NEB Self-Assessment Tool:
Evaluating the Adaptive Reuse of the 'Magazzini Raccordati' through Sustainability, Beauty, and Inclusion

Sofia Bonini 250047

Politecnico di Milano

In the contemporary sociopolitical context, in which the ecological transition is one of the main areas driving the redefinition of territorial policies and governance models, the concept of sustainability translates into regulatory tools and policy alignment mechanisms aimed at steering transformation processes toward environmental, social, and economic development goals. The New European Bauhaus (NEB) represents a significant effort to integrate these dimensions into a common evaluation framework, translating the European vision into criteria applicable to the design of interventions in the built environment.

This study aims to analyze the NEB Self-Assessment Tool as an expression of a specific interpretation of sustainability and the ways in which this is translated into operational criteria within contemporary discourse and practice.

The framework is applied to the FARMER redevelopment project in order to examine its generative and critical potential during the conceptual design phase.

The key critical point of the research highlights the difficulties the evaluation framework faces in providing a multidimensional view of a sustainable transition.

The main outcome of the research is the shift away from the current linear architecture toward an interconnected network model capable of simultaneously assessing the cross-cutting implications of every individual design decision.

This analysis contributes to a broader reflection on the role of evaluation tools in shaping contemporary design practices.

Introduction

The thesis explores the intersection between European environmental policies, architectural project evaluation tools as instruments of systemic transformation, and holistic interdisciplinary projects developed in academic settings. The analysis reveals a dual significance that manifests itself in the application of the NEB self-assessment tool and its operational criteria to evaluate the project's ability to meet these standards, as well as in the opportunity to study and analyze the consistency of the evaluation framework with respect to the objectives stated in the framework.
The opportunity to apply this assessment to a project carried out within the interdisciplinary context of a polytechnic university has allowed for a more in-depth application of certain indicators, with the aim of moving toward a more integrated approach in which sustainability, spatial quality, and social inclusion are effectively considered interrelated components of the same design paradigm.
The thesis therefore takes the New European Bauhaus as its framework, developing a critical interpretation of each dimension made possible by the application of this method and the resulting understanding of the role of individual indicators within the structure.
The aim of this thesis is to test the applicability of the NEB framework within a design and evaluation process applied to a theoretical project of architectural reuse and urban regeneration that involves various interconnected scales and dimensions. The strong interconnection between the urban and architectural scales, the atypical typological nature of the historic building that forms the project's context, and the integration of spatial, digital, and social tools are the project's key distinguishing features, which allow for testing the method's flexibility, recognized as a key application and methodological tool for achieving wider adoption of the framework.
The main research question identified can therefore be stated as follows:

To what extent can the NEB Self-Assessment Tool support and guide the design process during the preliminary stages of an urban regeneration and architectural reuse project?

The research is divided into three main sections: The first examines the political and historical context that led to the development of European environmental policies and traces a connection from the Green Deal to the formulation of the New European Bauhaus, clarifying its premises, ambitions, and limitations; The second illustrates the context of the FARMER project for the redevelopment of the Magazzini Raccordati in Milan and the surrounding areas, with a specific focus on the conversion of two warehouses into spaces serving public welfare, intended as tools for inclusion, cohesion, and support for the neighborhood; The third is the application of the evaluation system to the project, aimed at verifying its soundness, highlighting any room for improvement, and, at the same time, testing the method's flexibility with respect to a complex and unconventional building typology.

The project thus becomes a means for observing and discussing the method itself, rather than a final outcome to be validated after the fact.
The research begins with the hypothesis that the NEB Self-Assessment Tool can serve as an effective decision-making aid in the early stages of a project by enabling a comprehensive analysis of the environmental, social, and spatial dimensions of sustainability. It is further hypothesized that applying the tool to a case characterized by strong interaction between urban and architectural scales in a highly distinctive context,one that includes the use of hybrid management tools,may reveal interpretive and operational limitations useful for fostering critical reflection on the method itself.

Structure

The thesis is organized into three main sections that reflect the logical progression of the research and correspond to the three phases of the work, making them clearly identifiable in the document's table of contents. The first section establishes the theoretical framework, providing an introduction to European environmental policies and the NEB framework: here, the cultural and regulatory developments of European environmental policies are introduced, along with the role of the Green Deal, the achievement of a systemic vision of sustainability, the significance of the historical reference to the Bauhaus, the three pillars of sustainability, beauty, and inclusion, and the main methodological tools of reference, from the NEB Compass to the most recent self-assessment tools. The second section links the summary of the analysis and development phases of the FARMER project with the in-depth study conducted at the architectural scale regarding the details of the intervention on the two selected warehouses. The third section applies the evaluation to the project by subjecting the scenario to a critical review, with the aim of assessing the coherence of the choices made while simultaneously examining the method's ability to adapt to the project's specific characteristics and analyzing the structural and theoretical implementation of the three dimensions of sustainability, beauty, and inclusion. The structural separation between design and evaluation was introduced to provide greater clarity and ease of reference, but is not intended to imply that the design is fixed in relation to the inputs resulting from the verification phase. In fact, the thesis suggests adopting an iterative structure, in which the evaluation phase is integrated into the design process as an integral part rather than as a concluding phase. Precisely for this reason, evaluation is applied during the preliminary and conceptual design phases as a form of ongoing assessment to identify a series of adjustments to be considered before proceeding to the conclusion of this phase.

Methodology

From a theoretical perspective, the research was based on a critical review of the literature and key European policy documents, focusing on the evolution of strategies for achieving sustainable development and providing an in-depth analysis of the construction sector. The summary presented here aims to clarify the origins of the NEB principles and the role of the assessment tool, which are presented as an attempt to put into practice a transition that simultaneously addresses environmental, social, and spatial dimensions.

With regard to project development, the work is based on territorial assessments, morphological and functional analyses, SWOT analyses, and stakeholder mapping,tools already incorporated into the FARMER project and crucial for defining the master plan. The decision to apply this tool to a project developed within the context of the Magazzini Raccordati as a case study stems from their unique urban condition and significant strategic position within the urban fabric: an extensive historic infrastructure marked by spatial discontinuities, accessibility challenges, and social fragility, yet also possessing strong potential for identity and community building. The project emphasizes precisely this dual territorial and social value as a resource to be reactivated through new collective functions.
The individual in-depth analysis phase focuses on two of the warehouses slated for redevelopment in the master plan and adopts an architectural and technological approach, with particular attention to the functional use, energy performance, and material choices of the project. The use of energy simulations, the definition of building assemblies, and the configuration of the main tools for LCA calculations allow for the integration of conceptual and technical aspects, enabling the potential to influence the project by verifying the feasibility of the proposed solutions.
The final phase,that is, the evaluation phase,applies the reference framework to the project to assess its compliance with NEB principles and to highlight critical aspects. This step serves primarily as an interpretive function, aiming to understand the method's analytical framework, the effectiveness of the identified parameters in relation to the scale, type, and phase of the project presented, and, where possible, to identify potential adaptations that allow for a full grasp of the case study's complexity. The thesis thus treats evaluation as a moment of knowledge and design rather than as an ex post verification.
To ensure an objective and multidimensional validation of the adaptive reuse project, this study employs simulation and evaluation tools integrated into various stages of the research process. The table below summarizes the function of each tool, the established objectives, the underlying assumptions, and the identified methodological limitations.

Tool	Research phase	Purpose	Assumptions	Limits
Power-Interest Matrix & SWOT Analysis	Urban Analysis	map the local stakeholder ecosystem to guide the strategy of the "FARMER" Master Plan and its public welfare functions.	The collaboration between public agencies, the third sector (e.g., the Sammartini Center), and technology partners (UVF) is considered a prerequisite for the success of the initiative	The academic nature of the project precludes the development of a genuine contractual/financial framework for private investors.
Honeybee & Ladybug (Grasshopper)	Project	dynamic energy simulation to calculate peak heating loads and energy demand	Climate data for Milan (Zone E)	The simulation is limited to the analysis of thermal loads but does not address the thermo-fluid-dynamic behavior that is expected to be developed during the construction phase.
OneClick LCA	Project	map the environmental profile and measure embodied carbon according to the European Level(s) criteria.	Life cycle timeframe: 50 years; Phases analyzed: A1–A4 (production/logistics), B4–B5 (replacement), C1–C4 (end of life).	Mandatory use of average/generic datasets (e.g., equipment and furnishings) in the absence of specific EPDs; conservative exclusion of biogenic carbon credits due to the inability to define a definitive end-of-life.

NEB Self-Assessment Tool	Evaluation	assess the project's alignment with the principles of sustainability, beauty, and inclusion; test the flexibility of the framework on a historic and atypical building.	Application of the concept design in the preliminary phase; the validity of data collected at the urban scale also applies to the architectural scale, where conditions do not undergo significant changes	Some indicators cannot be applied in the absence of actual data (e.g., CFD simulations for air quality or financial business plans).

Table 1. *Mail characteristics of the used tools.*

Limitations of the study

The decision to use the FARMER project as a case study stems from the close alignment between the project objectives proposed by the partners identified by the polytechnic university and the founding principles of the New European Bauhaus. What makes the project particularly suitable for verifying the framework's practical applicability lies in the combination of existing heritage regeneration, technological innovation, social inclusion, and the development of a large-scale social network, objectives characterized by high complexity and strong interaction between different scales of intervention and the disciplines involved.

However, the research has a number of limitations that must be made explicit. The first identifiable limitation concerns the lack of operational maturity of the framework itself, which is still in a phase of methodological consolidation and constitutes an initial attempt to synthesize the complexity of a context of systemic transition: the ability to trace these phenomena back to fully objective, quantifiable, and measurable parameters remains an extremely complex goal, particularly with regard to criteria related to beauty, cultural identity, and the quality of the spatial experience, given the presence of a strong interpretive component.

Second, while the selection of a single case study belonging to an extremely specific building typology allows for a detailed examination of how the method performs under particularly challenging conditions, it does not permit the automatic generalization of the research findings to all other categories of projects or to all geographical contexts.

The main challenge, however, lies in the fact that research focuses primarily on the design and simulation phases of the project. Certain effects relevant to the framework, particularly those related to the actual use of spaces, long-term social impact, and participatory governance processes, can only be verified through future applications of the method to projects that are implemented and monitored over time, making them inapplicable at this stage.

The findings of this thesis will therefore not constitute a definitive validation or critique of the framework, but rather a contribution to its practical application in an academic setting.

I. From Environmental Policy to Holistic Design: The European Path towards the New European Bauhaus

With the drafting and signing of the Single European Act (1986), the European Communities incorporated the concept of environmental protection into their socio-economic framework, recognising its central importance for our times and for the future development of society. This decision represents the institutional response to the growing awareness of the physical limits to economic growth, which had already been officially highlighted in 1972 by Donella Meadows, Dennis Meadows, Jørgen Randers and William W. Behrens II in “The Limits to Growth” (Meadows, 1972) and which will also be covered in the Brundtland Report (WCED, 1987). Given the forecast of rapid growth in resource requirements, addressing these challenges has required – and continues to require – urgent priority, which over the years has resulted in a multitude of agreements, implementations and updates. These are summarised and interpreted in the Agenda for Sustainable Development adopted by all United Nations Member States in 2015, which sets out 17 Sustainable Development Goals (SDGs).

The European Union, aligning itself with this global framework, has embedded these goals in its policies and strategic priorities, most notably in the European Green Deal, a set of initiatives aimed at achieving climate neutrality in Europe by 2050, which was introduced and subsequently confirmed and reinforced as a driver of post-pandemic economic recovery. This ambitious European strategic plan is based on eight pillars: Increasing the EU’s climate ambition for 2030 and 2050; Supplying clean, affordable, secure energy; Mobilizing industry for a clean and circular economy; Building and renovating in an energy and resource-efficient way; A zero-pollution ambition for a toxic-free environment; Preserving and restoring ecosystems and biodiversity; Farm to Fork: a fair, healthy, and environmentally friendly food system; Accelerating the shift to sustainable and smart mobility. (European Commission, 2019).

Strategy Pillar	**Key Objectives**	**Key Stocks and Sectors**
Climate Ambition (2030/2050)	A net reduction of **55%** in emissions by 2030 (compared with 1990) and carbon neutrality by 2050.	Revision of emissions regulations; stricter benchmarks for all polluting activities.
Clean, Safe and Affordable Energy	Decarbonising the energy system (which accounts for 75% of EU emissions).	Revision of the Renewable Energy Directive; expansion of clean energy sources; review of regulatory frameworks.
The Circular Economy in Industry	Promote environmentally friendly products and closed-loop production cycles (circularity).	Focus on: electronics, furniture, high-impact intermediate products. Raising awareness of repairability and durability.
Energy-Efficient Construction (Renovation Wave)	Renovation of Europe's building stock to improve its energy performance.	Renovation of existing buildings; improving occupants' well-being; resource efficiency.
Zero Pollution	To create a toxin-free environment and protect human health.	Replacement of hazardous chemicals with safe alternatives; phasing out of non-essential harmful compounds.
Biodiversity and Ecosystems	Protecting and restoring nature to boost climate and social resilience.	Protecting forests and biodiversity; tackling food insecurity, wildfires and zoonotic diseases.
Farm to Fork	A fair, healthy and environmentally friendly food system.	Nutritious and affordable food; promoting sustainable agriculture and healthy eating habits.
Sustainable and Smart Mobility	A 90% reduction in transport emissions (which account for 25% of the EU total).	Reducing dependence on fossil fuels; strengthening regional connectivity for freight and passengers.

Table 2. *European Green Deal Policy Areas (European Commission, 2019)*

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As a result, a significant portion of those initiatives that fall within this organizational paradigm has addressed the building sector, as the main contributor to the consumption of a large proportion of environmental and energy resources. To be more specific, buildings utilize more than 40% of the total EU's energy consumption and are responsible for 36% of greenhouse gas emissions (Commission, 2010). Moreover, current data highlights a significant gap in the adequacy of the existing building stock: estimations show that 75% of existing buildings do not comply with the current standards. This becomes even more concerning when considering as a benchmark the level of ambition reflected in European targets of climate neutrality: following this scenario such percentage would rise to 97% of non compliance.

Besides even if by only implementing measures to improve the energy performance of existing buildings it could be possible to achieve a reduction of total energy demand by 25% compared to current levels, only 1%of the existing buildings undergoes annual energy-efficient renovation every year (European Commission, 2019). These data underline the importance of considering the entire building life cycle and the entire building industry with a focus on a key area of action: Operation and maintenance activities, including repair tasks, equipment replacement and building renovation, strongly related to the performance of buildings in use (Jiménez-Pulido, Jiménez-Rivero, & García-Navarro, 2022).

As this evidences brought more and more awareness towards the needs for a systematic approach , in 2014 the European Commission reinforced its commitment towards a more sustainable building industry with the Communication on Resource Efficiency Opportunities in the Building Sector (COM/2014/0445), calling for a unified effort to improve environmental performance across the entire building life cycle.

