation methods, the system is estimated to generate approximately 136,900 kWh of electricity annually.[7] In addition, IoT (Internet of Things) smart HVAC and lighting systems have been implemented to help optimize energy use based on occupancy and environmental conditions. Together, these technologies can provide an integrated approach to active energy efficiency by combining renewable energy generation with intelligent energy management. As a result, the school can achieve significant cost savings.
- **Behavioral and educational measures**
  Workshops, energy-saving activities, and carbon footprint calculators encourage sustainable practices among teachers and students, while a carbon accounting system (a method for measuring and tracking carbon emissions) promotes awareness and reduction of carbon emissions within the school community.
- **Sustainable implementation**
  Renovation works were planned in carefully delineated phases to help minimize disruption to school operations while maximizing renovation benefits.

Social impact

The renovation project brings multiple benefits:

- **Education and behavioral change**
  Sustainable practices are integrated into the curriculum, with activities like recycling competitions and low-carbon cooking reinforcing students' environmental awareness.
- **Environmental performance**
  The project is expected to reduce annual carbon emissions by 60-70%, with remaining emissions offset through carbon trading.[8]
- **Community engagement**
  The project creates a platform for collaboration among teachers, students, and the community, enhancing unity and responsibility through environmental activities and recycling programs.

This renovation project demonstrates how adaptive reuse and regeneration of old buildings can promote social and community development while enhancing environmental benefits. By integrating technology and community participation, the project sets an example for sustainable urban renewal, showing how current needs can be met while preserving the planet.

These cases provide valuable insights for urban renewal projects, demonstrating that old buildings can be transformed into functional, sustainable spaces.

Contacts:

Song SHI
Head of Marketing,
Infrastructure & Real Estate
Deloitte Hong Kong,
WCWP International Limited
soshi@deloitte.com.hk

John WANG
Associate Director,
Infrastructure & Real Estate
Deloitte Hong Kong,
WCWP International Limited
johnjiwang@deloitte.com.hk

Endnotes:

1. UN Environment Programme, Global Status Report for Buildings and Construction: Beyond foundations: Mainstreaming sustainable solutions to cut emissions from the buildings sector, p. 1
2. Net Zero Carbon Guide, Retrofit or New Build? p. 1
3. Hong Kong Housing Authority, Energy Efficiency Regulation (APP-67), 1995
4. Ministry of Housing and Urban-Rural Development of the People's Republic of China, Standard for Calculation of Carbon Emissions in Buildings (GB/T51366-2019), 2019, p. 22, 26, 47
5. 1 Accessibility features were implemented in accordance with Hong Kong's 'Barrier Free Access' Code (1997). GBP drawings were approved by the Hong Kong Building Department.
6. Hon Wah College in Hong Kong, Utility bills for electricity, water, and gas, October 2021–September
7. Estimated annual energy generation is based on site-specific solar radiation analysis, assuming 750 square meters of photovoltaic panels, a generation efficiency of 100 W/square meter-hour, and an average of 5 effective sunlight hours per day throughout the year.
8. WCWP, Carbon Neutrality Renovation and Sustainability Proposal for Hong Kong Hon Wah College, 2024

This article was originally published in August 2025 by Deloitte China.

