

# Translating EU climate policies into building design requirements. The EIB West Campus Programme – a case study

By Maria Costi de Castrillo<sup>1</sup>

## **ABSTRACT:**

The European Investment Bank (EIB) is one of the largest providers of global climate finance and a pioneer in promoting sustainability and circular transition, both through its lending activity and its own projects. This paper presents the EIB West Campus programme (WCP) in Luxembourg as a case study on how to translate and integrate EU climate policies into design and construction requirements from the initial stages of design.

The WCP is a large-scale project (GIA circa 79,300 m<sup>2</sup>) that includes the renovation and energy efficiency upgrading of the EIB historic brutalist headquarters (1980) and of its Extension building (1995), located in Luxembourg. This paper introduces the methodological approach adopted for the integration into the project brief and the design requirements of sustainability and circularity objectives as translated from EU regulations, directives and guidelines through tasks and deliverables for the concept design stage and further stages of design and construction. A specific challenge has been the structuring of the design requirements to create synergies and promote innovation and novelty around sustainability and circularity aspects. This case study may serve in the future to provide guidance on integration of climate policies in large scale building design processes.

*Keywords: Circular Economy Strategy, Renovation Scope, Innovation, Building Design objectives and requirements, Project Brief, Invitation to Tender*

## **1. Introduction**

The European Investment Bank (EIB) statute stipulates its dedication to supporting the policy objectives of the European Union and the decisions of the European Council, such as the European Green Deal (European Commission, 2019), making it the EU Climate Bank (European Investment Bank, 2020; European Investment Bank, 2024a). Environmental sustainability is one of the key priorities of the EIB along with reinforcing the transition to a circular economy (CE) through finance, advisory support and awareness-raising activities (European Investment Bank, 2024b). The EIB Climate Bank Roadmap (European Investment Bank, 2025a) shows EIB's commitment to aligning all its financing activities with the goals and principles of the Paris Agreement. In 2024, the EIB Group financed €50.7 billion in climate action and environmental sustainability, representing a 14% increase from the previous year and accounting for 57% of the Group's total financing for the year (European Investment Bank, 2025b). The focus of the EIB is to lead by example; hence, it demonstrates climate action commitment not only in its lending activities but also in its own operations and projects.

<sup>1</sup> Design Advisor on Architecture, West Campus Programme Unit, Real Estate Development Division, Corporate Real Estate Department, European Investment Bank, Luxembourg.

The ongoing West Campus Programme (WCP) of the European Investment Bank in Luxembourg, which involves the renovation of its historic campus building, relates to the west side of the EIB Campus on the Kirchberg plateau in Luxembourg. The location is adjacent to the Grand Duchess Charlotte Bridge (Pont-Rouge) which connects the Kirchberg plateau to the historic city centre of Luxembourg. The Kirchberg area is called the European Quarter as numerous European Union institutions are located here (Figure 1); many local Luxembourg authorities are also housed in this area. Until the 1970s, the area was mostly agricultural land but since then it has been transformed into a major international business and cultural hub.

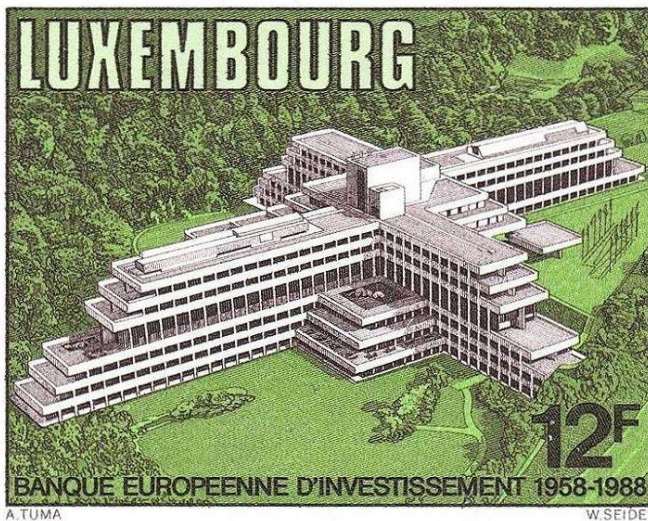


**Figure 1:** Drone view of the WCP area looking eastwards.

EIB's historic building, one of the first buildings on the Kirchberg plateau, is called the West Kirchberg Immeuble (WKI Main Building). This building was commissioned to the British practice of Sir Denys Lasdun in 1973 (completed in 1980) (Figure 2) as a direct response to his reputation for designing The National Theatre in London. It aimed to embody principles of modernist architecture adjusted and enhancing the local landscape. It additionally aimed to represent the core values of the newly established EIB with a design responding to EIB's activities and staff needs. The EIB further continued to commission Lasdun's practice with an extension building (WKI Extension building) in 1990 (completed in 1995). The WKI Main and Extension Buildings have a combined area of ca. 79,300m<sup>2</sup>.

In 2008, the EIB added a new building to its Luxembourg campus, the EKI Building (East Kirchberg Immeuble) of ca. 71,500m<sup>2</sup>, designed by Ingenhoven Architects, built immediately to the east of the WKI Buildings, connected internally. Finally, the most recent EIB Building is the NKI Building (North Kirchberg Immeuble) of ca. 63,500m<sup>2</sup>. It was designed by Mecanoo and Buro Happold (and IDOM for the Execution Design) and is in its final construction phase, scheduled to open its doors in the second half of 2027.