The following more important act of the European Commission (EC) has been the launch of an ambitious package of initiatives focused on impacting directly the professional view towards new ambitions and standard: the new 'Renovation Wave' strategy and the New European Bauhaus. Both the projects were presented in the State of the Union 2020 as a concrete application of the European Green Deal aspirations. While the 'Renovation Wave' strategy was presented as a practical tool for impacting on the existing stock and encouraging reuse other than new construction, the New European Bauhaus represents an abstract space for discussion, dialogue and craft of ideas

The Philosophical Shift: From Technical to Cultural

Analysing and examining the developments that the EU has spearheaded within the context of its climate, environmental and social policies is therefore of fundamental importance for understanding the NEB framework project and its pillars. The President of the European Commission, Ursula von der Leyen, has in fact presented the NEB as the heart of the European Green Deal: "*If the European Green Deal has a soul, then it is the New European Bauhaus which has led to an explosion of creativity across our Union*."

With this “explosion of creativity”, the EU is taking its first steps towards applying the Green Deal’s macro-policies to the practical, tangible reality of everyday professional practice. The NEB thus serves as the necessary bridge between academic and political debate and the work of architects, designers, engineers and urban planners.
The NEB initiative is therefore one of the informal implementation strategies that the EU has identified to mark a practical shift towards sustainability. The term ‘soul’ used by President Ursula von der Leyen is no accident. The NEB is, in fact, distinct from legislative or regulatory strategies: it forms the basis for a dialogue that can directly engage with the lives and values of European citizens, recognising the inadequacy of a purely technical approach to achieving systemic change. The proposed transition reflects the interdisciplinary spirit of the Green Deal, maintaining its cross-systemic perspective, and challenges the sectoral mindset of the construction industry by putting its ‘silo mentality’ to the test, advocating for the need for co-creation between technical performance and the social inclusion of the communities involved. Ultimately, the aim is to make change desirable rather than merely necessary, by combining social, urban and architectural regeneration and bridging the gap between institutional ambitions and the real needs of the people who inhabit the urban environment.

The Historical Legacy and the “New” Identity

The clear eponymous reference evokes a specific historical moment, and this choice is certainly no accident. The Staatliches Bauhaus, founded by Gropius in 1919, had in fact established itself as a benchmark for artistic and cultural transformation during a period marked by profound upheavals, and had served as a meeting point between craftsmanship and new methods of industrial production. Gropius himself described this reality as “a new community of creators, without the class distinctions that create an arrogant barrier between craftsman and artist” (Walter Gropius, 1919). This spirit of innovation and sharing is the very same that the EU seeks to evoke with the NEB project in the post-pandemic era.
The New Bauhaus thus presents itself as a critical reinterpretation of these very principles of artistic community and the interdisciplinary nature of the arts. The 1919 movement had been driven by the Industrial Revolution, new mass production techniques, standardisation and the use of new materials, such as concrete and steel. The NEB, on the other hand, is an institutional project that responds to the new challenges of the 21st century, which are often, ironically, ultimately caused by industrialisation itself. This historical parallel offers a further step towards understanding the identity of the NEB project, emphasising its interpretative rather than continuative nature within the German school. In this sense, post-industrial awareness plays a central role in defining the new challenges of deceleration, regeneration and the rebalancing of resources. Design changes its purpose but retains its role as a practical link and mediator between the tensions arising from the characteristic complexities of an era. The thesis explore the role of design as a strategy for resolution and as a language. Furthermore, this comparison reveals some interesting differences between the two eras: whilst the German Bauhaus championed and sought to universalise design (the International Style), abstracting it from local conditions, the NEB explicitly recognises the need for a

locally-based approach that responds differently to distinct stimuli, whilst respecting the identity of the context in which it is applied. Herein lies one of the great challenges facing modern Europe, which all too often risks using this rhetoric of diversity to conceal approaches that in reality reproduce standardisation frameworks still too rigid to truly adapt to the diversity of the many entities that make up the Union. A key distinction lies in the NEB's desire to position itself as a decentralised body and in the absence of a defined structure; it explores the possibilities of a world that is interconnected yet distant, such as the one we live in today, and represents one of the most ambivalent aspects of the entire project: on the one hand, it ensures experimentation and diversity; on the other, it risks diluting the impact of the project into a mere list of related initiatives.
Historical reference is therefore an interesting strategy for legitimising a European narrative and linking the ecological transition to the continent's cultural and artistic heritage.

The Three Core Pillars

The European environmental policies of the last two decades, briefly outlined above, whilst yielding significant progress in terms of regulation and performance, have failed to bring about a profound cultural transformation in the way we live and build. In this sense, reducing the climate crisis to a matter of energy efficiency and technological optimisation has revealed its systemic inadequacy, generating isolated improvements incapable of influencing the structural trajectories of resource consumption and emissions.
The NEB's cross-sectoral model stems from these premises and interprets the vision of the transition process outlined by the Green Deal by focusing its analysis on three key areas of sustainability: environmental, aesthetic and social inclusion. Attempting to interpret these three concepts without recognising that the ultimate goal for the NEB remains the achievement of harmony and balance between these dimensions, rather than the study of any one of them, would risk diminishing and devaluing the ambition and very nature of the project: these areas must always be considered as coexisting and collaborating components within the same paradigm, whose significance is generated precisely by their interaction.

The integrated approach promoted by the New European Bauhaus should not be interpreted solely as a downplaying of the climate crisis, but must be understood as a strategic response to the historical limitations of an approach to sustainability based primarily on technocratic measures.
As highlighted by Jeffrey Sachs in *The Age of Sustainable Development* (*2015)*, economic progress, social inclusion and environmental sustainability are not alternative or sequential objectives, but rather interdependent dimensions that must be pursued simultaneously in order to avoid instability or political rejection: without a solid and unified social and political foundation, even the most ambitious environmental policies risk lacking legitimacy, rendering them weak and ineffective in the face of economic crises, conflicts or shifts in public opinion. This perspective finds convergence and validation in the model discussed by Kate Raworth in *A safe and just space for humanity: Can we live within the doughnut (2012)*,

in which the biophysical limit represents the insurmountable ideological peak, whilst the social foundation constitutes the fundamental condition of equity without which the ecological transition cannot be sustained over time.

Building on this understanding and the resulting socio-political analyses, the NEB's initiative aims to operate on a broader scale than its previous areas of activity. It thus goes beyond mere technical and energy regulation, recognising that sustainability is, first and foremost, a matter of values, collective perceptions and economic and social feasibility.

The theoretical soundness of this approach is borne out by the extensive and now well-established debate concerning the impact that the climate crisis has had and will have on the human ecosystem. A crisis which, as suggested by Gregory Bateson in *Steps to an Ecology of Mind* (1972), is, ultimately, a crisis of thought patterns: intervening solely on the technical body of the system without acting on the mind of society would mean failing to break the very logic that has generated unsustainability. Similarly, Jeremy Rifkin in *The Third Industrial Revolution* (2011) has highlighted the close interdependence between the energy transition and the need for a radical rethinking of social infrastructure as a whole. Together, these arguments show that the fragmentation of sector-specific approaches is one of the main obstacles to achieving what should be the most important shared project of our time.

The integration of environmental, social and aesthetic dimensions into the NEB framework is therefore the result of a vision that has been widely debated and subsequently established within the European and international communities. As argued by Bruno Latour in *Facing Gaia* (2015), the modern separation between scientific facts and values has historically prevented effective action on climate change; by bridging this divide, the NEB proposes sustainability as a systemic project, in which the environment is not treated as an isolated sphere, but as a relational condition that requires consensus, culture and imagination to become transformative.

The NEB proposal is therefore intended as an attempt to make environmental priorities politically and economically viable. It remains to be seen, however, whether the sustainability framework proposed by the NEB continues to focus on factors that reflect areas of environmental impact, or whether this ambitious endeavour has, overall, lost its effectiveness.

Within the very concept of sustainability, the NEB also proposes a series of updates that go beyond assessing the building as a final product; instead, it analyses the entire life cycle of the building and its constituent materials, in line with the principles of circularity, regeneration and the protection of biodiversity. In this sense, the aim is also to emphasise the importance, as highlighted above, of reusing and upgrading the existing building stock. The concept of the building as a complex and dynamic metabolic organism is beginning to move beyond the academic and scientific context and is now being proposed through European frameworks. Sustainability is therefore beginning to consider not only the reduction of emissions, but also the impacts that the project has on environmental regeneration. To understand and follow the concept of sustainability highlighted by the NEB, it is necessary not only to comply with current regulations and the ambitions of carbon neutrality, but also to redefine the very concept of design and thus participate in a change that is technical, but above all cultural.

The most complex and controversial aspect of the initiative is undoubtedly the aesthetic dimension. Emphasising the need to consider this aspect as well serves to confirm that the concept of quality does not depend solely on the project's environmental performance. This second pillar represents a bold and uncertain testing ground, and one that is certainly less well-established within the EU context. The formulation of a shared concept of beauty conceals a series of challenges inherent in the subjectivity of the term itself. The initiative's vision resolves this complex debate by moving beyond formal stylistic discussion and recognising the qualities of space,as an experiential, emotional and sensory reality,as the true focus of this aspect. A sense of belonging, respect for the genius loci, and physical and psychological well-being both within and outside the designed space form the building blocks of this pillar. Architectural quality, light, proportions, materiality and spatial atmosphere retain their validity, but in the light of an approach that goes beyond the merely formal. The long and complex discussion regarding subjectivity and ornamentation that had dominated the modernist debate is resolved through the introduction of a new concept of beauty that transcends pure aesthetics, reopening the question of how cultural and emotional values can form the basis of contemporary design.

The final element of the triad is defined as inclusion and encompasses not only aspects such as physical accessibility but also issues such as respect for social and economic equity. In particular, the most extensively explored themes relate to energy vulnerability and spatial marginalisation. Excluding these Consideratedons risks making the transition process the preserve of privileged groups and thus limiting its effectiveness and reach. A project is therefore considered valid only if it provides sustainable, high-quality spaces that also meet the economic and social needs of different user groups. The complexity of reconciling high environmental and quality standards with solutions that are accessible and applicable on a large scale confirms the ambition of this European initiative. Yet it is precisely in this tension that the transformative power of NEB initiatives lies.

Whilst it is true that the co-planarity of these three dimensions often gives rise to areas of conflict, it is also true that it is precisely in these areas that the NEB project seeks to inject new momentum towards interdisciplinarity and collaboration. Rather than viewing these conflicts as a call for simplification, the invitation is to use these limitations to create a new balancing force from which to draw inspiration for the creation of new solutions.

The search for this balance does not, therefore, lie in identifying a single, definitive answer, but rather in a dynamic strategy capable of adapting by balancing these three pillars, whilst respecting the way in which they redefine areas of conflict depending on the context in which they are to develop. The result is not a single model, but a proposal for a design approach that is relative and embraces complexity, contradictions and the role of architecture as a practice of mediation within the broader context of socio-ecological transition.

Methodological Tools: The NEB Compass

An initial proposal to translate the three-pillar paradigm into an operational and evaluative framework to guide project criteria was put forward with the publication of the NEB Compass, introduced by the European Commission during the first phase of development of the New European Bauhaus initiative. The Compass serves as a guide for professionals in the sector in interpreting the principles of the NEB and applying them in various contexts. Precisely for this purpose, the tool is designed to be as flexible as possible, leaving room for a flexible and adaptable approach to analysis. The result is a framework that differs significantly from the typical lists found in formal evaluation systems, as it is explicitly designed as a heuristic tool for reflection rather than a rigid statement of compliance.

The Compass is therefore the first concrete tool against which the NEB's values are measured: sustainability, beauty and inclusion are beginning to take on parameters that go beyond mere rhetorical reflection and seek practical application. The breadth and complexity of the issues addressed could not initially be resolved through a combination of qualitative and quantitative criteria: whilst parameters such as energy efficiency and material quality could already be expressed numerically, other aspects concerning spatial quality and accessibility presented significant challenges and were therefore proposed in qualitative form.

These interdependent variables make it possible to assess the merits of project choices based on the EU's proposed transition framework and to adjust or reassess their direction during the process. The Compass functions as a hybrid tool that combines measurable indicators with critical judgement.

As a first attempt at implementation, one of the strategies adopted is the creation of a scalable framework offering various levels of targets, ranging from 'standard' to 'ambitious'.

However, this scale should not be confused with a hierarchy of technical performance; rather, it reflects the extent to which the project consciously integrates coherence between the three pillars identified by the NEB.

The 'standard' level refers to projects that aim to comply with current regulatory requirements and meet the existing thresholds set out in terms of energy performance, quality and accessibility.

Projects that, on the other hand, demonstrate a greater and more deliberate commitment to the framework proposed by this initiative fall into the intermediate categories: the integration of environmental sustainability strategies from the earliest stages of the design process, the Consideratedon of the concept of beauty as a tool for achieving quality and well-being, and the use of participatory processes involving the communities concerned are the key features of these projects. At this stage, the tool serves a diagnostic function, necessary for identifying conceptual and practical gaps, missed opportunities, and potential areas for development that have not yet been explored.

The highest level of compliance with NEB principles is the 'ambitious' level: the project does not merely balance the various criteria, but capitalises on their interdependence to generate new value. In other words, the tools and strategies employed address multiple areas simultaneously and are not limited to resolving a single aspect of the design: solutions to reduce environmental impact not only influence energy and ecological resilience, but also improve spatial quality; aesthetic choices reinforce a sense of belonging and cultural identity, supporting social cohesion. Recognising that the impacts of a design choice affect not only the specific area it is intended for but also other areas of development open our eyes to the

power of this integration. The Compass is applied here as a generative tool that guides towards exploring further options.
The adoption of this tool inherently reflects a view of the design process as non-linear and interactive, shaped by an ongoing dialogue of responses, critiques and provisional solutions, bringing together different professionals around a shared round table. This platform serves as a shared space designed to streamline communication between different technical disciplines, which is often hampered by fragmentation.
In conclusion, the initial outcome of this platform can be commended for developing a tool that embraces design complexity and for attempting to do so without resorting to oversimplifying the criteria. In particular, the effort to avoid fragmentation and to regard the evaluation process as a fundamental, continuous and integrated part of the design process,rather than a final condition for meeting regulatory standards,represents a significant step towards integrating the incremental nature inherent in the socio-ecological transition.