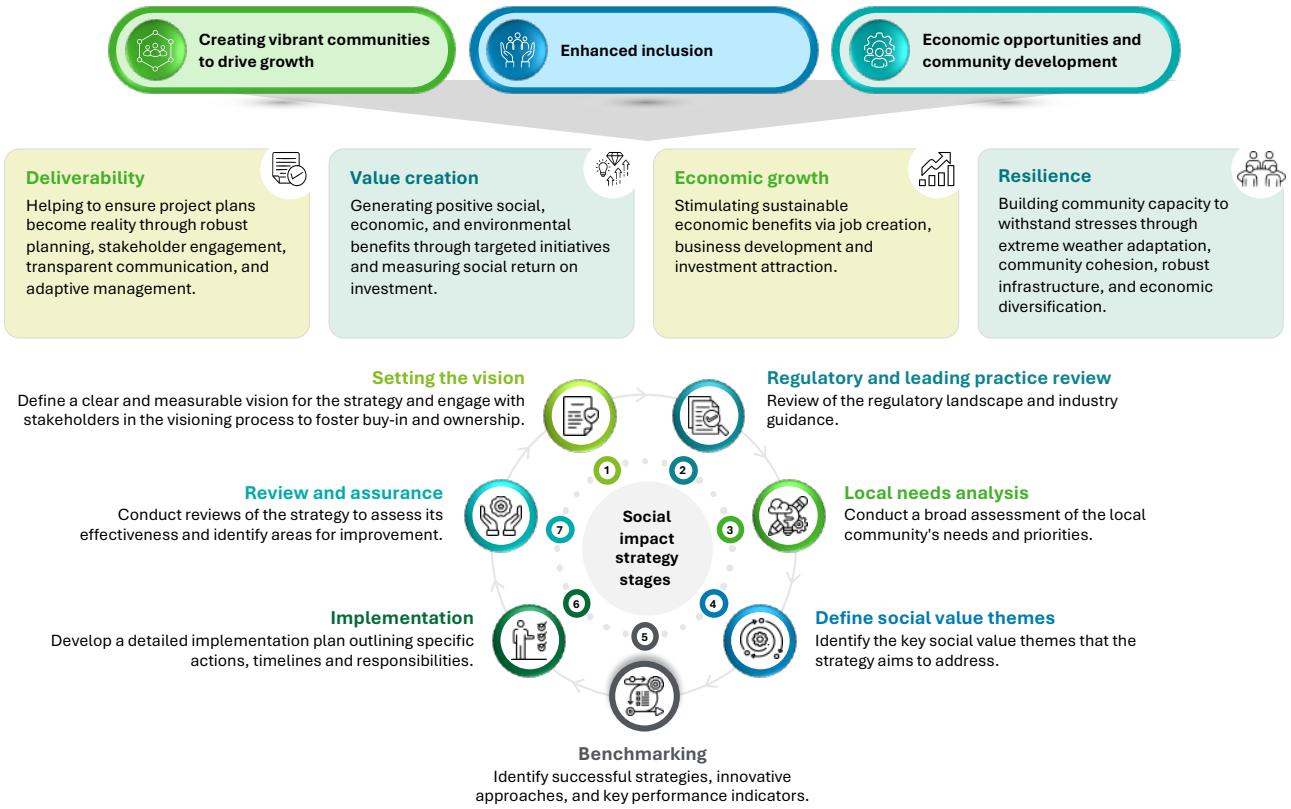
Resilience and community impact

Driving social impact within sustainable urban development

With the United Nations Environment Programme (UNEP) projecting that 70% of the world's population will reside in urban areas by 2050 (areas currently responsible for up to 80% of global energy consumption and 75% of carbon emissions), the need for sustainable urban development continues to climb the priority list. This remains true despite the evolving and more measured approaches to certain environmental challenges on the global agenda.[1]

Sustainable urban development can require a holistic approach to planning, design, and management of urban areas, maximizing and balancing economic growth, social impact, and environmental responsibility. By integrating these factors, developers can help mitigate risk in their investment decisions and create commercially resilient and attractive environments. By embedding these considerations, vibrant urban spaces that benefit both communities and businesses can be created.

The strategic ambitions and their implementation:



Source: Deloitte UK

Vibrant communities to drive growth

Creating vibrant communities is important for driving growth in today's urban environments. Strategically designed urban spaces, incorporating elements such as accessible outdoor areas, proximity to essential services like healthcare and education, and efficient transport networks, play a key role in both improving quality of life and attracting investment.[2] These features can foster social interaction, promote physical activity, and reduce stress, contributing to the overall well-being of residents and making these areas desirable places to live and work.

While leading practice suggests allocating 45-50% of urban land to streets and 15-20% to open public spaces[3], the UN-Habitat World Cities Report 2024 highlights a concerning decline in global urban green spaces over the past 30 years. This trend underscores the increasing importance of prioritizing green spaces in urban development projects, which can also offer commercial benefits.

Enhanced social inclusion

Urban disparity manifests in various ways, extending beyond income disparities. This disparity creates a complex set of challenges, which may contribute to social mobility and public well-being challenges. Factors such as inadequate public transportation infrastructure, limited access to healthcare and education, and a lack of outdoor spaces can exacerbate existing gaps and contribute to a lower quality of life.

In response, community hubs are increasingly being positioned at the heart of sustainable urban developments, serving as important resources and catalysts for positive change. Addressing these multifaceted challenges can require a broad approach that considers economic development and community development initiatives aimed at improving access to essential services and opportunities.

Economic opportunities and community development

Cities are important drivers of economic growth providing a catalyst for employment opportunities and contributing to overall economic prosperity. Local development initiatives can revitalize economies by creating access to quality jobs, investing in high-quality education, training, and skills, thus empowering residents with the capabilities needed to promote economic development.