The WKI Main Building was declared a protected building in 2017 by the City of Luxembourg under the category: Protected area of communal interest-built environment, and the subcategory: buildings that require the external parts (the building envelope) to be preserved, reinstated, or refurbished. The WKI Main Building has great significance as a monument, reflecting European history and heritage. This is additionally enhanced by its strategic location on the corner of two important urban axes, Boulevard Konrad Adenauer (east) and John F. Kennedy Avenue (south). It is also adjacent to the Pfaffenthal transportation hub (tram, buses, train, funicular) which gives it additional visibility and status with thousands of users passing by the area daily. The landscape of the Trois-Glands Forest (west) and the steep slope and forest of Val des Bons Malades (north) which leads to the banks of the Alzette River, surrounds and embeds the WKI in a unique landscape. This combines an intense urban setting next to a protected forest biotope of high ecological value making it exceptional.



**Figure 2:** Luxembourg Postage Stamp depicting the WKI Main Building.

In 2018, the first project brief was developed, including sustainability objectives (environmental, social and financial) according to the EU policies, regulations and guidelines in effect at the time. This emphasised the leading role of the EIB in its climate action strategy and ambition as the EU Climate Bank. It also underlined the importance of integrating sustainability and circularity considerations from the early stages of design (Incelli et al., 2023; Atta et al., 2024). This paper focuses on presenting the environmental planning of the WCP and how various EU climate policies were integrated into the strategic planning and preparation of procurement documents.

The WCP strategic definition and planning phase was completed with the launch of the “Design and Author’s Supervision (DAS) Services for the EIB West Campus Programme” restricted tender procedure in June 2024. The final updated project brief was annexed (Annex A) to the tender (EU Funding & Tenders Portal, European Commission,

2024a). The DAS tender was awarded in March 2025 (European Union, 2025) and immediately after the WCP preliminary design phase was initiated.



**Figure 3:** South view of the West Campus Programme area (outlined in red) on the EIB Luxembourg Campus.

The West Campus Programme scope includes the following components:

- Determination of the renovation scope for the modernization of its heritage building (WKI Main Building, 1980) and for the refurbishment of its extension (WKI Extension Building, 1995);
- Enhancement of the landscape and biodiversity;
- WCP optioneering:
  - Creation of a Campus Welcome and Visitor centre;
  - Adaptations for a 2nd tunnel access to the underground parking for safety purposes;
  - Potential construction of a new area on the South-West corner, consisting of a gateway building that would act as an interface between the Campus and the existing public transport hub.

## 2. Methodology

The methodology followed for the strategic definition and planning of the WCP started from the identification of the relevant European directives and guidelines, being a

project that combines the restoration of a heritage building with its energy efficiency upgrading, nZEB new construction and landscape/ biodiversity enhancement. Atta et al. (2024) categorize the key mandatory and voluntary contributions, such as EU policies, regulations, directives and communications found in project briefs and tender documents, into three main categories:

- European initiatives on Sustainability and CE aimed at setting goals and objectives towards carbon neutrality (under column A in Table 1);
- European initiatives and tools developed in the field of Sustainable Finance (under column B in Table 1);
- European and international voluntary tools developed for specific application in the building sector, including EU tools, international voluntary standards, and green building rating and certification systems (under column C in Table 1).

This categorization, which supported the WCP strategic planning phase for categorizing the contributions used for the preparation of the WCP project brief and tender documents, can be seen in Table 1 below, categorized according to Atta et al. (2024).

**Table 1:** Categorization of the key Mandatory and Voluntary Contributions of the WCP According to Atta et al. (2024).

A	<ul style="list-style-type: none"> <li>• The European Green Deal:               <ul style="list-style-type: none"> <li>○ Renovation Wave Strategy</li> <li>○ Circular Economy Action Plan (CEAP)</li> </ul> </li> </ul>
B	<ul style="list-style-type: none"> <li>• NEB</li> <li>• EU Taxonomy</li> </ul>
C	<ul style="list-style-type: none"> <li>• EU Level(s) Framework</li> <li>• NEB Investment Guidelines</li> <li>• Renovation Passport</li> <li>• Energy Performance Certification</li> <li>• The Luxembourg Circular Dataset Initiative</li> <li>• BREEAM Certification</li> <li>• WELL Certification</li> </ul>

The New European Bauhaus (NEB) was instrumental for the definition of an important methodological tool used to develop and guide the initial strategic and conceptual phases of definition, planning and project briefing of the WCP: the establishment of the five key drivers of the project, which served to define the specific WCP objectives. The NEB advocates three core values: Beautiful (enriching), Sustainable and Together (inclusive). These core values are supported closely by three working principles: participatory process, multi-level engagement and transdisciplinary approach. The NEB investment guidelines (European Commission, 2024b) supported the practical introduction of the core values (i.e., ‘designing for climate adaptation’, ‘deploying the potential of green and blue infrastructure’, ‘fostering biodiversity’, and ‘connecting to nature’) and working principles of the NEB in the various aspects of the WCP project planning.