Parallel Frameworks: Technical Assessment in the European Context

Whilst promoting a cross-sectoral approach and highlighting the need for transformation within the construction industry, the New European Bauhaus certainly does not introduce any groundbreaking methodological innovation. In fact, it forms part of a broader category of European and international assessment methods that have been instrumental in codifying a shared, yet not unproblematic, understanding of sustainability within the construction sector.
In particular, certification schemes such as LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Method) and DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen) have now taken on a central role, alongside institutional initiatives such as Level(s), which is funded by the European Union.
After all, however, it cannot be denied that the existence and use of these assessment systems have reflected a highly significant trend towards recognising and treating environmental sustainability as a measurable and operational concept based on quantitative criteria. These measurements largely relate to categories such as energy performance, water efficiency, the integration of green features, and ecological impact. Despite structural and organisational differences, the aforementioned systems share a similar methodological approach, namely transforming complex environmental issues into a series of sub-categories to be assessed individually, producing a summary of points and performance classes that allow for the comparison of similar projects.
The greatest impact achieved by certification schemes, however, has been on market dynamics, within which they have established themselves not only as a benchmark but, above all, as a source of added value. In terms of their effects during the design phase, however, we have witnessed the consolidation of approaches driven more by compliance objectives aimed at achieving a high score than by the creation of greater awareness and understanding of energy and environmental issues or the search for innovative and integrated solutions.
Although they have recently begun to incorporate a greater awareness of sustainability – such as aspects relating to the full life-cycle costs of a building – these tools retain a structure

defined by a strong focus on performance and do not seek to adopt a holistic view of the design process. The result is therefore a blindness to the true environmental logic inherent in conscious practice, particularly regarding the impact of the built environment on the urban ecosystem in terms of resource consumption and the creation of new social systems. This highlights the failure resulting from the excessive simplification adopted in understanding the complexity of the context to which it applies, and reveals a growing tension between the need for reference standards and the inherently complex nature of architectural practice.
It is within this context that the European Union has begun to take action through increasingly targeted initiatives, with the aim of creating new alternatives to achieve greater methodological harmonisation across all EU member states. The NEB, with its Compass proposal, has therefore positioned itself within this established framework, aiming to redefine the ability to measure and assess sustainability through a new interpretation of the project as an inter-systemic entity. The EU had previously explored this possibility in relation to environmental sustainability with the development and publication of the Level(s) framework.
Level(s) is designed as a voluntary benchmarking method rather than a regulatory tool, and was officially launched in 2020 following years of consultation involving experts, authorities and industry stakeholders. The central objective is to establish a shared methodological framework capable of harmonising the assessment practices used in different countries, thereby supporting a collective transition towards low-emission practices, energy efficiency and the circular economy. Level(s) is not intended as an alternative to certification systems such as LEED or BREEAM, but rather as a set of complementary tools that supports their alignment within a more harmonised European approach. Unlike certification systems structured similarly to LEED or BREEAM, Level(s) offers a more flexible programme and provides specific tools for its interpretation; it is not organised into rigid scoring schemes. The indicators identified are organised into three key thematic areas (Resource use and environmental performance, Health and comfort, Cost, value and risk), from which six macro-objectives and 16 indicators are derived. The most interesting and innovative principle incorporated into the assessment is the approach focused on the entire life cycle of the building (Life Cycle Assessment), which allows for a greater understanding of impacts by encompassing all stages of production, from raw materials to the end of life of the components involved. This concept broadens the perspective by introducing elements such as the environmental footprint of buildings, embodied carbon and long-term resource flows into the discussion.

What makes this assessment even more interesting is the inclusion of a wealth of supporting materials (technical guidance, standardised calculation methods, and clearly defined metrics) which explain its logic and principles in great detail, going beyond a purely practical purpose and lending the framework an educational dimension. This hybrid nature promotes transparency and the comparability of different projects depending on the phase and context. This positions Level(s) among the most interesting tools for policymakers, developers, and designers seeking to meet the thresholds identified by the EU in relation to the objectives of climate neutrality and the circular economy.

The Gap: Between Vision and Measurement

What emerges clearly, therefore, is the existence of a growing gap in methodological application between value-based, qualitative and holistic approaches, and quantitative tools focused on indicators primarily linked to the energy dimension, but which are not particularly sensitive to the intrinsic complexity of the project. The ambitious policies set out in the European Green Deal therefore remain far removed from established technical practice and thus risk remaining ineffective, leaving room for projects built on partial metrics, with the potential for greenwashing.

In fact, many companies use BREEAM/LEED more as a way to boost their image than as genuine design constraints (Serck, 2024). For example, they may focus their efforts on securing the few mandatory sustainability credits, completely ignoring factors such as the liveability of spaces or accessibility, or worse still, failing to be transparent even about the project's actual environmental sustainability and then claiming the 'sustainable' label without any substantial shift in paradigm. For example, they may focus their efforts on securing the few mandatory energy credits, completely ignoring factors such as the liveability of spaces or accessibility; or, worse still, they may not even be transparent about the project's actual environmental sustainability, yet still boast the 'sustainable' label without any substantial shift in approach. Given the points-based structure of certifications, it is in fact possible to achieve classes considered ambitious by trading points dependent on crucial aspects such as energy performance for points of equal value derived from areas that have a completely different impact, such as the presence of bicycle racks. In this way, the illusion of a building that is perfect in every respect is created, concealing the project's actual shortcomings whilst exponentially increasing its commercial value. These certifications are, in fact, costly and complex processes which, due to the need specialised expertise and adaptation. Beyond certification fees, they also entail substantial fixed transaction costs associated with specialised consultancy, technical simulations and extensive documentation procedures. Recent industry estimates indicate that these "soft costs" alone may reach over £15,000–35,000 for medium-scale projects (Averill, 2026) While these requirements may be relatively manageable for large-scale developments, they can weigh on smaller organisations and projects with limited resources, contributing to structural disparities.

Level(s) has set an interesting precedent, positioning itself as a complementary tool that enhances and aligns with existing certification methods, the ineffectiveness of which risks undermining transition objectives; however, it still overlooks important qualitative elements that need to be investigated and therefore remains on the fringes of a systemic model. In this regard, Grazuleviciute-Vileniske et al. highlight that sustainable buildings should enhance 'social equity, aesthetic quality and the preservation of cultural values' (Grazuleviciute-Vileniske, Viliūnas, & Daugelaite, 2021), " aspects that are virtually absent from traditional technical protocols, raising concerns about the risk of an 'excessively eco-centric' bias in many frameworks.

However, from an epistemological perspective, there remains a clear distinction between quantitative and qualitative approaches, which poses significant challenges in the search for a concept of beauty and inclusivity that is effectively measurable and suitable for an evaluative context.

The comparison presented in this section between assessment and certification methods has highlighted numerous and substantial differences in terms of purpose, assessment logic and the scope of the assessment itself. Indeed, whilst LEED and BREEAM are primarily based on quantitative criteria using pre-defined scoring scales, NEB Compass introduces a framework that is more focused on the building's entire life cycle, aligning with European principles. The NEB Compass, on the other hand, seeks to integrate qualitative aspects by proposing, for the first time, a cross-sectoral dimension of sustainability, adopting a holistic approach and introducing context-sensitive criteria. The following table summarises the main characteristics of each framework, revealing not only methodological differences, but fundamentally different conceptions of sustainability and architectural value.

Appearance	NEB Compass	Level(s)	LEED / BREEAM / DGNB
Scope	The three pillars of NEB: beauty, inclusion	Environmental sustainability of buildings (life cycle)	Green building
Metric	Hybrid KPIs (qualitative and quantitative) broken down by indicators	Quantitative indicators of environmental impact (CO_2, energy, resources)	Technical scores based on checklists
Geographical scale	Building / neighbourhood / urban context, new construction and reuse	Mainly buildings and neighbourhoods (EU focus)	Single-building projects (internationally led)
Stakeholder	Planners, local authorities, communities (self-assessment)	Designers, engineers, clients (detailed reporting)	Certification bodies, clients, developers
Key strengths	A holistic approach, taking into account aesthetics and inclusion, adaptable to different contexts	Technical rigour and the comparability of regulations and EU ambitions;	Recognised worldwide
Limitations	Difficulties in objectively quantifying beauty and inclusion; self-assessment, which is potentially subjective	The complexity of LCA calculations; a potentially subjective self-assessment	Offsetting between unrelated areas; models that are sometimes outdated

Table 3. *Comparison between different certification and evaluation systems*.

Whilst Level(s) ensures greater rigour than international certifications and guarantees greater robustness and transparency, the NEB Compass seeks to combine this approach by also incorporating qualitative aspects and a framework that clearly defines the holistic objectives of the Green Deal. The discrepancies highlighted and the scope for further investigation into how these tools can be improved have prompted the NEB to propose a new integration with the NEB Self-Assessment Tool.

The NEB Self Assessment Tool: Towards an Integrated Evaluation Framework

Recognising the central importance of dialogue between professionals and stakeholders for the delivery of comprehensive and effective projects, the NEB Self-Assessment Tool – developed in 2023–2024 by the EU (JRC) to support the New European Bauhaus initiative – is designed precisely as a guide for this dialogue. As stated by the Commission, it is 'a multidisciplinary and synergistic approach' based on measurable criteria (Key Performance Indicators) and specific performance thresholds, with the aim of quantitatively assessing the quality of European projects across the three NEB dimensions. Its main objectives can be summarised as follows:

- To provide an immediate and structured tool for use by administrators, policymakers and planners to assess and guide project decisions in accordance with the NEB principles.
- Encourage and introduce a methodology for implementing a cross-cutting process that addresses issues involving environmental, aesthetic and social factors.
- Incorporate the European regulatory framework directly into the dialogue. The method aligns with existing standards, aiming to test their adaptability and applicability with a view to identifying necessary extensions
- To promote a discourse on cooperation aimed at continuous improvement, moving away from the competitive rhetoric associated with existing certification methods. The assessment does not, in fact, assign a single rating, but rather encourages critical reflection on the project's strengths and weaknesses.
- Ensuring accessibility at various levels by involving local authorities, small local government bodies and organisations with limited resources, which should be able to carry out the assessment without the administrative complexity of a formal certificate. In addition to striving to be adaptable to different types of projects (new builds, renovations) and spatial scales.
- Develop a methodological framework that clearly distinguishes between the dimensions, identifying separate KPIs and indicators for each of the three.

Its structure identifies three main categories: Sustainability, Beauty and Inclusion, and then sets out the various project objectives, justifying them with arguments drawn from both the traditional pillars of sustainability and the principles of the Green Deal. Each dimension has been developed by a separate research group and therefore has a completely independent structure, whilst adhering to the same hierarchy. For each of the three dimensions, a series of Key Performance Indicators (between 8 and 11) has been identified, reflecting the impact objectives of that dimension and taking the form of thematic groupings of between 1 and 4 indicators. An indicator is therefore the most basic unit of measurement that will enable the evaluation to be carried out, converting data into measurable factors and transforming performance and strategies into comparable percentages. The KPI score depends on the

result of each indicator and the type of indicators involved, depending on the scale of the project or the objective of the assessment. Each of these reports the result on a performance scale (e.g. 'Basic Level', 'Intermediate', 'Ambitious') based on the data collected. The weighted average of the KPIs provides the score for the respective dimension, from which their performance class is derived. The internal hierarchy between dimensions is designed to achieve maximum transparency and simplify data consultation to identify gaps and issues. The initial and fundamental step is the classification of the project itself, which is carried out by defining the spatial scale (building, neighbourhood, urban area), the type of development (new build vs. renovation) and the property's primary use. The selection of indicators, their weighting and the comparison thresholds depend on the project category and its specific characteristics: for example, in large-scale urban projects, certain indicators (public transport, social regeneration) may carry greater weight than in the case of a single building, whilst for a historic building, indicators relating to standard energy performance might be excluded or modified. The decision to devote particular attention to this phase stems precisely from the need to make the method as flexible and adaptable as possible, whilst maintaining rigorous and easily understandable internal consistency.
Perhaps the most ambitious aim of the tool, however, is to serve not only as an evaluation method but also as a design aid. Indeed, from the very first stages of concept development, the three dimensions provide important design guidelines. The search for integrated solutions emphasises the importance of adopting a holistic view of the project from its earliest stages to achieve a coherent and effective outcome. Observing how certain choices simultaneously impact three different dimensions allows one to grasp the true scope of the project and better manage its impact.
The implementation of an online interface for the tool aims to speed up the display of results and make the tool easier to share with other project stakeholders by summarising the outputs of the various dimensions on a single dashboard. This should speed up the review process and enable resources to be allocated in a more informed manner. The ultimate aim would be to encourage, through improved readability, the sharing of the process with local communities, administrators and investors, involving them in the compilation and including them in the decision-making phase.
Although the tool presents itself as an interesting synthesis of European ambitions and features a robust and transparent structure, it is nevertheless worth emphasising that, as it is recent and still evolving, it occupies a space of methodological experimentation in which the project's ambitions exceed, at least in part, the level of operational consolidation. In particular, the integration of qualitative aspects such as beauty, cultural identity and social inclusion within a quantitative evaluation system introduces a degree of complexity that has not yet been fully resolved in its current architecture. If we consider the methodological structure based on a complex hierarchy of indicators, the reference to already established frameworks, similar, for example, to structures such as Level(s),becomes clear. The translation of criteria with an inherently subjective nature raises important questions regarding validity, comparability and interpretation, which relate primarily to the risk of oversimplification, the legitimacy of conceptual reformulation and, more generally, the extent to which quantitative expressions are sufficient to capture the complexity that the NEB aims to highlight.
A further point of concern relates to the decision to structure the evaluation process across three distinct dimensions: whilst this promotes transparency and is likely necessary for this initial exploratory phase, it is worth considering how this separation avoids contradicting the profoundly interrelated and co-constitutive nature of these principles, as conceived by the NEB itself.

The study and use of this tool should help to interpret European standards not as rigid constraints, but rather as starting points for exploring methodologies that continually adapt and evolve within the technical and academic landscape.

Research and Application Gaps

The analysis of contemporary assessment and certification systems highlights the structural differences between the Level(s) framework and the New European Bauhaus (NEB) Self-Assessment Tool compared to more widely adopted certification protocols. While established methodologies favor a sector-based approach, grounded in predominantly quantitative metrics and focused on the energy and environmental performance of the building without, however, considering rigorous systemic logic, the self-assessment frameworks proposed by the EU aim to provide a tool more oriented toward decision support and the redefinition of the project and the concept of sustainability as systemic entities in which every action has an impact on multiple fronts.

Although this proposal introduces innovative elements into the landscape outlined above, there is currently a clear gap in the scientific literature on the subject. This gap in the literature can be attributed to the recent publication of the assessment tool; indeed, the state of the art is limited to a small number of instructional documents attached by the Joint Research Centre to the main manual, which document its founding principles and initial applications. However, there are no academic studies that provide a comparative analysis between the NEB Self-Assessment Tool and existing technical-environmental assessment methods or that offer a critical evaluation of the framework.

Another operational shortcoming stems from the lack of comprehensive and well-established applications of the method. The absence of a broad, long-term body of practical applications of the tool across projects of various types and scales currently represents one of the main challenges in testing its true robustness and in utilizing empirically validated benchmarks. Applying the method to a specific case study thus allows for an initial empirical test of the tool itself, which serves as a foundation for bridging the gap between the European strategic vision and contemporary architectural discourse.