To build more livable cities, strategic policy coordination and smart investments are needed[4]. Authorities should proactively shape urban futures, helping to ensure inclusive opportunities for all. Investing in urban infrastructure and services can help transform cities into powerful development hubs, securing long-term economic success for future generations.[5]

The path forward

In the face of pressing challenges like extreme weather, resource depletion, and social disparity, sustainable urban development can offer an important path toward resilient and thriving urban futures.[6] Achieving this can require a holistic approach from key urban development stakeholders, integrating social considerations into planning and development to create inclusive, safe, resilient, and sustainable urban environments. Liveable and sustainable cities require effective, inclusive accessibility strategies. These are crucial for reducing carbon emissions and improving air quality by promoting public transport, active travel (cycling and walking), EVs, smart traffic management, mixed-use development, and accessible housing, thus enhancing mobility and social equity.

Thinking in action

Deloitte UK is acting as the lead advisor to a UK football club on its ambitious relocation project, which includes the development of a new state-of-the-art stadium and sports quarter. This move aims to create a vibrant "world-class sports quarter" for its community, generating over 8,500 jobs and delivering significant local benefits.

Deloitte UK's role in overseeing the development of the sports quarter requires the creation of the project's overarching master plan design objectives, aligning with the overall vision. As part of the master plan design brief, a sustainability and social impact strategy was created, each incorporating the key sustainable development and social impact topics discussed above.

Contacts:

Philip Parnell
Partner,
Sustainability & Climate Lead
Deloitte United Kingdom
pparnell@deloitte.co.uk

Faye Hargreaves
Manager, Sustainability & Climate
Deloitte United Kingdom
fhargreaves@deloitte.co.uk

Endnotes:

1. "Goal 11: Sustainable Cities and Communities," United Nations Environment Programme (UNEP), last updated 25 March 2025
2. UN Habitat. "Healthier Cities and Communities Through Public Spaces" 2025, p. 2
3. UN Habitat. "Healthier Cities and Communities Through Public Spaces" 2025, p. 4
4. Deloitte. "Inclusive smart cities". Accessed 28 August 2019
5. World Bank. "Urban Development." Accessed June 2024.
6. "Climate change: a threat to human wellbeing and health of the planet. Taking action now can secure our future" The Intergovernmental Panel on Climate Change (IPCC) 28 February 2022

This article was originally published in September 2025 by Deloitte United Kingdom.

