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Accelerating the Decarbonization of Buildings: The Net-Zero Carbon Cities Building Value Framework

BRIEFING PAPER

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Executive summary

The transition to a greener built environment requires a shift in how value is defined and perceived.

“ The Building Value Framework can be applied in diverse contexts across different types of building assets and used at any point in the investment planning and decarbonization timeline.

With over half of the world’s population living in cities and producing over 70% of carbon emissions, cities play a key role in combatting climate change. Construction and the operation of buildings are responsible for 38% of global emissions, and there is an urgent need for solutions to help accelerate the decarbonization of the urban built environment to limit the global temperature rise to below 1.5°C.

Although some leaders in sustainable buildings have started to consider social and environmental impacts in their decision-making, many obstacles to investment in net-zero buildings still relate to financing, both real and perceived. The World Economic Forum’s Net-Zero Carbon Cities Building Value Framework seeks to accelerate investment by overcoming these barriers.

The framework proposes that a more holistic decision-making approach, which recognizes the importance of social and environmental outcomes and system performance, is key to increasing capital flow towards decarbonization solutions. The framework guides decision-makers to connect non-financial benefits such as “user satisfaction” and “systemic value efficiency” and correlate them with *reducing risk* or *increasing return on investments.*

The Building Value Framework has been developed and validated through case studies to understand the investment decisions and evaluate outcomes in real projects. From this process, key insights and a practical checklist (focusing on reducing operational emissions) have emerged to maximize value creation, as illustrated through the presented cases.

– First, it is vital to invest in decarbonizing technologies and combine them to optimize impact. For example, the Belgian real estate company Extensa used complementary solar and geothermal technologies to renovate and refurbish an old railway station in Brussels. This project demonstrates how bundling these technologies greatly impacts flexibility and system resilience.

– Second, investment in digital can maximize the benefits of decarbonizing technologies. In a case study from Turin, Italy, a municipality, in collaboration with Enel X, a leading smart energy service provider, retrofitted municipal buildings for energy efficiency and on-site renewable generation. Integrating these with a digital platform added value to the project by enabling data-driven management decisions across the municipal system.

– Third, investing in city ecosystem services and equipping buildings with distributed renewable power generation, storage and smart energy management solutions can enhance local resilience and accelerate decarbonization across cities without the need for disruptive grid upgrades.

The flexibility of the Building Value Framework means it can be used for the retrofit and refurbishment of existing buildings, as well as for the construction of new buildings. It can be applied in diverse contexts across different types of building assets and used at any point on the investment planning and decarbonization timeline.

The urgency to transition the world’s cities towards a net-zero carbon future is abundantly clear. The Building Value Framework presents an approach to help accelerate the investments needed to deliver a greener urban built environment.

Introduction

The World Economic Forum's Net-Zero Carbon Cities programme aims to accelerate the transformation of urban ecosystems towards a more sustainable, resilient and equitable future through integrated solutions that address energy, buildings and mobility. If the world is to keep pace with limiting the global temperature rise to below 1.5ºC compared to pre-industrial levels, a transition to a clean electrified world is needed. Buildings account for up to 38% of global carbon emissions. Reducing emissions in the urban built environment will therefore be a critical strategy to meet this challenge, and more investment is needed in relevant solutions, ranging from electrification to energy efficiency, from more digitalization to better weatherization.

The Net-Zero Carbon Cities Building Value Framework seeks to accelerate this transformation of the urban built environment by elevating the tangential benefits that are often qualitative in nature and helping correlate these with the return on investment in green buildings. This approach proposes that integrating the holistic value of investments in the decision-making process could increase capital flows towards decarbonizing projects and solutions. This framework and its accompanying recommendations are presented as tools that asset owners and investors from the public and private sectors can use in capital investment decisions.

1 The role of buildings in combatting climate change

Buildings are the largest contributor to emissions in cities – responsible for 50-70% of city emissions and 38% of global emissions.

Cities are the frontline in lowering global carbon emissions. Over half of the world's population live in cities, accounting for over 70% of CO_2 emissions.[1] Buildings are the largest contributor to emissions in cities, responsible for 50-70% of city emissions and 38% of global emissions.[2] Roughly 75% of building emissions are operational emissions generated from building systems (e.g. heating, ventilation and air conditioning, lighting and IT servers). The remaining 25% come in the form of embodied emissions – carbon generated from the manufacture of building materials, construction and internal furnishings.[3]

As the world strives towards a net-zero economy, all buildings must become net zero by design. The steps needed to deliver this outcome are outlined in the *Green Building Principles: The Action Plan for Net-Zero Carbon Buildings*. Due to the relative lack of net-zero buildings in existence (fewer than 1% of buildings worldwide are net-zero),[4] adopting scalable solutions to transform urban building stock is urgently needed. The current pace of economic growth and population rise in emerging economies will lead to a doubling of global building floorspace from new construction over the next 40 years.[5] Net zero by design is not limited to new construction, as 80% of all buildings that will exist in 2050 already exist today.[6] Retrofit and refurbishment projects are critical in the movement to decarbonize. In Europe, between 1-1.5% of all building stock is being renovated every year. However, to meet the goals of the Paris Agreement, the rate of renovation needs to reach 2-5% a year.[7]

Net-zero buildings are an essential tool in achieving global emissions goals. In addition, as energy systems evolve towards net zero, buildings will play a larger role in the energy system. Matching electricity supply to demand is a balancing act and buildings can host new distributed resources, store power and optimize demand to help strike this balance.