II. FARMER

The selection of the FARMER project and, specifically, the Interconnected Warehouses as a case study for the application of the NEB Self-Assessment was guided by the need to identify a project context that could address all three dimensions while also presenting specific characteristics. The presence of variations not attributable to the typologies and scales identified by the NEB allows, in fact, for testing the tool's flexibility of application a defining and necessary quality for a method that aims to be effective across the entire European building stock.

The decision to adopt this specific use case was driven by three key factors, which are closely linked to the nature of the European framework:

First and foremost, the primary objective of the project was identified as the implementation of a systemic urban renewal initiative that would involve both the historic architectural spaces within the area and the active communities and social organizations. From the outset, therefore, the central importance of a holistic approach was recognized as essential for achieving a permanent, progressive, and thus effective transition. This deep convergence between architectural redevelopment, environmental sustainability, and social inclusion reflects the NEB framework and thus makes the project an ideal testing ground for evaluating the interdependence among these three dimensions.

Second, the involvement of an interdisciplinary team resulted in greater complexity in managing workplace dynamics, but it also yielded a rigorous definition of intervention scenarios and a thorough contextualization of the data. The theoretical principles of NEB recognize the necessity of this characteristic for the project's success and for the application of the evaluation. Applying the tool to a case study structured in this way helps evaluate how effectively the method succeeds in highlighting this aspect.

Finally, the coexistence of highly multiscalar social and spatial logics has enabled the simultaneous development of different spheres and a strong connection between urban planning and architectural redevelopment. This close relationship makes it impossible to define a single, unambiguous scale for evaluation; rather, it requires further interpretive effort to identify meaningful indicators and KPIs.

The urban-scale project presented here was proposed and developed within the framework of the Alta Scuola Politecnica as an interdisciplinary project in collaboration with Alice Zorzan (mathematical engineering), Marta Lamanna (communication design), Shizuka Sasaki (landscape design), Marco Deluca (computer engineering), and Alberto Cozzi (management engineering). The summary report included only those sections pertaining to aspects strictly related to the spatial and functional redevelopment of the area, which are essential for contextualizing the architectural redevelopment and energy simulation project developed individually and presented in the second part of this chapter.

Magazzini Raccordati: past, present and future

Milano's Magazzini Raccordati (Connecting Warehouses) are a vast vaulted complex built between via Ferrante Aporti and via Sammartini beneath the elevated rail embankment of the Centrale station. This former freight facility – over 100 contiguous arches spanning roughly 2 km and ~40,000 m² – is a unique heritage asset at the city's core (Borsotti & Pistidda, 2020). For a century it underpinned Milan's logistics through concealed spur tracks and cranes, linking the station's goods yard with local wholesalers and forming a fundamental artery of the mid-20th century urban economy (Fassi & Crespi, 2020). The warehouses bear deep urban memory – used in World War II for military stores and as

thdeparture point for deportations to Nazi camps, and in the 1950–60s serving as the first reception site for southern Italian immigrants (now commemorated by the Binario 21 Shoah Memorial) (Fondo Ambiente Italiano (FAI), 2025).
The Raccordati originated in the 1910s when a vast raised embankment was constructed to carry the new high-level tracks into Milano Centrale. Beneath this, 126 vaulted brick chambers (plus 15 auxiliary units) were built as an integrated logistics infrastructure. The late Liberty/Decò facades, with geometric cement ornaments and wrought-iron portals, echo the Centrale station's architectural style. An internal rail link inside the embankment ran through each tunnel, shuttling merchandise from the station's platforms to any warehouse bay – hence the name *raccordati* ("connected"). From the 1920s to the 1950s, 22 turntables, overhead cranes, and side tracks made this complex a fully integrated distribution hub enabling railroad intermodality on an unprecedented scale (Borsotti & Pistidda, 2020)
From the 1960s onward, as road transport supplanted rail for freight, the internal rail spurs fell into disuse. The state manager withheld or raised rents, and after 2000 none of the tenancy contracts were renewed. Bagnacani describes this as a deliberate "piano di liberazione" aimed at emptying all warehouses for future redevelopment that never materialized (Bagnacani, 2021). By the 2010s, the entire complex was virtually silent apart from a few holdouts. The vacancy transformed the site from a vital commerce hub into a barrier between the east and west urban sectors of the railway embankment. Without meaningful public uses, the warehouses became "poorly accessible" and perceived as insecure, marked by social uselessness and creating a visible scar on the city map (Fassi & Crespi, 2020).
In the early 2020s, only 13 of over 100 vaults remained occupied for commercial or social functions. On Via Ferrante Aporti, one refrigerated food warehouse operates near the station alongside the Binario 21 Shoah Memorial. Via Sammartini houses municipal offices, an arts venue (the "Tunnel" nightclub), and a wholesale fish depot. The Milan Caritas organization operates emergency dormitory shelters in refurbished bays at the far east end (Progetto Arca, 2024). Structurally sound but showing their age, the warehouses lack modern utilities, lighting, and accessibility features.
Despite these challenges, significant redevelopment is underway. In late 2024 construction began on Dropcity, a city-backed Architecture and Design Center designed by architect Andrea Caputo. The project will restore roughly 10,000 m² (28 tunnels) between via Sammartini and via Aporti, converting them into galleries, makerspaces, a civic architecture library and startup ateliers. The initiative includes reopening the spaces above the tunnels with a cycleway and parkway, while over 400 meters of decorative facades undergo meticulous restoration under cultural heritage supervision (Macchi, 2022). This unprecedented investment acknowledges the warehouses' heritage value while injecting contemporary cultural life, potentially transforming a "forced uselessness" into a multilayered urban reservoir that bridges past and future.

Magazzini Raccordati: analysis

A comprehensive site visit was conducted to assess the current conditions and identify key opportunities and challenges within the study area. The following observations provide critical insights into the spatial, social, and infrastructural dynamics:

- Significant spatial fragmentation and underutilisation of the area. Discontinuity of pavements and limited pedestrian infrastructure, accentuating the disconnect between the east and west sides of the railway;

- The Magazzini Raccordati warehouses have many empty or dilapidated spaces, despite some restoration work mainly connected to Dropcity project;
- The vaults under the railway embankment are notable for their significant architectural character (masonry vaults, iron details, historic façades). These spaces, although rich in potential, are still inaccessible and socially inactive;
- A big contrast in public infrastructure, while the area has good public transportation connections, the pedestrian experience is ruined by dark underpasses, limited resting areas, and a scarcity of green public spaces;
- Informal uses such as ad hoc shelters for unhoused individuals were frequent along the route, notably in neglected interstitial areas. The lack of urban comfort, coupled with visible social marginality, reaffirmed the need for spatial interventions that address both physical connectivity and social vulnerability;
- The area's hidden social fabric is actually a valuable resource. Places like Giardino Cassina de Pomm, the Rifugio Sanmartini, and the Welcome Center for newly arrived migrants suggest a strong presence of local organizations that are already actively working to support vulnerable groups;
- Weekly markets and culturally diverse food outlets reveal a dynamic, multicultural community. This socio-spatial paradox, vital human presence amid infrastructural decay, further validated the project’s objective of combining urban farming with educational, cultural, and health-oriented services in the same spaces;
- The railway embankment was built to interact with the city, but now it feels more like a dividing edge.

SWOT analysis

Building upon the site assessment detailed above, a SWOT analysis was conducted to systematically evaluate the redevelopment potential of the study area. This strategic framework synthesizes the observed spatial, social, and infrastructural dynamics into actionable insights that will inform the design of community-focused interventions.

Strengths:

- strategic location within an easily accessible urban area, well-served by public transport;
- covered areas of the old warehouses provide optimal conditions for activities requiring controlled indoor environments (temperature, access management);
- proximity to schools, social care centers, and green areas encourages educational and social inclusion projects;
- close to the Sammartini Centre, offering social and health services for marginalized individuals, creating opportunities for training and urban agriculture initiatives;
- existing local associations, such as those involved with the “Cassina de’ Pomm” community garden, can serve as strategic partners for territorial regeneration.

Weaknesses:

- low safety perception due to dim lighting in long passageways, narrow and disconnected sidewalks;
- actual infrastructure issues: poorly insulated spaces and general decay requiring major renovations;
- land ownership by RFI (a private entity) complicates public use and redevelopment, with negotiations potentially lengthy and costly.

Opportunities:

- promote sustainable mobility and reduce dependence on motorized traffic through pedestrian and bicycle paths;
- enhance urban continuity and environmental responsibility by linking urban areas;
- develop educational and social inclusion projects through urban agriculture;
- leverage partnerships with local associations for community engagement.

Threats:

- risk of gentrification and displacement of long-time residents due to increased investment and rising costs;
- vulnerable populations may be unable to afford changes or access new spaces;
- persistent perception of insecurity or neglect may deter community use, regardless of physical improvements.

Any improvement plan should go beyond renovating buildings: it must actively involve local residents, create a welcoming and safe environment, and give the community a real voice to ensure socially sustainable development.

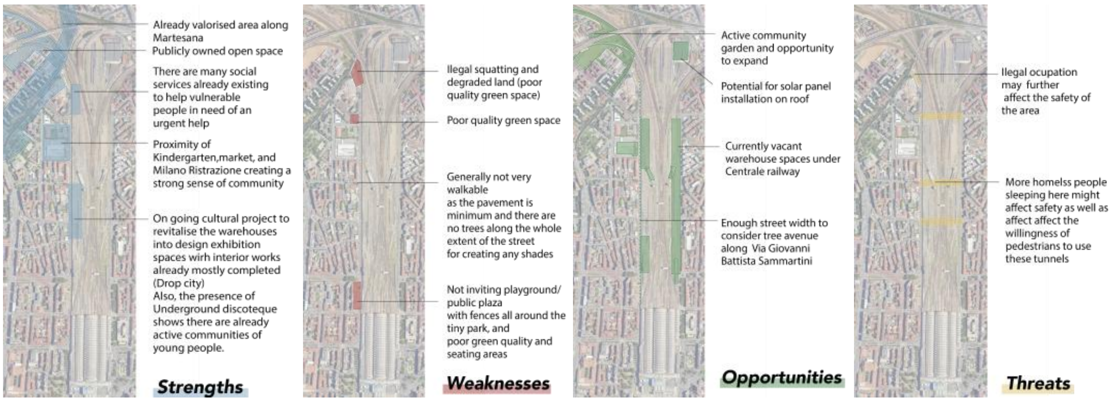


Figure 1. *Spatial SWOT analysis of the area around Milano Centrale.*

Stakeholders analysis

According to the above-mentioned objectives, different stakeholders have been identified for the area of Milan Central Station. In this context, the Power-Interest Matrix was applied to map the stakeholder (Caruso and Datola, 2023).

This matrix allows for the identification of different clusters of stakeholders. Moreover, for each of these clusters, a specific engagement strategy has been selected, as described below.

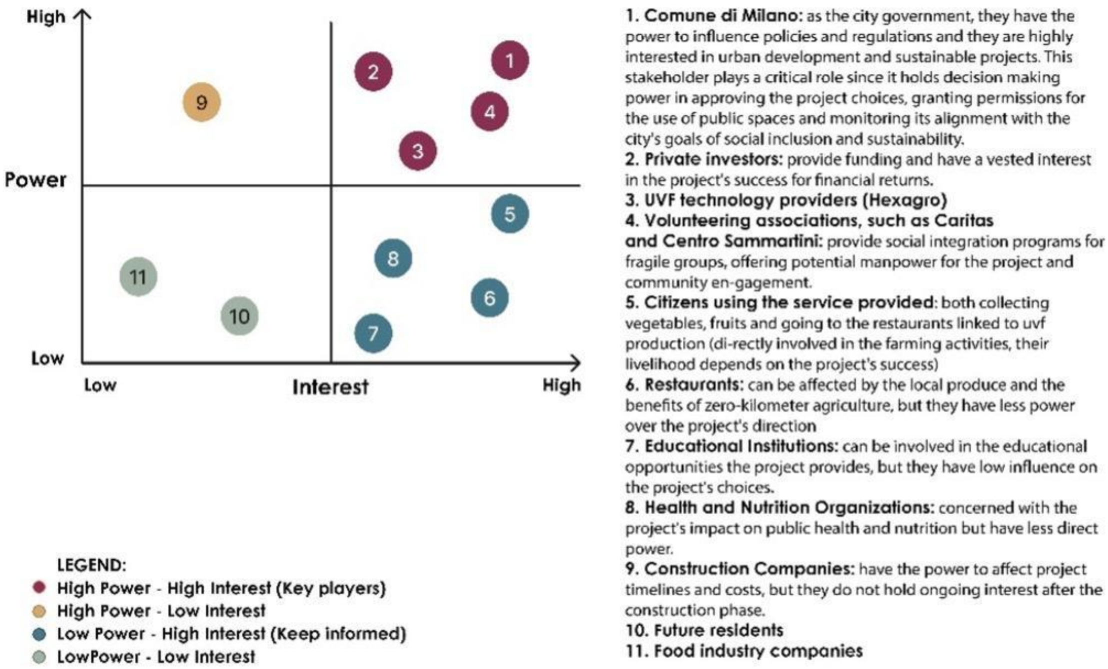


Figure 2. *Stakeholder Power-Interest matrix.*

Key players:

- Milano municipality (1): has the power to influence policies and regulations and is highly interested in urban development and sustainability projects;
- Private Investors (2);
- UVF technology providers (3): Hexagro start-up has a strong interest in the successful implementation and holds high power to influence decisions;
- Volunteering Assoc. (4): Community organizations can also be powerful allies, especially for outreach and education. Their networks run deep, and their involvement can help bring the broader public on board.

Engagement strategy: **Actively collaborate**. Engagement needs to be active and ongoing from the very beginning. Good practices include the scheduling of regular joint planning sessions or steering committees with municipal officials, investors and tech partners. Sharing detailed project timelines, clear milestones and transparent progress updates is equally important. It is important to co-design decisions (e.g. site layouts, funding models, technical specs) in workshops or working groups where everyone can weigh in. It is also fundamental to promptly address their questions and incorporate their feedback, since their buy-in is critical.

Keep satisfied:

- Construction Companies (9): they have high influence (permits, execution) but may not follow daily details of the FARMER project.

Engagement strategy: **Periodic consultation**. These stakeholders should be kept satisfied through clear timelines, requirements, and assurances about the project's direction. Briefings on site plans and schedules can prevent unexpected concerns, while addressing logistics early avoids complications. Incentives such as future contracts or recognition help maintain goodwill. Executive summaries, rather than technical detail, are effective for communication, and creating space for early feedback reduces the risk of resistance. Regular updates further ensure manageable expectations and minimize last-minute objections.