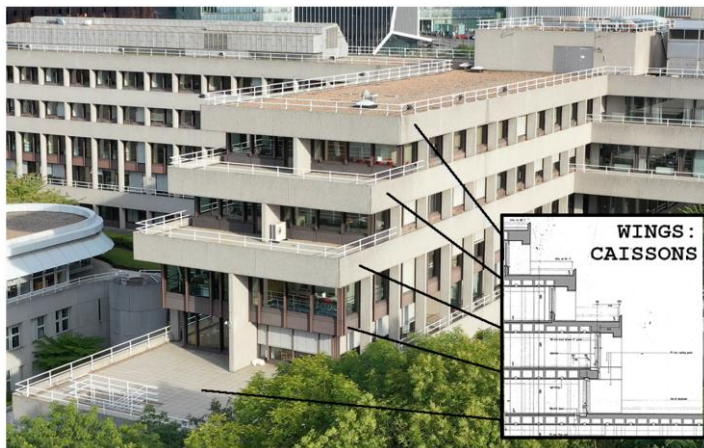
**Figure 4:** Synergies between the NEB and the West Campus Programme.

The WCP Design and Author's Supervision services Terms of Reference (EU Funding & Tenders Portal, European Commission, 2024a) outline clearly the five key drivers which define specific objectives as follows:

- **People:**
  - To improve the well-being, sanitation and security of end-users.
- **Climate/Circularity:**
  - To make the existing buildings as energy efficient as possible as well as the WCP operations as sustainable as possible, close to net-zero carbon emissions.
  - To introduce innovative CE principles, minimizing the use of new resources, carbon emissions and waste.
  - The project should consider the existing building and any new interventions as a 'material bank' that can be upgraded, reused, or recycled in future renovations.
- **Heritage:**
  - To ensure the legacy of the WKI buildings is preserved and continued, by providing flexible and functional accommodation for the next 30 years as a minimum.

- To protect and enhance the architectural intent of Lasdun's original design, in line with the protections placed upon the WKI Main Building by the City of Luxembourg.
- Flexibility:
  - To ensure the EIB Campus is more resilient to future changes including social, economic and environmental.
  - To allow the EIB to increase the occupancy of the existing buildings (WKI main and WKI extension).
  - To make the EIB Campus more efficient for the end-users. Consequently, to also improve the connections between the individual buildings within the EIB Campus.
- Best value for money:
  - To achieve the best overall value for money project.

Figure 4 provides a graphical representation of the synergies between the five WCP key drivers and the three core values of the NEB. The key driver 'Climate - Circularity' focuses on promoting sustainability, circularity and low carbon footprint in all aspects of the WCP project. The key driver 'Flexibility' encompasses the reshaping of the existing WKI Main and Extension Buildings to increase adaptability to new needs and occupancy levels while preserving and enhancing the existing spatial qualities and structure. The key driver 'People' focuses on enhancing the well-being, security and accessibility of the Campus by its diverse users. The key driver 'Heritage' emphasizes the protection of the significance and values of the WKI Main Heritage Building and aims to respect and possibly enhance the architectural intent of Lasdun's original design (Figure 5), while balancing it with innovative configuration of workspace and upgraded energy efficiency solutions. Finally, 'Best Value for money' is the key driver which ties all other key drivers together. The aim is to propose the best of the state-of-the-art practices and market solutions focusing on achieving architectural and engineering value through innovative solutions and novelty in strategies, methodology and technology transversally.



**Figure 5:** NW wing of the WKI Main Building (original detail-section of structural elements and stepped layout of the heritage building).

The synergies between the NEB and the WCP led to the development of specific operational and environmental WCP objectives, which were also clearly outlined in the project brief: Annex A – Description of the WCP of the tender (EU Funding & Tenders Portal, European Commission, 2024a), following the EU policies, regulations, directives and communications seen in Table 1. In summary, the specific WCP objectives outlined in the project brief are:

- West Campus development optioneering aiming to reorganize the functional and circulation structure of the Campus.
- Determine the renovation scope, defining the strategic plan including rough cost and time estimates to achieve the established objectives. This includes analysing two levels of renovation: (i) outlining the minimum measures to comply with current local regulations for continuing the building operation; (ii) defining and prioritizing the additional upgrade measures, in order to achieve the established objectives (renovation roadmap) for a period of approx. 30 years.
- Achieve high scoring on environmental certifications i.e., energy performance certificate (EPC); BREEAM rating; Net-Zero Carbon.
- Introduce innovative CE principles, minimizing carbon emissions and waste, and the use of new resources. In this context, the existing buildings and any new interventions are considered in the framework of ‘buildings as material banks’ (BAMB), which can be upgraded, reused, or recycled in future refurbishments/ renovations.
- Enhance EIB campus adaptability, resilience and flexibility (i.e. the buildings flexibility in occupancy) to future changes (i.e., social, economic, and environmental).
- Improve the well-being of all diverse users, by enhancing accessibility, connectivity and overall spatial conditions.

An important part of the methodology from the beginning was the introduction of a step-by-step wholistic approach establishing a qualitative and quantitative decision-making process based on the existing situation. The four-step methodology followed is:

- Create a baseline: documentation of the existing/ current state by conducting surveys/models (i.e., pathologies, structure, ecological, energy, flood risk, air-quality etc.) and creating inventories (i.e., materials and components);
- Verify compliance with regulations, legislations and directives (i.e., EU Taxonomy-Renovation of existing buildings) and develop certification strategies and planning: energy performance certification, BREEAM, WELL, Circular Economy Strategy);
- Define quantitative sustainability performance indicators for WCP;
- Design and lead multidisciplinary stakeholder collaboration, communication and decision-making based on comparison of information and conclusions from all the above steps.

Quantitative sustainability performance indicators included in the WCP preliminary design phase can be seen in Table 2 below. These indicators are a very important part of stakeholder communication strategy and decision-making process.