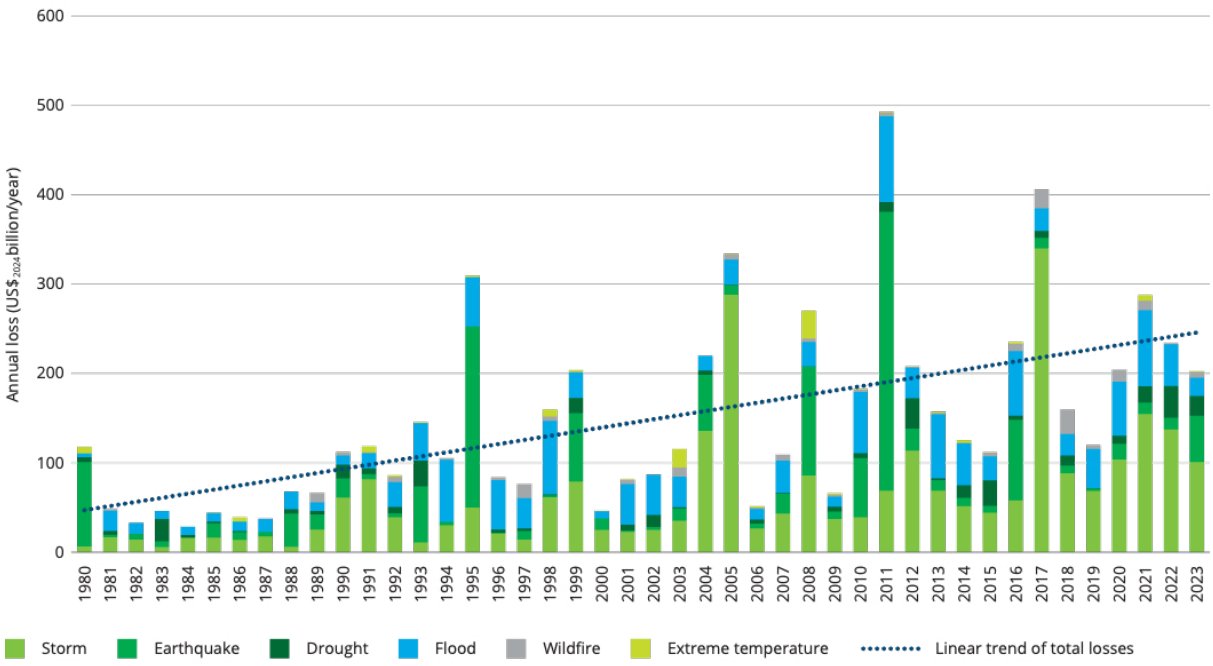
AI for infrastructure resilience

Infrastructure serves as the backbone of communities and society and can shape how we live, work, and move. Essential services like energy, water, healthcare, sanitation, and transportation rely on infrastructure to support human well-being and economic resilience. When infrastructure thrives, societies can flourish. However, with growing populations and economic development, infrastructure systems should evolve to meet rising demands.

Rising risks to infrastructure

Natural disasters alone are projected to cause approximately US$460 billion in average annual losses to infrastructure globally by 2050, a dramatic increase compared to the US$200 billion annual average globally over the last 15 years . As natural hazards such as storms, floods, and wildfires become more frequent and intense, resilient infrastructure—capable of absorbing shocks, recovering quickly, and adapting to changing conditions—is important for protecting lives, maintaining essential services, and enabling economic growth.

Historical losses due to natural disasters (including acute shocks and chronic stresses)

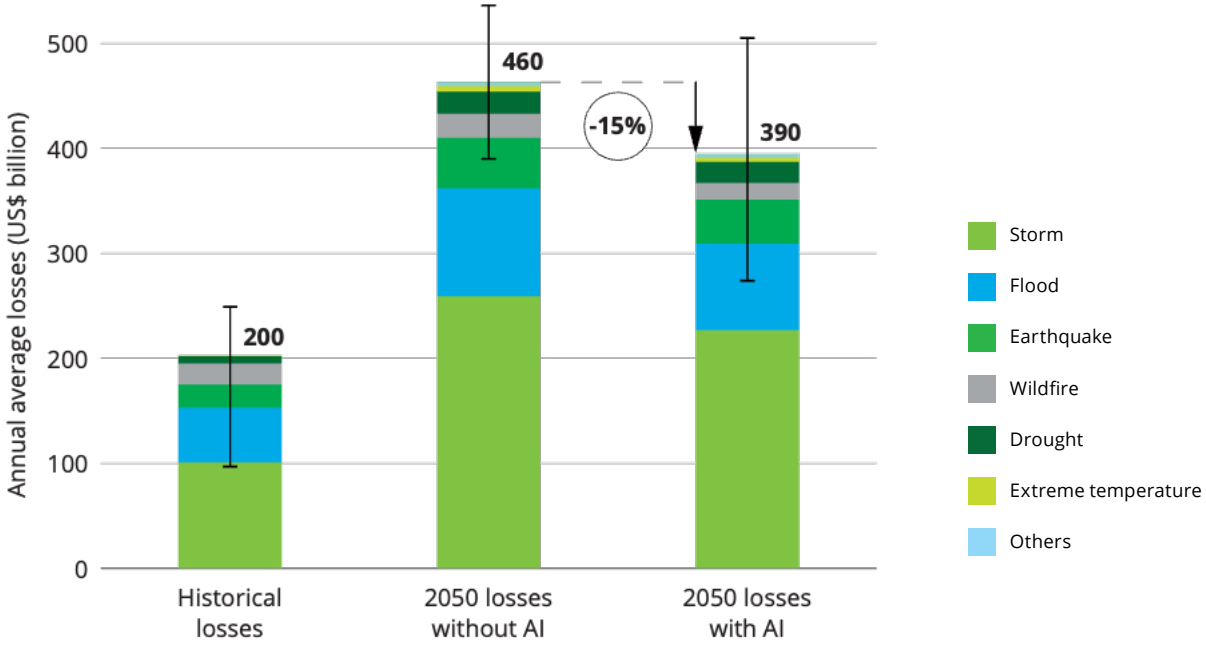


Source: Deloitte Global

The role of AI in helping to build resilient infrastructure

Leaders have an opportunity to enhance infrastructure resilience by investing in and applying artificial intelligence (AI) at scale–doing so could help prevent approximately 15% of annual direct damage costs, representing approximately US$70 billion in potential savings annually.