2 The Building Value Framework

Although traditional financial outcomes have historically driven investment decisions in the building ecosystem, many industry leaders are increasingly recognizing non-financial considerations[8] and are often including outcomes such as environmental and social impacts in building construction, valuation and acquisition decisions. However, the World Green Building Council's recent *Beyond the Business Case* report has found that three of the top five most substantial obstacles to investment in sustainable buildings still relate to financing, with 53% of respondents citing higher upfront costs, either real or perceived, as the biggest barrier.

The Building Value Framework[9] helps tackle this barrier by contextualizing the value of sustainable buildings to include environmental and social benefits, as well as improvements to system performance. It aims to accelerate decarbonization investments by changing the perception of the holistic value and benefit of those investments for key decision-makers across the building life cycle.

The framework guides decision-makers to link these holistic performance outcomes to a reduction in risk or an increase in return on investment. For instance, increased user satisfaction in a green building may link to lower risks of vacancy and higher rents by attracting tenants willing to pay for higher standards.[10]

FIGURE 1 **The Building Value Framework evaluates social, economic, environmental and energy system outcomes resulting from investments in decarbonization solutions**

In analysing each case study, we ask:

What **risks** are reduced through these outcomes?

What **returns** are generated through these outcomes?

Source: World Economic Forum, *Net-Zero Carbon Cities: Building Value Framework*

3 Key insights

The above framework was used to evaluate the value of several real-life examples. Three key insights emerged to maximize value creation:

Invest in decarbonization technologies and bundle for impact

Technologies such as heat pumps, distributed renewable electricity and storage can have a greater aggregate impact on emissions reduction when implemented together rather than individually. For example, distributed energy generation is more impactful when combined with storage than when deployed alone.

Invest in digital

Buildings that are equipped to operationalize data (such as that for energy use and emissions) and connect systems within a building to enable smart optimization will be more future-proof. Digital and data fluency will amplify the impact of low-carbon technology interventions through enhanced operational decision support or automatic controls of building management systems. The use of digital twins can improve decision modelling and efficiency during construction, operation and maintenance.

Invest in city ecosystem services

Buildings can be a cornerstone of transport and energy decarbonization by providing services to the broader city ecosystem. Those buildings equipped with distributed renewable generation, storage and smart energy management solutions can contribute demand or frequency response services that accelerate city-wide decarbonization by offering solutions that do not require disruptive grid upgrades. Co-siting smart charging for electric vehicles with multi-residence or commercial buildings can provide grid services as well as contribute to the decarbonization of individual vehicle transportation.

Highlighting the key insights with case studies

CASE STUDY 1

A state-of-the-art sustainable office building at the heart of a locally self-reliant energy community: Gare Maritime, Brussels, Belgium

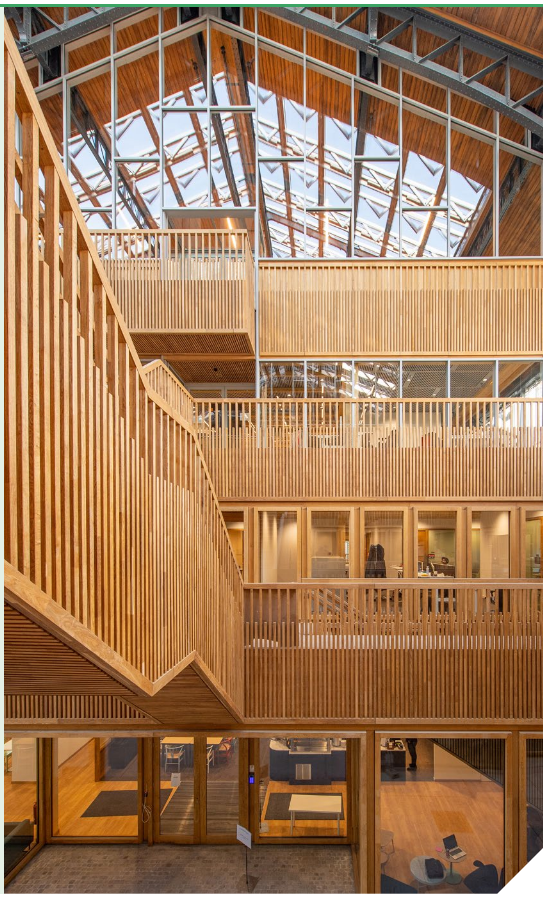
The Belgian real estate company Extensa converted an old railway station in Brussels into a state-of-the-art mixed-use building. Their aim in this project was to achieve the highest sustainability standards while positioning the building at the centre of an up-and-coming district with a locally self-reliant energy community. This project clearly illustrates the value of bundling decarbonization technologies to maximize impact.