**Table 2:** Quantitative Sustainability Performance Indicators for WCP.

Category	Indicator	Description / Example
Carbon Reduction:	Whole life cycle analysis including life cycle GWP (global warming potential)	Of materials and greenhouse gas emissions including annual energy use and CO <sub>2</sub> emissions during operation
	Embodied Carbon	Emissions from materials and construction processes
Primary Energy Reduction:	Total primary energy under maximum occupation conditions	Comparison with baseline from surveys of existing buildings
	Renewable energy production	By means of low or zero carbon technologies
Life Cycle Analysis	Life cycle Analysis and Life Cycle Cost Analysis (LCCA)	Over the building's lifetime
	Renovation Passport/Roadmap	Staged investment plan (including maintenance, energy efficiency upgrading, with cost estimates)
Social Benefits	Accessibility & Inclusivity	Spaces meeting universal design standards
	Occupancy & Flexibility	Improved building use and adaptability

	Multidisciplinary stakeholder Engagement	Stakeholder meetings and participatory events
Resource Efficiency/circularity	Reduction in New Material Use	Decrease in use of new materials
	Materials Reused or Recycled (material passports and a digital twin)	Amount of reused or recycled materials. Also, systematic methodology for facilitation of reuse and reintroduction in material market.
Waste Reduction	Construction & Demolition Waste Diverted	Waste diverted from landfill
Biodiversity Enhancement	Green Space/Biodiversity Features added	Area of green space or biodiversity features added

The quantitative sustainability performance indicators presented in Table 2 above will allow comparison and evaluation of methodologies and strategies followed from the initial phases of the WCP with future steps of the WCP design and construction process but also post-renovation evaluation.

### 3. Results and Discussion

The strategic planning of the WCP from the beginning aimed to reflect the ambition of the EIB as the ‘EU Climate Bank’: the renovation of the WKI Main and Extension Buildings has been planned to not only provide workspace quality and resource efficiency for the EIB headquarters but also be an example and a pioneer for sustainable building renovation processes. At a high level it encompasses the EU's and EIB's climate objectives as outlined in documents such as the European Green Deal (European Commission, 2019), in particular the CEAP (European Commission, 2020b) and the Renovation Wave Strategy (European Commission, 2020a), aiming to fully renovate and decarbonize the European building stock by 2050.

Specifically, the WCP includes the climate and environmental minimum requirements and green finance objectives set for potential EIB investments and lending projects’ financing eligibility, as described in the EIB climate documents:

- The benchmarks to assess alignment with the objectives of the Paris Agreement as described in the EIB Group Climate Bank Roadmap Phase 2 - 2026-2030 (2025) are aligned with the EU Taxonomy Climate Delegated Act DNSH criteria to mitigation and adaptation. In essence, this reflects compliance with national energy standards defined by the Energy Performance of Buildings Directive (EPBD) (see also Table D in Paris Alignment Framework – Low carbon Version 1.1, (European Investment Bank, 2023)).
- Additionally, for lending projects’ eligibility, the responsibility of the promoter is to assess potential environmental, climate and/or social impacts and risks associated with the project as described in The EIB Group Environmental and Social Policy (European

Investment Bank, 2022a) and EIB Environmental and Social Standards (European Investment Bank, 2022b).

In addition, though, the WCP project includes even more requirements, such as objectives in regard to green building certifications, alignment with the NEB, and use of tools related to Life cycle thinking. This underlines the EIB's walk-the-talk approach first and foremost with its meticulous climate action in its own projects. It exemplifies how the EIB's Climate Bank financial leadership, which in the case of the WCP has been implemented from the initial strategic planning and design phases, can reinforce innovation and push boundaries in climate-responsive construction projects by mandating circularity and performance metrics. Other EU-led building programs which often rely on municipal or regional authorities (i.e., Horizon 2020-funded 'Buildings as Material Banks' (BAMB) initiative and the 'Smart Cities Marketplace' etc.), struggle in this sense, to reinforce sustainability transitions through procurement and policy alignment due to difficult alignment between financing and strategic planning bodies.

The drafting of the Terms of reference for the "Design and Author's Supervision (DAS) Services for the EIB West Campus Programme" (EU Funding & Tenders Portal, European Commission, 2024a) and tender annexes aimed to embed the sustainability principles throughout the design and construction process. The quantitative sustainability performance indicators and environmental sustainability performance objectives as included in the WCP, refer to reduction of buildings' energy use and emissions, promotion of the use of renewable energy sources and innovative clean energy technologies, decrease of natural and manufactured resources usage as much as possible, enhancement of the biodiversity of the site and adoption of measures to combat environmental degradation in order to safeguard the natural habitats and ecology. In this way, these metrics become comparable throughout the lifecycle of the project and provide valuable material for decision making.

Innovation is an important circularity enabler according to Hart et al. (2019). A specific challenge for the WCP has been the structuring of the design requirements in the project brief and tender documents to promote innovation and novelty and instigate synergies transversally for all key drivers, in relation to renovation, energy efficiency, sustainability, circularity and enhanced environmental impact. To ensure that innovation is not limited to aesthetic or conceptual novelty, the WCP integrated, as presented above in the methodology, quantitative sustainability performance indicators and targets as a strategy for the continuous monitoring of sustainability objectives. The definitions of baselines early in the process along with the study of minimum and optimum levels of interventions promote the clear definition of metrics for aiming towards innovation from the beginning in measurable terms. In relation to this and in line with the BREEAM (2024) and WELL (International WELL Building Institute, 2025) definitions on uniqueness and innovation (Figure 6), the 'WCP statement for innovation' was also developed and integrated in the project brief in order to set a clear innovation framework and expectations: *"The WCP is unique in that it is a large-scale project that involves in its scope heritage protection combined with energy efficiency upgrading. The ultimate outcome for a successful design process will be a 'pilot project' that will establish a methodology and provide an example on how to approach such projects at a European and international level. This will give added value and status, making it a catalyst project establishing further the EIB as the 'EU Climate Bank'."*



**Figure 6:** BREEAM (2024) and WELL (International WELL Building Institute, 2025) definitions on uniqueness and innovation.