Keep informed:

- Citizens (5): interested in local food security and in the community;
- Restaurants (6): interested in local and fresh produce;
- Educational institutions (7) and Health and Nutrition Orgs (8): they have comparable levels of power and interest, due to their limited direct influence over the project and their significant involvement with educational opportunities and health impact.

Engagement strategy: **Frequent updates and involvement**. These groups are highly interested in the project but have less influence. They should be kept informed through tailored communication such as newsletters, community meetings, or social media updates, with an emphasis on direct benefits like fresh food access, jobs, or education. Their input is valuable for practical matters, so feedback via surveys, workshops, or tasting events can be useful. Encouraging them to act as project ambassadors can also help build wider public support. As one guide notes, "we keep them informed with relevant information… and leverage their enthusiasm for support".

Minimal effort:

- Future Residents (10);
- Food Industry Companies (11).

Engagement strategy: **Occasional updates**. These stakeholders have little power or interest, so only minimal engagement is needed. Basic information channels, such as city newsletters, industry bulletins, or automated updates via email or the project website, are sufficient. Including FARMER milestones in existing communications (e.g., a farmer's market newsletter) keeps them informed without significant resource use, while periodic updates ensure they remain included if their interest grows.

Masterplan

The final scenario for the FARMER project is conceived as a hybrid scenario that merges into a cohesive, multifunctional system, to integrate the strengths of the three original strategies, to better achieve the declared objective of the intervention.In this sense the strategic vision and the masterplan of the Magazzini Raccordati is based on the following pillar:

- urban food production, with urban vertical farming infrastructure that produces fresh, zero-kilometer food. The produced food is intended to be distributed through a local market and used directly in an on-site, sustainability-focused restaurant;
- engagement of the community and marginalized groups in skill development, food literacy, and environmental awareness through educational labs, training programs and public welfare spaces of cocreation accessible for all the local associations.
- and research innovation to support technological advancement in urban agriculture and offer valuable data to inform policy and system optimization, thanks to partnership with academic institutions.

The combination of these three main pillars support the implementation of a resilient and a replicable urban ecosystem that not only revitalizes underused infrastructure but also fosters inclusivity, circularity, and long-term sustainability.

The masterplan's territorial strategy is rooted in a rigorous analysis of the spatial and functional morphology of the Magazzini Raccordati and their urban context. The intervention articulates a renewed urban ecosystem that reactivates residual spaces and reinterprets their latent connective capacities. At its core is a multidimensional notion of reconnection,linking infrastructure and the city, production and community, and historical identity with contemporary use. This strategic framework aligns with the broader ambitions articulated in the urban section study, which contrasts the site's current condition,defined by infrastructural detachment and underutilization,with a future vision of integrated, multifunctional space anchored in sustainability and resilience.

Functional zoning and spatial logic

The spatial organization follows a stratified logic that integrates spatial constraints with the site's transformative potential. A central design move is the reactivation of the interstitial void between the linear warehouse volumes. These underused, inaccessible spaces become the nucleus of the site's productive framework.

This intermediate zone is designated for UVFs,high-performance hydroponic and aeroponic systems aligned longitudinally within the corridor. Their insertion is guided by two primary criteria: (1) maximizing solar exposure and passive ventilation to support year-round cultivation, and (2) functionally repurposing an otherwise inert space. New transversal cuts between the internal farming zones and the outer façades along Via Ferrante Aporti and Via Giovanni Battista Sammartini introduce light and air, while redefining the interface between infrastructure and public realm. This porosity catalyzes a paradigmatic shift from infrastructural opacity to urban permeability.

These spatial and environmental reconfigurations resonate directly with the objectives set forth in the urban section study, particularly the transformation of the warehouses into highly efficient vertical farming systems and the reconnection of disjointed pedestrian pathways via new green corridors.

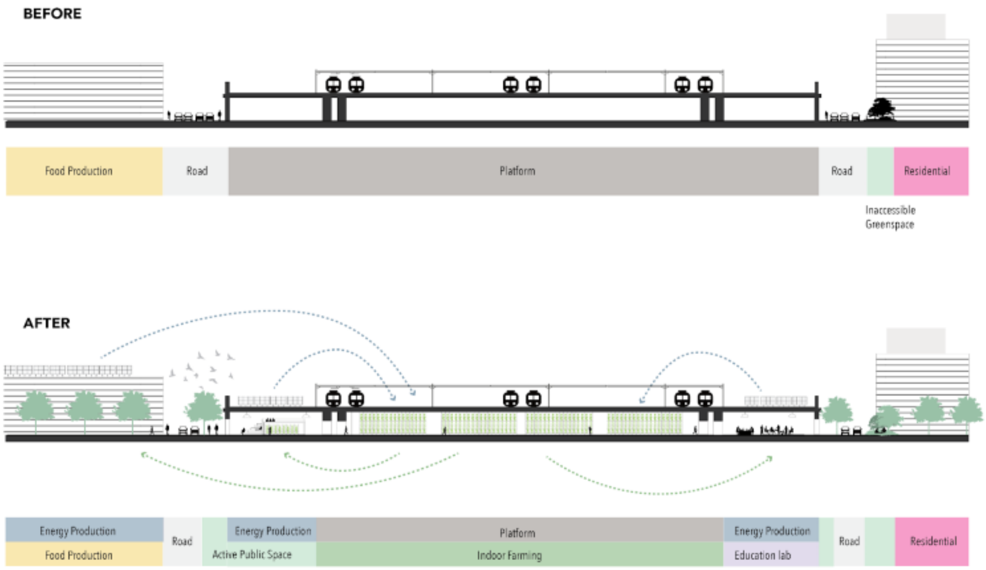


Figure 3. *Transformation of Milano Centrale and reconnection with its surroundings.*

Mobility, access, and public realm

A critical axis of transformation addresses mobility and accessibility. The strategy proposes full pedestrianization of Via Ferrante Aporti and Via Sammartini, enabled by the removal of surface parking. To reconcile parking demand, a parking facility is embedded within the railway embankment, leveraging its volumetric capacity without sacrificing surface usability.

The pedestrian framework is augmented with green infrastructure,linear parks, permeable paving, and structured vegetation,to mitigate heat-island effects and enhance stormwater management. The public realm is defined through a cohesive palette of materials and lighting strategies, fostering a safe and legible environment across diurnal cycles.

For sustainable transit, the masterplan proposes an extension of bus line 55, integrating new multimodal nodes along both streets. These are paired with bi-directional cycling infrastructure and a redesigned underpass, which becomes a key connective element. The underpass is reimagined with increased vertical clearance, improved lighting, and transparent apertures exposing interior functions such as the vertical farms and parking, thereby enhancing visual continuity and orientation.

These interventions reinforce the goals outlined in the urban section study, specifically the creation of a more walkable and ecologically sensitive environment around the station, replacing vehicular dominance with accessible public space and fostering ecological connectivity across the urban fabric.

Programmatic distribution: permanent and adaptive uses

The programmatic structure alternates between infrastructure-anchored permanent uses and modular, lease-based adaptable spaces, accommodating long-term vision and temporal urban dynamics.

Permanent uses:

1. UVFs (light blue): Technologically advanced cultivation systems operated in synergy with academic and private sector partners;
2. Politecnico di Milano Research Hub (green): A dedicated node for agro-technological R&D, facilitating translational knowledge flows between academia and applied urban systems;
3. Parking Infrastructure: Strategically integrated into the embankment to support modal shift while releasing valuable surface area.

Flexible or rentable uses:

1. Urban Market (blue): Infrastructure for short food supply chains, adaptable to seasonality and socio-economic flux;
2. Educational Labs (dark blue): Modular environments for environmental and food education, aligned with local curricular and civic agendas;
3. Training and Reintegration Programs (orange): Professional development hubs for food-related skills, tailored for youth and socially vulnerable populations;
4. Restaurants (yellow): Public-facing, pedagogical food venues reinforcing the identity of the site as a hub of sustainable culinary innovation.

These uses correspond to the urban section study's call for a multifunctional transformation of the area,linking food production, education, and community engagement in a continuous, spatially coherent system.

Activation of urban nodes and public squares

Key intersections,particularly triangular urban fragments adjacent to the warehouses,are reconceived as semi-covered public squares. These multifunctional platforms accommodate cultural programming, markets, and community. Modular roofing structures ensure climatic adaptability, extending temporal usability. These nodes function as both spatial hinges and social condensers, mediating between the site's internal activities and the urban fabric. The architectural language emphasizes environmental comfort via passive ventilation, solar control, and porous material systems.

Interconnected strategy and design coherence

All interventions operate within an integrated systemic framework. Productive cores, mobility systems, educational anchors, and public spaces are co-designed to reinforce one another. The masterplan thus serves as a spatial interface between technological innovation in urban agriculture and holistic regeneration of abandoned infrastructure.

Rather than a barrier, the railway embankment is reconceptualized as an ecological and productive spine, unlocking latent urban potentials. In doing so, the Magazzini Raccordati are transformed from residual logistics infrastructure into a critical apparatus of resilient urbanism, capable of catalyzing inclusion, sustainability, and food system innovation.

This territorial transformation directly realizes the vision presented in the urban section study: reconfiguring Milan's Centrale Station from a mono-functional transport corridor into a dynamic civic common that supports ecological, educational, and socio-economic vitality.

Stakeholder key insights

The semi-structured interviews conducted with the Welcome Center and Centro Sammartini provided essential insights that have directly informed the design and programmatic articulation of the final integrated scenario for the regeneration of the Magazzini Raccordati. These contributions emphasized the importance of aligning spatial interventions with the lived experiences, needs, and aspirations of local vulnerable populations.

The Welcome Center, part of the SPRAR-SAI system for the protection and integration of asylum seekers, highlighted the relevance of green and cultivated spaces not only as productive zones but as culturally resonant and socially inclusive environments. Staff members noted prior interest in initiating a small-scale cultivation project and referenced precedents such as the Giardino Condiviso Bing ("Giadino condiviso Bing", n.d.) and collaborations involving neurodiverse youth, underscoring the potential of agriculture as a medium for inclusion and therapeutic engagement. Crucially, they advised that the core function of these spaces should not be narrowly focused on horticulture. Instead, they advocated for multi-use, accessible environments that support intergenerational interaction, environmental education, and social integration. This feedback directly shaped the inclusion of educational gardens and modular community spaces in the final scenario, designed to host activities ranging from cultural programming to school workshops. Their emphasis on beauty and sensory appeal also reinforced the project's commitment to high-quality public space design, acknowledging aesthetics as a driver of mental well-being and place attachment, particularly relevant for migrant communities seeking familiarity and rootedness.

Centro Sammartini, part of the municipal network for adult severe marginality, offers services to approximately 4,500 individuals annually, the majority of whom are foreign nationals facing extreme exclusion. Their input stressed two critical dimensions. First, while a portion of their user base requires urgent subsistence support, others possess a degree of autonomy that could be mobilized through low-threshold, structured opportunities such as urban farming or maintenance of public space. This supported the inclusion of accessible training and reintegration programs linked to UVF operations and market management in the masterplan. Second, staff emphasized the importance of shifting the perception of the area,from a zone of disorder and insecurity to a place of opportunity and civic engagement. They described existing efforts to host thematic community events, including discussions on plant cultivation, and expressed willingness to integrate with neighbourhood-based initiatives. These insights validated the proposal's focus on combining productive infrastructure with public-facing components such as open-air markets, event platforms, and semi-covered plazas. Moreover, their reflections on urban safety, framed as both perceptual and material, reinforced the project's emphasis on visibility, transparency, and active edges, especially in areas surrounding the railway tunnels.

By integrating these insights, the project repositions the Centrale area not only as a site of technological innovation in urban agriculture but also as a socially resilient and inclusive ecosystem. The Welcome Center's emphasis on aesthetic quality and emotional connection to spaceas, especially for migrants, led to the prioritization of high-quality landscape design, ensuring that the environment supports both psychological well-being and social cohesion. Meanwhile, insights from Centro Sammartini about the varying levels of autonomy among service users informed the inclusion of graduated engagement opportunities within the UVF and market operations, such as modular training labs and flexible roles in maintenance and logistics, accommodating individuals with different capacities and trajectories toward reintegration.

Furthermore, both organizations highlighted the stigma associated with the area's perceived insecurity. This reinforced the need for open, transparent, and visibly active spaces, which translated into the design of semi-public plazas, transparent façade interventions, and programmatic overlaps between cultivation, commerce, and education. These design choices aim to transform the Magazzini Raccordati into a visible and inviting civic commons, shifting the narrative from marginality to inclusion, from abandonment to innovation. Through this participatory and context-sensitive approach, the project aspires to produce not only a functional urban farming system but also a socially anchored and ecologically regenerative urban node.

Implementation phases of the FARMER project

The implementation of the FARMER project is articulated across three phases over 10 years, progressively transforming the underutilized areas of Milan's Centrale Station into a hub of sustainable food production, renewable energy, education, and public space. This strategic sequencing ensures progressive transformation, operational scalability, and urban integration that support sustainability of the project. Each phase builds upon the previous, incrementally reactivating the underutilized infrastructures of Milano Centrale and embedding them within a resilient, productive, and socially inclusive framework.

Figure 4. *Phases of FARMER project.*

Phase 1 , Groundwork and spatial recalibration (Years 1–2)

The initial phase prioritizes enabling infrastructure and spatial reorganization to prepare the site toward public-oriented spatial organization. Key interventions include:

- sub-railway parking infrastructure: The introduction of a parking facility beneath the railway line aims to displace surface-level vehicular storage, thereby liberating street-level space for pedestrian-oriented and ecological functions;
- initiation of Renewable Energy Production: Solar panels will be installed atop existing structures along Via Sammartini and public buildings adjacent to the station. This deployment marks the beginning of a decentralized energy system;
- green corridor and green pocket park formation: Avenue of tree plantings will establish a north-south ecological spine, linking the Naviglio Martesana to the main plaza of the railway station. Existing pocket parks will be restructured and activated as social green infrastructures.

Figure 5. *View of Green Corridor and Green Pocket Park Formation.*

Phase 2 , Productive Core and Socio-Spatial Activation (Years 3–5)

The second phase concerns the operational launch of the UVF agenda and the activation of multifunctional community programs. Core developments include:

- establishment of UVF production: vacant warehouse volumes beneath the railway are converted into Urban Vertical Farming (UVF) units, employing soil-based vertical farming systems for high-efficiency food production;
- expansion of solar infrastructure: photovoltaic coverage is extended across additional rooftops and railway-adjacent surfaces to reinforce the site's energy autonomy;
- Magazzini activation: in this phase, activation will be focused on expanding public spaces that need minimal renovation costs, creating urban markets and restaurants that can generate capital to support further development;
- formation of support networks: a cooperative ecosystem is initiated, linking local institutions specially already established actors in the area like Centro Sanmartini and Caritas to support and disseminate UVF-related knowledge and outputs.