The project included extensively renovating the existing industrial railway station and refurbishing 10,000 m^3 in new wood construction. This use of alternative building material with lower embodied carbon saved 3,500 tonnes of CO_2 compared to a similar application of concrete, steel and aluminium. Extensa fitted the development with 10,000 solar PV panels, ten geothermal energy wells, two 1,300 m^3 rainwater collection tanks and 3,000 m^2 of indoor gardens.

Deployed individually, each of these investments can improve the targeted outcomes. However, the benefits of each intervention are multiplied when complementary technologies are deployed together.

For instance, solar PV and geothermal wells are complementary solutions. Locally generated clean electricity combined with a more energy-efficient heating and cooling system minimizes operating emissions, lowers operating costs and enables near-autonomy from grid energy. Taken alone, neither solar nor geothermal technologies could generate the same benefit to system resilience and flexibility.

Similarly, the combined applications of rainwater harvesting and cultivating indoor green space create a closed-loop system for irrigation that minimizes water consumption and water waste while enhancing user satisfaction by providing a pleasant environment for tenants.



CASE STUDY 2

Creating a systemically and energy-efficient, resilient building portfolio by enhancing decarbonization technologies through a digital platform: San Mauro Torinese, Turin, Italy

The municipality of San Mauro Torinese led a project with Enel X, a leading smart energy service provider, to retrofit and digitalize their portfolio of municipal buildings. The project's main objectives were to reduce municipal operating expenses and increase energy efficiency at the building and portfolio levels while maximizing the quality of life for local residents.

This project highlights how the application of digital technologies can unlock and leapfrog value creation from conventional building efficiency measures by improving the operation of systems within buildings and synchronizing operations across the building portfolio.

The municipality deployed retrofit solutions, including building insulation, LED lighting for buildings and street lights, on-site renewable generation and hybrid heating systems with gas boilers and heat pumps. These technologies delivered on key outcomes of improving energy efficiency and quality of service to residents, and in the case of street lighting, enhancing public safety. Additional value was created by integrating a suite of digital tools, including monitoring devices and sensors to capture data across different systems, and an internet-of-things platform to collect and process a "single source of truth".

At the building level, automated building management enabled predictive maintenance, which reduced operating expenses and maintenance costs. At the system level, the use of automation and data analytics across the building portfolio enabled the municipality to prioritize maintenance issues and optimize resource deployment to achieve a better quality of service for all residents.

4 Practical application of the framework

The framework can evaluate both the new construction and retrofit of existing buildings. It is also intended to be universally applicable for different types of asset owners across different asset categories and building types. This flexible approach can be adapted to different contexts to spotlight the most important outcomes in each project. For instance, a social housing agency may prioritize "user satisfaction" and "socio-economic improvement", whereas a commercial building owner may choose to focus on "systemic value efficiency" to create additional revenue streams from grid services.

The three key insight areas derived from the project case studies present approaches to maximize project value creation. The operational checklist shown in Figure 2 serves as a basis to help identify relevant options at the time of any investment planning. These nine operational points can assist asset owners to and investors to practically achieve the key insights, especially those focusing on reducing operational emissions. The selection of investments (singular or bundled) may of course vary according to building type or asset owner profile.This checklist is meant to be applied across all building asset types at any stage of the investment planning and decarbonization journey.

FIGURE 2 **Three key insights drawn from case studies are mapped to a nine-point checklist of practical considerations to guide decision-makers**

Key insights	Operational checklist
Invest in decarbonization technologies and bundle for impact	❑ Electrify what you can ❑ Make use of distributed power generation and solar ❑ Install active and passive energy efficiency technology
Invest in digital	❑ Monitor energy consumption ❑ Design for the connectivity and interoperability of deployed assets ❑ Optimize energy use with building management systems ❑ Optimize life cycle efficiency with building information modelling
Invest in city ecosystem services	❑ Design to support the grid and local energy communities ❑ Contribute to clean mobility by installing smart electric vehicle charging

Conclusion

The Building Value Framework, key insights from case studies and operational checklist are universally applicable in diverse contexts. This flexible approach allows the user to adapt the tool for different contexts to highlight the priorities and outcome drivers unique to each project.

These tools are intended to serve as living products that may be revisited and updated periodically as needed. While the framework's objective will remain constant, the outcomes may be adjusted as global needs and the context evolve. The accompanying operational checklist may similarly be updated according to changing technological developments and capabilities in the future.

The urgency to transition the world's cities towards a net-zero carbon future is abundantly clear. The Building Value Framework presents an approach to help accelerate the investments needed to deliver a greener urban built environment.

More details about this initiative can be found on the Net-Zero Carbon Cities Building Value Framework project page.[11]

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Endnotes

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