This innovation statement is practically implemented from the early stages of design of the WCP through measurable environmental outcomes, including Life Cycle Assessment (LCA), Life Cycle Cost Analysis (LCCA), and circularity indicators such as material passports and digital twins. This allows design decisions such as adaptive reuse, modularity, and low-carbon materials to be discussed and evaluated by all stakeholders in regards to quantifiable impact on carbon reduction, resource efficiency, and long-term resilience but also in terms of originality.

Compared to BREEAM, which awards innovation credits for exceeding standard environmental performance benchmarks (e.g., reduced embodied carbon, enhanced biodiversity), and WELL, which focuses on health-related metrics such as air quality and thermal comfort, the WCP introduces these frameworks early in the design phase. This alignment underlines the importance of innovation as a core driver of sustainability and not simply a ‘good to have’.

By positioning the WCP as a pilot project, the EIB’s strategic approach illustrates how institutional leadership can transform innovation from a concept to reality, promoting successful interventions in regard to energy efficiency and material circularity in public projects. This provides a firm example on how financial institutions can reinforce innovation through funding mechanisms that prioritize environmental and social outcomes.

### 3.1 Circular Economy (CE)

Since 2015, the EU has been steadily introducing tools and regulations that stimulate the transition from a linear to a CE model. This affects directly the renovation of buildings like the WKI Main Building, but also the whole construction sector. Institutions and private entities have been working intensely to define and outline CE (Ellen MacArthur Foundation, n.d.) and guide stakeholders, practitioners and clients through the various stages of design and construction of buildings giving them guidelines and tools (i.e., Circular Design Guide, Ellen MacArthur Foundation, n.d. and Circular Buildings Toolkit, Arup and Ellen MacArthur Foundation, n.d.). Since 2020, the CEAP

(European Commission, 2020b), one of the main building blocks of the European Green Deal (European Commission, 2019), outlines a series of CE actions to achieve a climate-neutral Europe by 2050, such as responsibly designing buildings and products, reducing waste, increasing the durability of materials and components and thinking of their reusability or recyclability in the future in order to reach by 2050 climate neutrality and stop biodiversity loss.

The importance of evaluating circularity from the concept-design stage (Incelli et al., 2023) is fundamental for the EIB. For defining the CE requirements of the West Campus Programme, many EU and International policies, regulations, documents and guidelines, but also research articles have been taken into account for all the various aspects and components of circularity in buildings and construction such as reduction of whole-life carbon, BAMB concepts and tools (i.e., material passports), waste management and life cycle thinking. The circular design principles listed in the project brief to be considered for developing the WCP CE Strategy from the initial conceptual design stages, as extracted from EU Level(s) Indicator 1.2, Dodd et al. (2020a), are:

- Efficient building shape and form;
- Optimised nZEB construction;
- Optimised material utilisation and circular value;
- Extending building and component service lives;
- Design for adaptability;
- Design for deconstruction.

The WCP scope emphasizes the importance of the initial stages of planning and preliminary design development for the carbon reduction potential which is also essential for integrating CE principles. Specifically, the project brief points out that in order to reduce the embodied carbon throughout the lifecycle of the WCP, a strategic approach must be implemented balancing requirements of the brief and incorporating the CE strategies and principles so as to achieve the most carbon efficient result. Aiming to promote reduced use of virgin material, water and energy through recycling and reusing, the design team is required to consider the whole-life carbon impact of their proposals from the beginning. The ‘whole life carbon’ definition is according to the World Green Building Council (2016-2025).

Additionally, the brief requires the design team to consider the EU Level(s) Framework (European Commission, 2021) within their design, aligning it with the indicator framework to further inform the EIB about the benefits of the proposals. The EU Level(s) framework indicates that “BAMB concepts could be applied to the conceptual design of the building (e.g. design for disassembly and reuse of prefabricated elements at the End of Life)” (EU Level (s) Indicator 2.2, Dodd et al., 2020b). The European funded BAMB2020 project “Buildings as Material Banks” (Sharp et al., 2019), initiated in September 2015 as an innovation action within the EU funded Horizon 2020 program, developed the understanding that construction must make a shift towards viewing buildings as banks of valuable materials, aiming to slow down the usage of virgin resources and produce less waste. The integration of BAMB concepts, methodologies and strategies to include materials passports, reversible building design, design for deconstruction, etc.

in the WCP is considered essential for material upgrading, reusability and recyclability for future projects. The strategy to be developed in relation to these frameworks will consider the potential future development of an adequate digital twin, creation of materials passports, decisions on a material passport platform, the life cycle analysis (including life cycle cost analysis) and the waste management concept (WCP waste targets must be set as defined in BREEAM) including removal of hazardous and polluting materials. In relation to this, the digital twin will also be an important tool to calculate, reduce and optimise the material volumes required for construction and interventions.