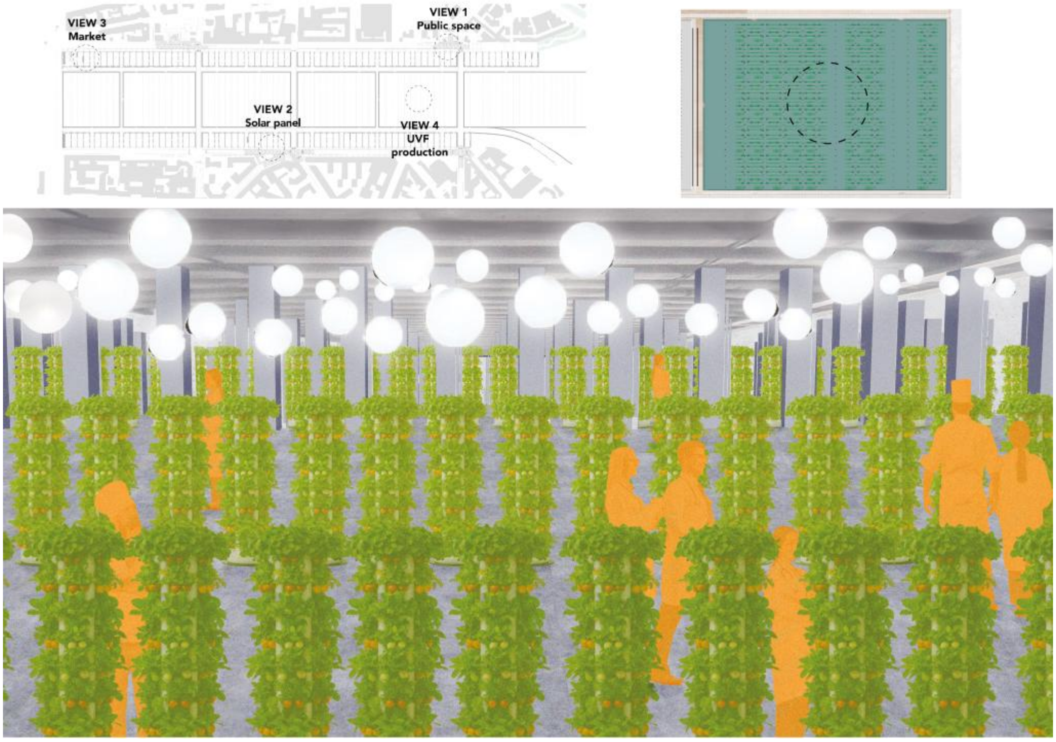


Figure 6. *Concept view of UVF production space.*

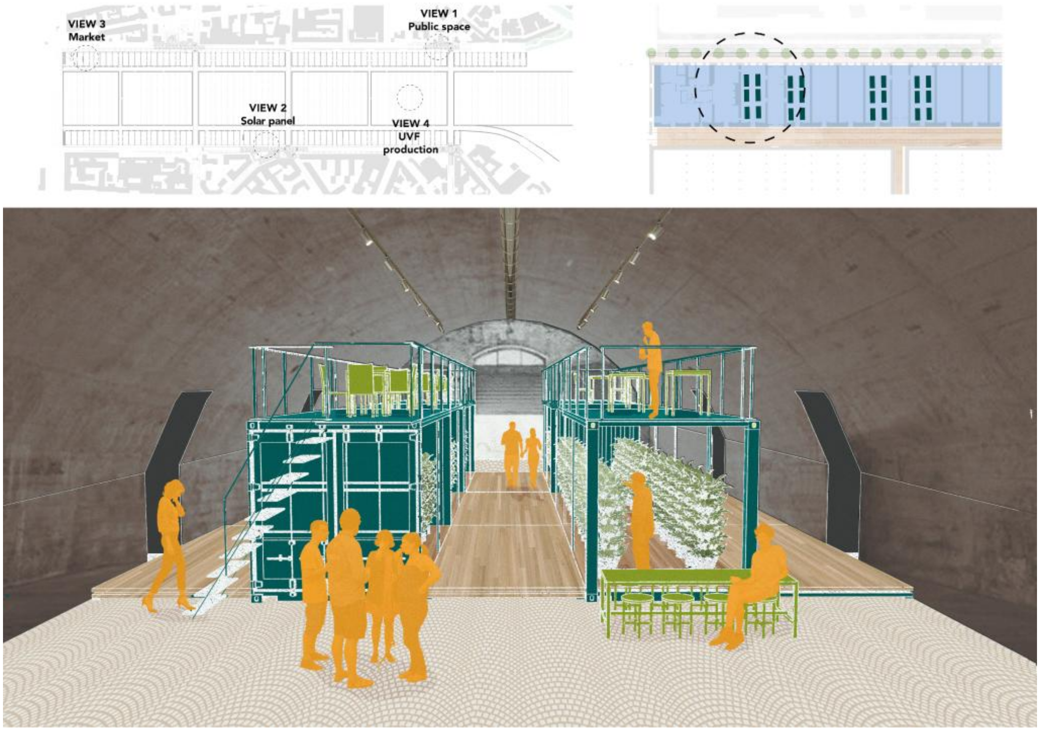


Figure 7. *View of UVF integrated eating space at urban market.*

Phase 3 , Integration, Expansion, and Urban Reconnection (Years 5–10)

The final phase emphasizes urban integration, programmatic expansion, and long-term system resilience. Interventions include:

- activation of all Magazzini: the remaining space in Magazzini, including the east side of the railway, will be revitalized with the establishment of educational facilities and workshop spaces to promote the expansion of knowledge and collaboration in the food innovation ecosystem;
- green corridor consolidation: the ecological network is expanded to neighbouring green spaces like BAM (Biblioteca degli Alberi Milano) and Parco Trotter, creating a continuous urban green system and walkable street network;
- community integration: ties between stakeholders on the west and east sides of the railroad will be strengthened through improved physical connections, shared community space, and promotion of shared know-how.

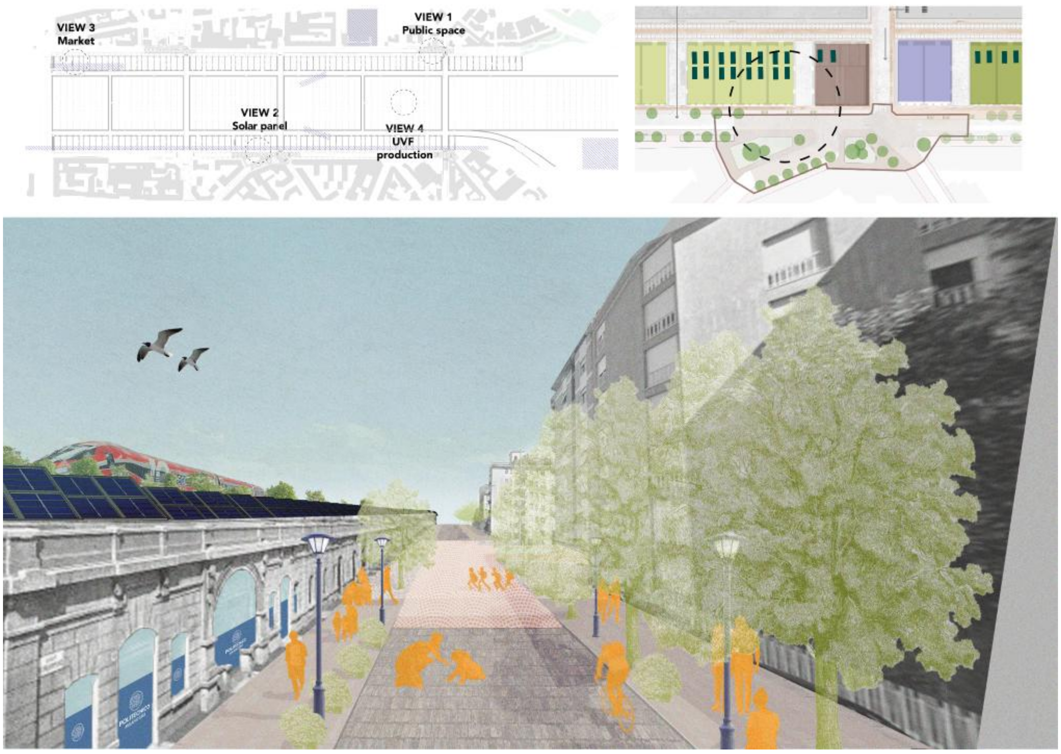


Figure 8. *Concept view during final phase.*

This phase realizes the FARMER project's full territorial transformation: a hybridized urban landscape that repositions Milano Centrale as a catalyst for sustainable food systems, renewable energy transition, and community inclusion.

The FARMER project has developed a comprehensive framework for rethinking urban regeneration in Milan through the integration of urban sustainable agricultural practices. By combining territorial, social, and economic analyses, the project demonstrated the potential of transforming underutilized spaces, such as the Magazzini Raccordati at Milano Centrale, into productive and inclusive hubs. Tools such as SWOT, stakeholder analysis, ES evaluation, and CIE helped identify the most promising scenarios, highlight risks, and design strategies that not only balance environmental sustainability, social inclusion, and economic viability, but that are also aligned with the diverse stakeholder interests. The stakeholder analysis has shown that the FARMER project is embedded in a highly articulated network of actors whose expectations and capacities shape the project's trajectory. The Power–Interest Matrix clarified their differentiated roles and influence, revealing synergies between public institutions and technology providers, but also potential tensions linked to uneven economic returns and the vulnerability of certain groups. The evaluation of impacts highlighted the project's potential strong social impact and its capacity to enhance food security, generate employment opportunities, and promote environmental sustainability. Particularly relevant are the contributions to social inclusion and participation, as well as the activation of new forms of community engagement that can strengthen local cohesion.

The analysis confirms its potential to reinforce economic resilience and environmental impact reduction, while also emphasising the importance of participatory governance mechanisms to sustain long-term effectiveness. Beyond its immediate impacts, the FARMER project has the potential to act as a scalable model for urban regeneration, capable of inspiring similar initiatives in other metropolitan contexts. Its integration of vertical farming technologies with participatory governance and community engagement makes it not only a tool for sustainable food production, but also a catalyst for new forms of urban innovation, where technological solutions are intertwined with cultural, environmental, and social dimensions. For Milan, this represents an opportunity to consolidate its leadership in sustainable food policies and urban resilience, reinforcing the legacy of the Milan Urban Food Policy Pact and positioning the city as a global reference point for equitable, climate conscious urban development.

Welfare Warehouses

As already noted above, the main objective of the FARMER project was not to devise a comprehensive urban and territorial regeneration scheme, but rather to establish the strategic framework for the development of a resilient urban ecosystem, the effectiveness of which relies on the ability of productive structures to integrate and support a new network linking the social, institutional and commercial entities already present in the Milan Central area.
As revealed by the stakeholder analysis carried out during the preliminary phase and, above all, during meetings with the Sammartini Centre and the Welcome Centre, the Magazzini Raccordati area has historically suffered from a 'divide' between the imposing railway infrastructure and the surrounding community. The new network of partnerships centred on food production, serving as a pretext for strengthening local cohesion, becomes the project's central strategy. The success of the project and the regeneration of the area is therefore directly proportional to the strength of this new network linking the third sector, public administration and educational institutions.
Although the masterplan and the FARMER strategy envisage the implementation of multiple functions, the architectural development phase focuses on the refurbishment of two of the warehouses, which are intended to be shared by associations and used for public welfare purposes. These spaces, in fact, have far less defined characteristics and therefore present greater challenges in terms of spatial and administrative organisation. At the same time, it is precisely by testing its ability to meet the needs of the widest possible range of stakeholders, the most vulnerable groups and the associations active in the area that its transformative potential can be effectively gauged. The other elements of the masterplan would risk becoming isolated initiatives or, at worst, drivers of gentrification without the implementation of welfare warehouses acting as a social 'guardian' for the entire project, ensuring that agricultural technology remains rooted in the neighbourhood's real needs.
For these reasons, the following chapter examines in detail the conversion of two specific spans, viewed not merely as building envelopes to be repurposed, but as connecting elements. The redevelopment of the two spaces has been focused on satisfying the need of the close Welcome Center and Centro Sammartini for a space dedicated to community development, that following their suggestions should not be narrowly focused on horticulture. Instead, it should push for the realization of an environments that support intergenerational interaction, environmental education, and social integration; other than being able to host thematic community events, discussions, and neighbourhood-based initiatives

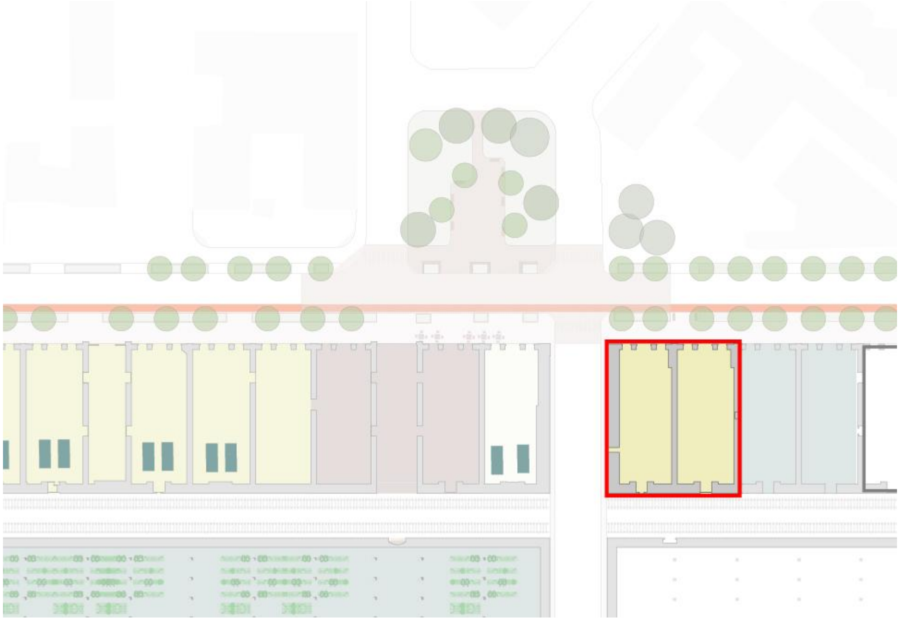


Figure 9. *Chosen spaces for the development of the design*

The Role of Shared Spaces in Public-Private Partnerships

The importance and central role of spaces that encourage collaboration and co-creation in supporting a diverse urban environment is a direct result of the emergence of an urban design philosophy that, for years now, has shifted the emphasis from mere physical regeneration to the creation of integrated social and environmental value.