The integration of AI into infrastructure resilience strategies offers transformative solutions across three stages: planning, response, and recovery. During the planning phase, AI-driven tools like machine learning can analyze risk data, simulate scenarios, and identify preventative measures, such as flood-resistant designs or fire-resistant materials. In the response phase, AI-powered early-warning systems and real-time monitoring enable faster detection of hazards and help guide emergency responses. For recovery, AI can help prioritize repairs using predictive damage assessments and optimize resource allocation, accelerating the restoration of services and minimizing economic disruption.



Source: Deloitte Global

Real-world applications of AI in infrastructure

Several examples highlight the effectiveness of AI-enhanced resilience solutions:

- **Digital twins:** In Lisbon, digital twins were used to simulate future flood risks and develop an appropriate drainage plan—projected to prevent up to 20 floods over the next century, saving more than US$100 million in damage over this period.
- **Predictive maintenance:** In Poland, the municipal water supply and sewerage company of Wroclaw, in collaboration with Deloitte Poland, used AI-powered predictive maintenance to analyze factors like pipe age, material, and environmental stressors to help modernize aging water infrastructure and predict potential failures with up to 90% accuracy.
- **Post-disaster recovery:** In the US, an inspection tool created by Deloitte Consulting LLP–OptoAI–uses photogrammetry and AI models to help reduce the time required to repair roofs post-disaster by 15%-30%.

Challenges to AI adoption in infrastructure

Despite its potential, the widespread implementation of AI-enabled resilience can face some significant barriers:

- **Technological limitations:** Effective AI solutions require high-quality, varying datasets, but data availability and accuracy remain a concern.
- **Financial constraints:** Upfront investment costs and uncertain short-term returns can deter adoption.
- **Regulatory uncertainty:** Evolving AI-specific frameworks, cybersecurity, and privacy concerns slow progress.
- **Institutional inertia:** Resistance to new technologies and ways of working can hinder momentum.
- **Lack of a skilled workforcewith experience in AI:** This talent gap can make it difficult to design, implement, and maintain AI systems effectively. Coordinated action across stakeholders.

Building resilient infrastructure can require collaboration across infrastructure operators, technology companies, financial institutions, insurers, engineering firms, and policymakers:

- **Infrastructure owners and operators:** Should look to embed AI across planning, design, and operations to unlock efficiency gains and enhance resilience. Early investments in pilot projects and AI-ready systems can enable continuous improvement and scalability.
- **Financial institutions:** Innovative financing tools like resilience bonds can bridge funding gaps for AI solutions. Internally, AI can enhance risk assessments, credit underwriting, and investment processes.
- **Insurers:** Insurers can help incentivize AI for resilience adoption by offering premium reductions for AI-enabled systems and developing products tailored to AI-enhanced infrastructure.
- **Technology companies:** As the innovation engine, tech firms can integrate AI with complementary technologies like IoT and digital twins, which can be important for enhancing and improving AI solutions.
- **Architecture and engineering firms:** These firms play a key role in embedding AI tools during the planning and design phases to create smarter, more resilient infrastructure systems.
- **Policymakers:** Governments help enable AI adoption by setting standards, offering economic support schemes, and modernizing legacy infrastructure. They can also help drive cross-sector collaboration and long-term planning.
- **Real estate:** Real estate developers, investors, and managers should prioritize adopting AI, both in new developments and existing properties. Doing so could help reduce operating costs, improve resilience and help mitigate losses to asset value from natural disasters.

A smarter, safer future

Coordinated action across stakeholders can help create infrastructure systems prepared for the challenges of a changing world. By integrating AI across the phases of resilience, societies can build a safer, smarter, and more resilient future.

Reference: This article is based on insights from Deloitte Global's AI for Infrastructure Resilience 2025. For more information, read the full report from the Deloitte Center for Sustainable Progress.

Contacts:

Jennifer Steinmann
Global Sustainability Business leader,
Deloitte Global
jsteinmann@deloitte.com

Michael Flynn
Global Infrastructure,
Transport & Regional Government leader,
Deloitte Global
micflynn@deloitte.ie

Endnotes:

1. Deloitte Global, "AI for infrastructure resilience", June 2025

This article was originally published in September 2025 by Deloitte Global

Contacts

Kathy Feucht
Global Real Estate Sector leader
Deloitte Global
kfeucht@deloitte.com

Michael Mueller*
Real Estate ESG leader
Deloitte Germany
mmueller@deloitte.de

* Indicates individual is not an employee of Deloitte Global or other Deloitte central entities and was instead commissioned to participate in authoring or contributing to this article.

Deloitte.