Material passports must be according to standardized data formats, transparent and promote use of materials which conform to life cycle requirements and the cradle-to-cradle design. The 'Luxembourg Circular Dataset Initiative' and the 'Product Circularity Data Sheet' (PCDS) (Government of the Grand Duchy of Luxembourg, 2025) in collaboration with the Ministry of the Economy of Luxembourg and the DOEN Foundation's Healthy Printing initiative, developed a standardised approach to materials passport datasets, which the WCP design team must consider. Besides this, for the WCP CE Strategy, the EIB requires to use the BAMB framework also in line with the Cradle-to-cradle approach.

Life Cycle thinking is embedded in the WCP CE strategy: (whole) Life Cycle Assessment (LCA) (materials and greenhouse gas emissions - life cycle global warming potential, construction elements, equipment, systems, including whole life carbon assessment) in combination with a Life Cycle Cost Analysis (LCCA) and maintenance definition but also social considerations. This is in line with the EU directive (Directive (EU) 2024/1275) on the energy performance of buildings: "A requirement to calculate the life-cycle Global Warming Potential of new buildings therefore constitutes a first step towards increased consideration of the whole-life-cycle performance of buildings and a circular economy." It is anticipated that this will allow the definition of ambitious but realistic targets and benchmarks for the reduction of embodied carbon through the renovation process while facilitating decarbonization strategies and options, which can be introduced in the design process at a very early stage and have therefore a deeper influence in the resulting building. Life Cycle Analysis in combination with Life Cycle Cost Analysis, as confirmed by the research, is an approach considered to be able to answer many building performance related questions and is used by many to identify environmental and economic factors in parallel in the context of life cycle sustainability assessments especially for new construction, existing buildings, or building operation (Schneider-Marín et al., 2022). The WCP (whole) Life Cycle Assessment (LCA) reporting, will be in compliance with the relevant BREEAM credits.

The design team is also tasked to develop the WCP Circular Design Roadmap for all stages of the building's future, i.e., planning, construction, operation, modification and disassembly, including consideration of maintenance requirements, future additional refurbishments and disassembly/ deconstruction techniques. This roadmap will include all aspects of a circular design concept in a broader decarbonization roadmap, including the necessary material inventories and audits, the key moments for the impact assessment, as well as the proposed framework and tools to measure that impact and to extract conclusions. These shall enrich design decisions throughout the whole process, considering their higher influence on carbon reduction during early design stages.

It is noted that all the complex standards that are being addressed in the WCP in regard to sustainability and circularity also come with challenges and important considerations in order to safeguard and respect the heritage value of the existing 1970s building's protected façade. In order to assure the safeguarding of its cultural identity and at the same time meet contemporary sustainability goals, extensive documentation of the existing heritage building through surveys, models, inventories is an important part of the strategic planning and preliminary design phase as described in the methodology section. In parallel, communication with all stakeholders, including city and heritage authorities, early in the process through a multidisciplinary approach, has been instrumental to identify different strategies and design paths to investigate from the beginning.

Very important in this process has been to study the design decisions of 'real life' examples of renovation projects of similar scale and scope in the adjacency of the WCP, as is the case of the Luxembourg New Cfl Headquarters of the 'Societe Nationale des Chemins de Fer Luxembourgeois', an EIB financially supported project. Its scope is the urban regeneration of the Luxembourg City railway district by renovating and extending the protected buildings (European Investment Bank, 2024c). Its scope is similar to that of the WCP and thus provides a very good example on how such projects are approached at a local level in terms of aligning heritage considerations with environmental sustainability goals. Specifically, this project is in line with the new (minimum) energy performance requirements prescribed for new and existing buildings (including renovations) in the Luxembourg regulation on the energy performance of buildings (Government of the Grand Duchy of Luxembourg, 2021).

In heritage buildings, the energy upgrading of the façade: dealing with thermal bridges and improving the windows details and performance is not an easy task. The simultaneous communication with heritage authorities and all stakeholders ensures that a variety of solutions are discussed from the initial phases of design and that the heritage value in combination with the best value for money aspect is discussed and investigated in parallel, in order to reach the optimum solution which will achieve a balance between all climate and other objectives while at the same time maintaining the heritage value of the building.

In the CFL project, the main structure of the building, a 1950s historic architecture example, is maintained. This reduces significantly its carbon footprint, achieving a big win towards their circular economy ambition. Additionally, in a similar way with the WCP, it combines old heritage with new design. Stakeholder negotiations and discussions (including city and heritage authorities) accomplish to guarantee preservation of the heritage building, but also to support regeneration of the train station district. Additionally, the project aims to comply with NZEB regulations and accomplish reduction of Primary Energy Demand. It additionally accomplishes Paris alignment (low carbon and resilience goals) and EIB criteria alignment for substantial contribution to climate mitigation (European Investment Bank, 2024d).

The WCP quantitative sustainability performance indicators presented in Table 2 in the methodology section aim to allow comparison and evaluation of methodologies and strategies followed throughout the design, construction and post-renovation stage of the WCP. Given that the WCP is still in the preliminary design phase, comparison is still not possible, hence this is a limitation of the current study but will be developed and presented

in future WCP studies as the project advances. Future WCP studies will demonstrate the clear measurable outcomes on resource efficiency, carbon and primary energy reduction, waste reduction, life cycle costs, and social benefits, thus connecting strategic planning and preliminary design phases with actual environmental performance of the completed project.