In this regard, Eric Klinenberg argues that social capital, understood as a network of relationships and mutual trust, cannot exist in a vacuum; it requires physical spaces that foster chance encounters and mutual support (Klinenberg, Palaces for the People: How Social Infrastructure Can Help Fight Inequality, Polarization, and the Decline of Civic Life , 2018). Considering this implies recognising that the material dimension of space is not merely a neutral backdrop to social practices, but an active and determining condition in their construction, since it is precisely through the presence, accessibility and quality of certain places that the emergence of forms of relationship, cooperation and belonging is made possible or not. From this perspective, social infrastructure cannot be reduced to a functional category comparable to traditional urban facilities, but must be understood as a complex set of spatial, cultural and relational mechanisms that contribute to the formation of social capital and its reproduction over time, constituting a structural element of urban resilience. This situation is particularly evident when examining contexts in which, despite similar socio-economic characteristics, there are starkly different outcomes in terms of the ability to respond to critical events, as demonstrated by Klinenberg's analysis of the 1995 Chicago heatwave, (Klinenberg, Heat Wave: A Social Autopsy of Disaster in Chicago, 2002), in which seemingly similar neighbourhoods recorded divergent mortality rates depending on the density of social relationships and the presence of spaces capable of fostering them, highlighting how vulnerability is not exclusively an individual or economic condition, but also and above all an emergent property of the spatial and relational configuration of the urban context. This interpretation leads to a redefinition of the role of architecture and urban planning, which can no longer be confined to addressing the form or functional layout of spaces, but must instead aim to create the conditions in which community life can flourish in an inclusive and sustainable manner, by exploring the ways in which space can facilitate encounter, lingering, exchange and mutual recognition.

The central role of the network of everyday relationships as the driving force behind a vibrant and healthy city was also supported by Jane Jacobs's entire body of work, which stood in opposition to the deterministic and oversimplified conception of urban planning.

Urban diversity, as expressed through density, scale, stratification, and the coexistence of functions, is an essential prerequisite for designing functional, stimulating, and dynamic environments where this coexistence serves as a catalyst for a continuous flow of activity that Jacob describes as "sidewalk ballet." (Jacobs, 1961). Far from being a purely descriptive phenomenon, this dynamic takes on an intrinsically operational significance, since it is precisely through the repetition of ordinary gestures and the overlapping of different temporalities that forms of widespread social control and perceived security are constructed - concepts encapsulated in the idea of "eyes on the street," through which the constant presence of people in public spaces becomes a guarantee of mutual attention and shared care. (Jacobs, 1961) The quality of urban space cannot be understood solely in aesthetic or functional terms, but can and must be measured in terms of its capacity to accommodate the complexity of human interactions, recognizing that even seemingly marginal elements can play a decisive role in promoting economic accessibility and the diversity of local activities, allowing individuals with limited resources to find a place within the urban fabric and thus contributing to the creation of an inclusive social ecosystem.

While Jacobs's analysis helps us understand the macro-level conditions of urban vitality, the work of Jan Gehl and William H. Whyte allows us to explore the relationship between space and human behavior on a scale closer to everyday experience, highlighting how the quality of the built environment directly influences the nature and intensity of the activities that take place there. Gehl's distinction between necessary, optional, and social activities introduces a hierarchy that highlights the decisive role of spatial conditions in fostering or inhibiting lingering and interaction; for while necessary activities take place regardless of the quality of the environment, optional activities, and, consequently, social activities, depend strictly on the perception of comfort, safety, and attractiveness of the space (Gehl, 1987). It follows that architectural and urban design cannot be limited to ensuring the minimum functionality of spaces, but must aim to create the conditions that encourage people to linger, observe, and participate, transforming places of passage into places of connection. Similarly, the concept of triangulation introduced by Whyte highlights how the presence of catalytic elements, such as commercial activities, installations, or urban features, can trigger interactions among strangers, generating micro-situations of social interaction that, as they accumulate over time, contribute to the construction of a collective dimension of public space. (Whyte, 1980) This interpretation further underscores that design should not be understood as a rigid definition of uses and functions, but rather as the

creation of conditions conducive to the emergence of behaviors that are not entirely predictable, thereby acknowledging the open and indeterminate nature of urban life.
This dimension is complemented by Richard Sennett's reflection, which introduces an ethical and relational perspective based on the idea of cooperation as a skill to be cultivated through daily practices and spaces designed to support them (Sennett & Richard, Together: The Rituals, Pleasures and Politics of Cooperation, 2012). The distinction between dialectical and dialogical conversations allows us to understand how the quality of interactions does not depend solely on their frequency, but also on their structure and the conditions that make them possible; for while dialectical logic tends toward resolution and synthesis, dialogical logic values openness, listening, and the persistence of difference. In this sense, architectural space plays a fundamental role in fostering or hindering certain modes of interaction, functioning as a mechanism capable of guiding behaviors without determining them in a univocal manner. The model of the open city proposed by Sennett (Sennett & Richard, Building and Dwelling: Ethics for the City, 2018) thus stands in contrast to modernist closed systems, in which every element is rigidly defined and every deviation is perceived as an error, proposing instead a vision of the city as a porous organism, capable of accommodating unforeseen uses and progressive adaptations, and of constructing - through these processes - a form of order that is not prescriptive but emergent. From this perspective, porosity represents not only a physical quality of space but also a relational condition that allows for passage, encounter, and transformation, distinguishing the "edge" - understood as an active and permeable margin - from the "boundary," conceived as a rigid and separating limit. (Sendra & Sennett, 2020).
At the same time, the concept of urban commons introduces a managerial and political dimension that complements the theoretical framework outlined above, highlighting how the sustainability of social practices depends not only on spatial configuration but also on the ways in which spaces are governed and shared. Elinor Ostrom's studies demonstrate, in fact, that it is possible to develop systems of collective management based on shared rules, mutual monitoring, and active user participation, thereby overcoming the dichotomy between state control and privatization and opening the door to hybrid forms of governance in which the community plays a central role. Applying these principles to the urban context allows us to interpret spaces not as resources to be consumed, but as commons to be cared for and sustained through collaborative practices that strengthen social capital and contribute to community resilience. (Foster & Iaione, 2017). In line with this vision, the concept of "threshold spaces" developed by Stavros Stavrides highlights how certain places can function as mediating devices between different conditions, fostering processes of inclusion and the construction of the commons through interaction and sharing. The threshold, as an intermediate space, does not fully belong to any of the domains it connects, but precisely for this reason it becomes the ideal place for the emergence of "commoning" practices - understood as collective actions through which the common good is continually produced and redefined. (Stavrides, 2010).
In light of these reflections, it becomes clear that an architectural project cannot be conceived as an isolated or self-referential act, but must be embedded within a complex network of social, economic, and cultural relationships, with the goal of not only resolving functional

problems but also creating conditions conducive to the development of more inclusive, resilient, and adaptive forms of collective life. It is in this sense that the restoration and transformation of existing structures - characterized by a strong identity and a strategic location within the urban fabric - can be reinterpreted not merely as reuse projects, but as opportunities to trigger broader processes of social and cultural regeneration. From this perspective, the case of the Magazzini Raccordati in Milan stands out as a particularly significant context, where the possibility of integrating social infrastructure, cooperative practices, and models of shared management allows for the spatial translation of the theoretical principles outlined above, proposing a vision of architecture capable of influencing not only the built environment but also the very conditions of urban coexistence.

The Case of "Rhapsody in West" in the Kolenkitbuurt

These same principles have inspired an urban and architectural initiative that has been very well received by the residents of a suburban neighborhood in Amsterdam, the Netherlands. Amsterdam is a city that, while maintaining a close connection to its free-spirited and innovative identity, cannot ignore the logic of land speculation and the resulting threat of disappearance for local communities that are not yet as strong or established. The project under Consideratedon is part of the larger “Rhapsody in West” development located on *Jan van Schaffelaarplantsoen* in Amsterdam’s Kolenkitbuurt, historically one of the city’s most disadvantaged neighborhoods. (Dorbolò, 2020). The area had originally been entrusted in 2008 to Cascoland - a collective of artists and urban creators - for planning and management, and the results of their activities and ongoing engagement had brought about clear improvements in the area’s livability and safety. As the housing crisis worsened and real estate developers showed renewed interest, this and other plots of land became a new focus of economic interest.

In 2015, the green space was a single public garden, which was later designated for development. The 2017 competition for the area’s development was won by Tangram Architekten with Urban Sync; construction began in 2017 and was completed in 2019. The main stakeholders include: the City of Amsterdam (urban planning, public redevelopment funds), the housing cooperatives Eigen Haard and Stadgenoot (public housing), the Tangram architectural firm, the developer De Nijs/SSB, and the international investor CBRE Global Investors (master developer and ultimate owner).

However, the community - which had become well-established over the previous six years - had anticipated the risk of not being consulted or taken into account during the process, even though it had managed the entire area independently with Cascoland’s support. The architects therefore proposed including Cascoland in the design of the outdoor spaces throughout all phases of the project. The result was a modestly sized inner courtyard with a community space, accessible to the entire neighborhood - not just the residents of the surrounding buildings - called *KolenkitKas*.

This small space is the result of a dialogue and a sustained effort lasting about three years, through which Cascoland succeeded in securing a public space within an entirely private facility.

Although the community greenhouse faced some initial opposition, it was inaugurated in 2019 on the very spot where the neighborhood garden once stood and has become a central part of neighborhood life.
KolenkitKas serves as a hub for a variety of community organizations and collective activities. Its main activities include: international cooking groups (KolenkitKoks from Mama's Kolenkit, which offer training to immigrant chefs); vegetable gardens and the cultivation of produce used in communal meals; sewing workshops; music nights; film screenings; and workshops on sustainability and food entrepreneurship. Local residents can rent the greenhouse at "social" rates (from 0 to €100 per day), subject to shared rules (doors must always be open to others, and the space must be cleaned after each event, as stated on their website) (KolenkitKas, s.d.).
On the dedicated website, you can find photos and documents that highlight its multifunctionality and accessibility - qualities that have made this project a place for people from diverse and varied social groups to meet and collaborate. The greenhouse was funded by the development consortium (as part of the urbanization fees) and is operated with housing subsidies (community managers receive rent discounts); structurally, it is privately owned by the condominium but is open to the public. (Silva, 2020).
The case of Rhapsody is emblematic of several of the theoretical frameworks mentioned above, precisely because of the role of a collaborative and co-managed space that develops within the communal greenhouse.
The Dutch experience highlights key insights regarding the need to strengthen the existing social network by validating it; the importance of adaptable spaces - not as alternatives to more rigid structures, but as complements to an established and permanent framework; and the choice of an open, accessible, and visible location as the hub of neighborhood activities.

Spatial functions

In light of the theoretical Consideratedons outlined above, it is interpreted as an infrastructure capable of facilitating practices of relationship-building, cooperation, and appropriation. In this sense, the Magazzini Raccordati project fits within a perspective that recognizes the active role of the material dimension in the construction of social capital.

Adopting this approach involves seeking to organize an open system capable of accommodating gradual transformations and diverse interpretations. As Richard Sennett has pointed out, open systems are characterized by a degree of incompleteness that allows users to intervene and reinterpret the space, transforming it to suit their own needs (Sennett & Richard, Building and Dwelling: Ethics for the City, 2018). In this regard, Jan Gehl emphasizes that the quality of urban space is measured by its ability to foster optional and social activities, which depend directly on the comfort, accessibility, and attractiveness offered by the built environment (Gehl, 1987).

The Magazzini Raccordati offer a particularly favorable spatial condition: their longitudinal configuration, combined with the width of the span and the continuity of the interior surfaces, allows one to conceive of the space not as a sequence of closed, separate rooms, but as a continuous field within which different activities - even simultaneous ones - can coexist.

Based on these Consideratedons, the project is not structured according to a traditional functional division, but rather through the definition of a spatial system organized by degrees of permanence, accessibility, and adaptability. This approach makes it possible to overcome the dichotomy between public and private space, moving instead toward a logic of the common good, in which spaces are shared and managed collectively in varying ways.

The design aim was therefore to create a layout that would provide distinct spatial conditions capable of supporting both daily, ongoing activities and temporary, transformative uses.

The project is therefore divided into three main spatial areas, which are not clearly separated but are organized according to a gradual and interconnected logic.

One key component consists of permanent spaces that are accessible year-round, intended for both individual use and the ongoing activities of organizations. These spaces play a fundamental role in establishing a constant presence, helping to create the continuity of use that, according to Jacobs, is the foundation of the safety and vitality of urban spaces.

Alongside this is a semi-permanent component, characterized by greater flexibility, which can be used for meetings, group activities, or temporary exhibitions. This space serves as a bridge between permanent and occasional use, functioning as a true active threshold capable of facilitating encounters between different users and accommodating transformations over time.

Finally, a third component consists of a highly adaptable space, organized using modular systems and movable furniture, designed to host workshops, educational activities, and shared study areas.

Through this structure, the project aims to strike a balance between stability and transformation, ensuring both the continuity of activities and the possibility of adaptation and reinterpretation.