### **3.2 Renovation Scope and Energy Efficiency**

The renovation scope aims to preserve and enhance the architectural intent of the original WKI design, and ensure that the building's legacy is continued, aligning with the protection requirements placed upon the WKI Main Building since 2017. However, the renovation scope also has as primary focus the enhancement of the energy efficiency and performance of the buildings, a fundamental objective of the WCP to make operations as sustainable as possible, targeting close to Net Zero Carbon emissions, based on a Whole Life Carbon analysis.

The project brief requires the design team to pay close attention to the revised Energy Performance of Buildings Directive (Directive (EU) 2024/1275) and the revised Energy Efficiency Directive (European Parliament and Council, 2024), but also the Integrated National Energy and Climate Plan for Luxembourg (2024) and Luxembourg's Long-term Renovation Strategy (Government of the Grand Duchy of Luxembourg, 2020b), which translate the EU directives into targets and strategies on the national level. A renovation-specific definition of nZEB requirements (nZEBrenovation) is currently under development by Luxembourg's NECP (2024), taking the mention of the EPBD (2023) (Article 9.3.) regarding heritage protected buildings and applying it locally. Considering the planned WCP time schedule, it is expected that this standard for building renovation will be highly relevant for the project. It is noted that in the project brief the renovation scope is tied with the five WCP Key Drivers through specific WKI renovation targets to be developed for each key driver during the WCP preliminary design phase.

Special focus of the renovation is placed on increasing adaptability, occupancy levels and security of the buildings to new needs, for the next 10 to 30 years. This is very relevant for the renovation scope and a detailed and strategic renovation plan and roadmap (including the rough cost and time estimates to achieve the detailed WCP objectives) is included in the design team's tasks. 'Renovation passports' (a tailored roadmap for the deep renovation/staged deep renovation in a maximum number of steps that will significantly improve the energy performance of the building aiming to achieve a 'zero-emission building') have been identified as a regulatory priority both by the EU Directive on Energy Performance of Buildings (Directive (EU) 2024/1275) and Luxembourg's long-term renovation strategy (Government of the Grand Duchy of Luxembourg, 2020b).

Through the development of the renovation scope of the WCP, the design team is required to outline and analyse the strategic implementation of the 'Renovation Passport/renovation roadmap' process. Hence, the renovation scope will identify and study the renovation roadmap scenarios involving initially two possible levels of renovation. One possible level refers to the minimum measures needed to be carried out to comply with current local regulations at the medium term. The other renovation level refers to the additional measures to be adopted in order to achieve the objectives and environmental targets as set in the project brief, making the existing WKI buildings fit for

purpose in the long term for at least 30 years. The investigation of roadmap scenarios will result in a tailored plan, considering the possibility of a stage-by-stage investment, to reach nZEB levels but also to identify the ‘must’ and the ‘nice to have’ components according to the sustainability objectives. This roadmap will allow for the WCP buildings’ renovation planning during the next 30 years (until the next major renovation is due) including all priorities and necessary steps to be taken regarding energy efficiency, materials, durability, certification etc.

The ‘buildings as material banks’ framework (BAMB) analysed previously is also relevant for the renovation scope and specifically for the ‘optimum’ renovation long term level of 30 years. The renovation scope must take into account the whole lifecycle of the WKI buildings, rough cost estimations and operational costs linked to the renovation steps, and the related main risks and opportunities which could affect the project development.

### 3.3 Certification Strategy

The certification targets for the WCP are in alignment with the objectives of the Government of Luxembourg but also with the EU policies and documents presented in Table 1. In the WCP tender documents, the design team is called from the initial stages of design to focus on planning and creating the strategies for the various certifications targeted by the WCP.

The Energy Performance Certification will be planned according to the Règlement Grand-Ducal (Government of the Grand Duchy of Luxembourg, 2020a). All WCP new constructions shall be Zero-emissions buildings, while the renovated WKI buildings shall reach a level as close as possible to the nZEB, as defined by Luxembourg’s regulations appropriate for heritage buildings.

For the green rating certifications, the WCP will focus on achieving a BREEAM certification. The design team will conduct a pre-evaluation of BREEAM scope, requirements and key issues to be considered during the future design process. Investigation and reporting on the relevance of the BREEAM bespoke procedure (BRE Global, 2025) for the WCP will be conducted. It is noted that the ambition is to achieve at least the BREEAM Excellent rating; the final target will be reassessed after the completion of the conceptual preliminary design phase, based on a holistic assessment of all key priorities and drivers, in line with the best value for money.

The WELL Certification (International WELL Building Institute, 2021) is especially relevant for the WCP key driver ‘People’. This implies the pre-evaluation of the WELL scope and requirements, to be met already in the early stage of preliminary design, as well as the key issues to be considered during the future design phases.

The design team will develop an analytical verification of compliance with the EU Taxonomy ‘Renovation of existing buildings’ (European Commission, 2023) considering at least: climate change mitigation, climate change adaptation, sustainable use and protection of water and marine resources, the transition to a CE, prevention and reduction of environmental pollution, protection and recovery of biological diversity and ecosystems.

#### 4. Conclusions

The work carried out until now for the definition of the WCP key drivers, objectives, sustainability and circularity priorities (including quantitative sustainability performance indicators), has succeeded in integrating EU policies, regulations, directives, guidelines and communications into the project brief and tender documents of the WCP design services. The WCP team has observed the multifaceted and complex regulatory framework on sustainability and CE for the building sector at the European level, as noted by Atta et al. (2024). This underlines that climate objectives must be complemented by management tools during all phases of design and construction to provide a strong foundation for aligning and implementing climate policies.

The WCP includes the climate and environmental minimum requirements and green finance objectives set for potential EIB investments and lending projects' financing eligibility but additionally includes objectives such as green building certifications, alignment with the NEB, and use of tools related to Life cycle thinking. This underlines the financial leadership of the EIB as the EU Climate Bank, and its walk-the-talk approach even in its own projects. WCP is also a firm example on how a core driver of sustainability is innovation which financial institutions reinforce through funding mechanisms that prioritize environmental and social outcomes.

The core working principles of the NEB integrated in the WCP project brief and tender documents promote a participatory process among all stakeholders (i.e., EIB management, local authorities, users), multi-level engagement between the various levels of decision makers and a transdisciplinary approach involving various internal (EIB) and external professionals, not only from the construction sector but also from other sectors (i.e., financial, legal, communications). The varied aspects of sustainability and circularity require from the very beginning a thorough and efficient management of stakeholder collaboration and communication, who must exchange on a regular basis in order to align throughout all the stages of strategic planning, design, construction and even use and maintenance of the buildings, in order to ensure the successful implementation of the varied sustainability and circularity objectives throughout the project. Site visits, onsite and remote meetings, submission presentation meetings, weekly progress meetings, monthly workshops are all part of the management tools which promote stakeholder collaboration and communication, in combination with information and communication platforms. However, one of the most important tools for successful stakeholder communication is the integration of the quantitative sustainability performance indicators from the very beginning of the design phases. This will facilitate the stakeholder discussions throughout the design, construction and post-renovation stage of the WCP and support the decision making based on clear measurable outcomes but also ensure continuous compliance with sustainability objectives even during the use of the finished project.

Zimmann et al. (2016) underline that CE within the built environment needs a clear approach to translate principles into practice; case studies such as the WCP provide a real-life example of CE strategy implementation in construction, offering feedback on the policies and principles. Large scale projects such as the WCP can provide valuable information regarding the practical applications of sustainability policies and CE principles in every step of the design, construction and use of buildings. Transfer of and open access

to knowledge regarding EU case studies can positively influence the transition of construction practices towards a CE throughout Europe and more.

In order to safeguard and respect the WCP heritage value addressing at the same time the complex standards in regard to sustainability and circularity, the four-step methodology followed has been fundamental: creating a baseline, verifying compliance and developing strategies, defining quantitative sustainability indicators and designing and leading stakeholder collaboration and communication. This methodology allows for protection of the heritage value but also for achieving the sustainability and circularity objectives throughout the project. Specifically, these steps support the development of robust strategies and study of their feasibility, preliminary market assessment of the relevant value chain operators, preliminary outlining of expectations and identification of relevant requirements for frameworks such as EU Level(s) framework (European Commission, 2021) and early engagement with all stakeholders and decision-makers.

The investigation of the WCP renovation scope between two renovation roadmap scenarios has proven to be a valuable tool which allows an in-depth approach to analyse from a whole 'life cycle thinking' point of view the various options and strategic paths towards achieving the improvement of the energy performance (carbon emission targets set by the EU directives) and cost-effectiveness through time, for the particular case of a heritage protected building such as the WKI where the directive allows a flexible application of energy performance standards. In a similar way, the West Campus development optioneering is a valuable tool for determining the best value for money aspect of the new components of the WCP: the welcome/visitor centre, the 2nd tunnel access and the potential new construction on the southwest corner of the West Campus. It is noted that the five WCP key drivers additionally promote the whole 'life cycle thinking' approach.

As a project focused predominantly on renovation, the WCP has started with sound implementation of policy frameworks and strong planning strategies and foundations. In the previous few years, within the broader European sustainability scene, the EU Renovation Wave has presented general barriers and shown that EU's ambition to renovate institutional buildings is often slowed down or blocked by high initial costs and uncertain returns, construction professionals knowledge gaps, technical incompatibility of older institutional buildings with new technologies, and regulatory and behavioral resistance (Iwuanyanwu, et al., 2024). These factors have slowed the rate/quality of renovation and limited the impact of EU funding in the institutional sector throughout Europe. This is evident in many public buildings in Central and Eastern Europe which still remain among the worst-performing in the EU due to insufficient policy frameworks, lack of capacity, and limited funding, resulting in modest progress toward energy efficiency and decarbonization goals (Redesign, 2025). However, the WCP has been built on a rich EU policy context from the initial strategic planning and design phases, starting with the alignment with the NEB and the strategic design of the WCP five key drivers. Through the WCP, the EIB's Climate Bank financial leadership, is anticipated to provide a robust pilot project with reinforced innovation which pushes boundaries in climate-responsive construction projects by mandating circularity and performance metrics.

Using WCP public information as can be seen in the references, this paper has presented the case study of the West Campus Programme of the European Investment

Bank in Luxembourg and the key aspects of how EU policies, regulations, directives and guidelines shaped the strategic planning and preparation stages and were integrated in the WCP project brief and tender documents for the design. In the future, the strategic planning and the design brief will be reassessed in relation to the implementation of the EU policies throughout the design and construction phases, highlighting benefits, risks and challenges. The management tools including stakeholder engagement, collaboration and communication are anticipated to be a decisive factor for the successful implementation of the EU policies throughout the project. The insights and knowledge from this case study may benefit other complex large scale private or public projects, particularly those involving renovation and energy efficiency improvements.

**Acknowledgment:** I would like to thank all WCP colleagues, internal and external stakeholders, past and present, who have supported and worked passionately on the West Campus Programme.

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