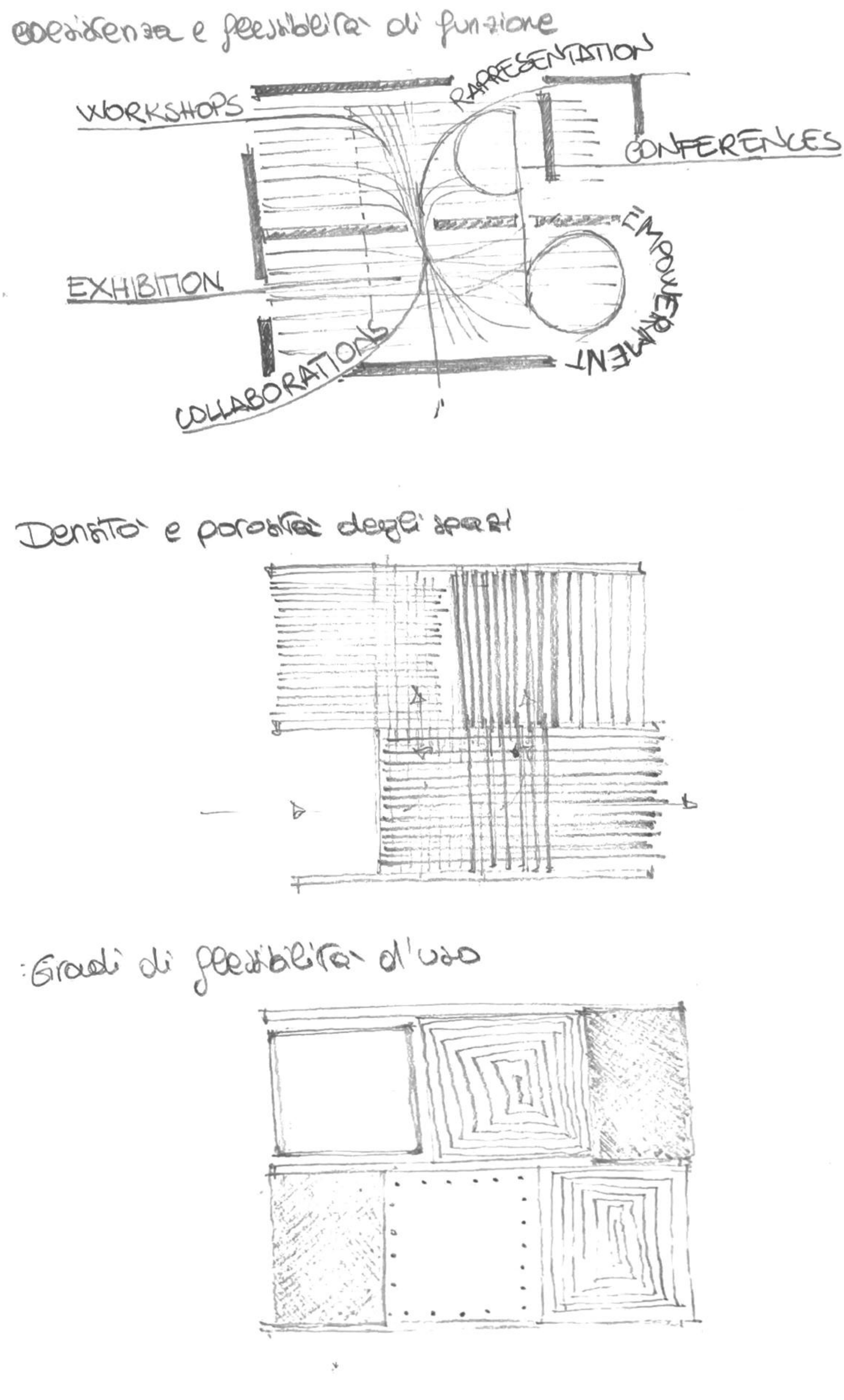


Figure 10. *Conceptual sketches*

Floor plan

The layout of the interior spaces of the two warehouses echoes the typical longitudinal nature of these spaces, alternating between different degrees of exposure, intimacy, and visibility, with a focus on creating porous thresholds that enhance the potential for and development of an internal social infrastructure. The entrance is located in the right-hand warehouse, adjacent to the reception area and the indoor parking area for electric bicycles. This space serves as the first point of transition between the urban environment and the interior, functioning as a place of transition and preparation for the collective experience by incorporating permanent functions for regulating and supervising internal activities and the flow of users. Lockers and storage cabinets are therefore provided, which can be used independently or managed directly by the associations, depending on the needs of the activities. This introduces an initial form of individual appropriation of the space, allowing users to establish a temporary yet concrete relationship with the place. The ability to manage and use these control spaces is intended to foster a sense of permanence and belonging, thereby reinforcing the everyday dimension of the infrastructure.

The semi-transparent partition that encloses the reception area and leads into the lounge area is conceived as a semi-transparent element consisting of a system of steel mesh and plants that echoes the geometry of the facade while allowing light to filter inward. This element is intended to serve as a physical interpretation of a porous membrane that modulates visual and light perception without interrupting the spatial continuity of the warehouses. The entire transitional space culminating in this element can be conceived as a band of depth where users perform ritual and preparatory gestures before accessing the rest of the spaces. The lounge area, accessed by passing through the green wall, is where the collective and participatory dimension is most evident, giving users complete freedom to use the space as they wish. The spaciousness, flexibility, and central location of this area make it ideal for simultaneously accommodating a lounge with tables and armchairs where people can relax between activities, gather in small groups, or spend time alone. At the same time, the space could host art installations, temporary exhibitions, or spontaneous community events, enabling the diversity of uses and people that Jane Jacobs identifies as a fundamental condition for urban vitality.

Figure 11. *Exemple for function disposition*

Moving through the warehouse, the gradual decrease in natural light is treated as a design opportunity rather than a limitation, giving rise to a qualitative differentiation among the spaces. At the far end of the right-hand warehouse, characterized by a more introspective atmosphere, a circular structure defined by curtains has been introduced, designed to facilitate moments of discussion, dialogue, and support among small groups of users. This space directly addresses the needs that emerged from discussions with local associations, offering a protected yet not isolated environment where relationships based on trust and mutual recognition can be built.
The choice of a circular shape and fabric reflects the desire to create an inclusive, non-hierarchical space, where the arrangement of users encourages dialogue rather than a front-to-back format. Furthermore, the fabric used to define the space makes it possible to integrate this area into a larger system, allowing it to be converted into an exhibition space when no specific activities require its use.
In the spatial layout of the second warehouse as well, special emphasis is placed on natural lighting conditions, with activities requiring greater concentration and extended periods of time - such as workshops and the library - located in the area immediately adjacent to the large windows.
Conversely, functions that require greater control over environmental conditions - such as screenings and conferences - are located in the central area of the longitudinal structure, taking advantage of a central position that allows for accessibility from both sides and greater independence from natural light. This layout helps reinforce the concept of coexistence among different activities, allowing for the simultaneous use of spaces without mutual interference.
Service areas such as restrooms, storage, and utility spaces, on the other hand, are located in the less well-lit areas, in accordance with a principle of optimization that frees up the most desirable areas for communal use. In this context, elements of structural inclusion have been carefully incorporated through a spatial layout that features a single entrance, integrated changing tables, and a configuration that facilitates accessibility.
The warehouse thus plays its own role in launching the new network of associations and organizations active in central Milan by providing a space for the shared management of materials and equipment. In this sense, it becomes an integral part of the system of commoning, helping to enable the collective use of the space and to sustain the practices that bring it to life over time.
The spatial organization of the project becomes a tool for redefining social practices and promoting a new, structured, accessible, and shareable system that addresses the needs of local communities in terms of representation and social complexity.

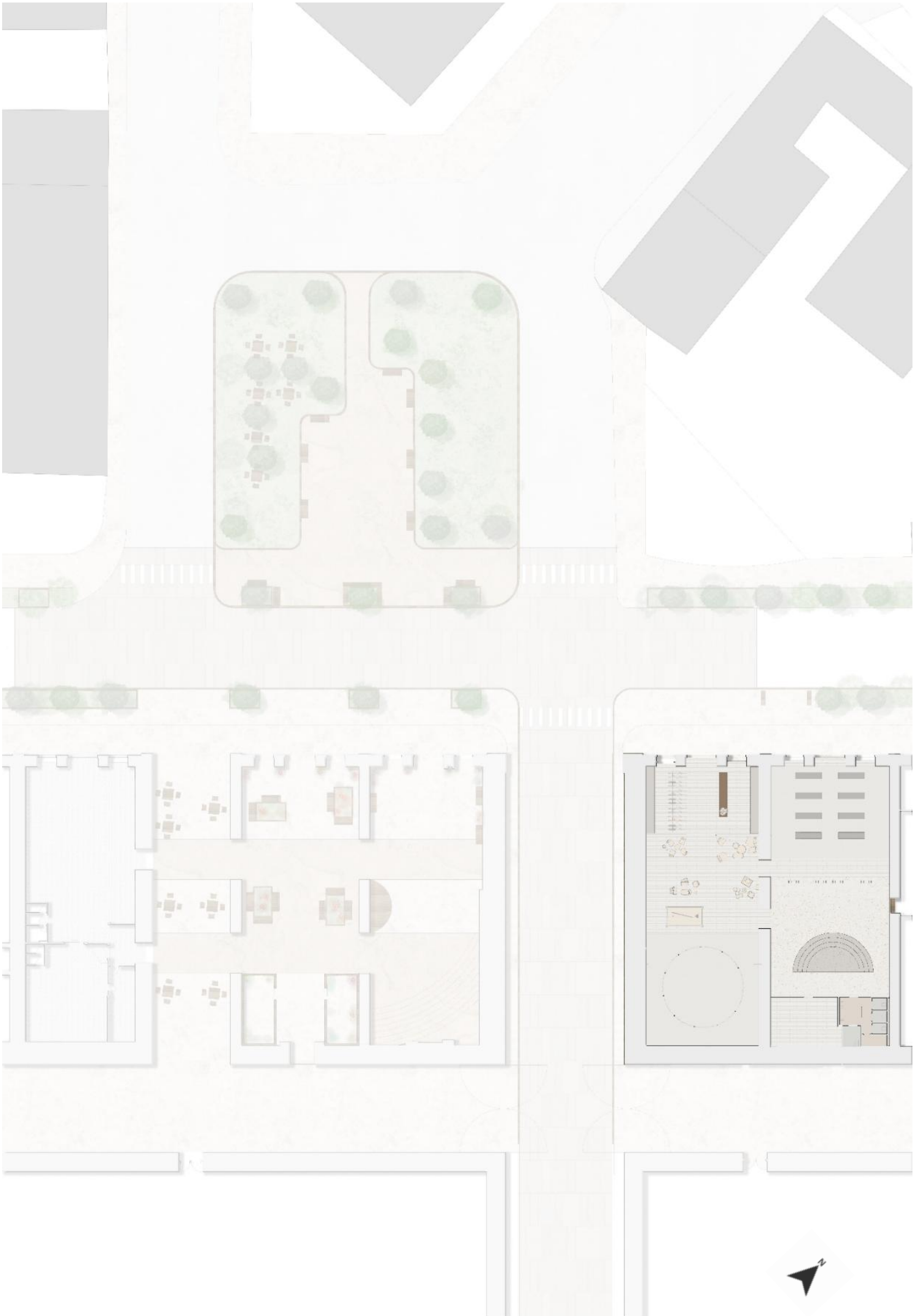
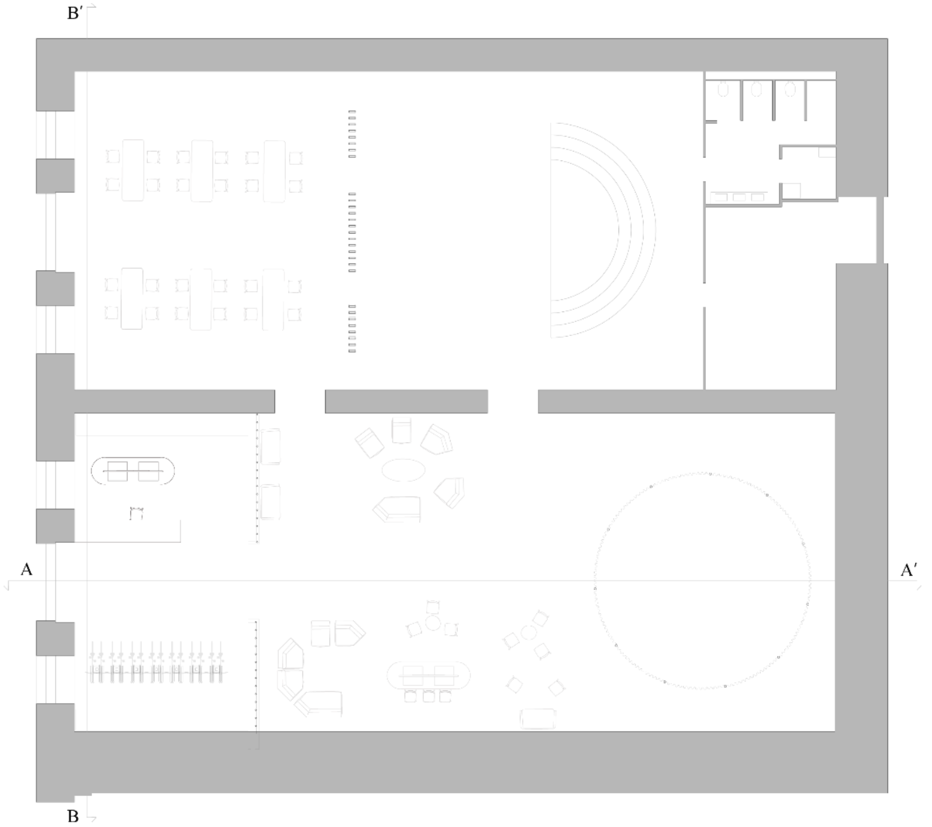
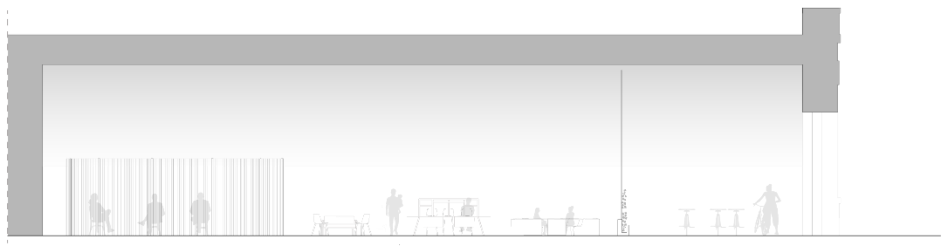


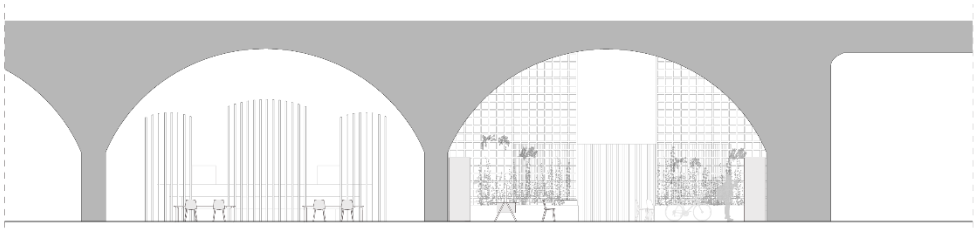
Figure 12. *Integration of the design in the masterplan*



Floor Plan



Section A-A′



Section B-B′

Figure 13. *Project representation_schematic design*

Stratigraphy

The design of the stratigraphies was primarily guided by a vision focused on construction reversibility and maximizing technical accessibility.

Each component has been integrated into a dry-type system to ensure that the utility compartments and the internal layers of the structure can be inspected immediately and that components can be easily replaced. This design choice is also intended to facilitate assembly and disassembly operations in line with the Design for Disassembly (DfD) approach, thereby minimizing the impact of maintenance work.

Materials such as cork, hemp fiber, and birch plywood were selected because they are highly recyclable biomaterials that are readily available in industries in Lombardy or northern Italy. In particular, cork was identified as the best option due to its breathability and good thermal and acoustic performance. These choices were validated through thermophysical analysis of the cross-sections using Opaque 3 software, which made it possible to test the behavior of the insulation packages and verify that the thermal resistance values complied with regulatory requirements for climate zone E, which includes the city of Milan.

FACADE

Internal lining for historic façade on Sammartini Street..

U=0,21 W/mK

Layer (Outside to Inside)	**Material**	**Thickness [m]**
Existing Wall	Brick	0.5
Structural Core	Studs (wood)	0.10
Structural Core	OSB	0.05
Thermal Insulation	Insulation Board	0.15
Vapor Control	Hygro-variable Membrane	0.001
Secondary Structure	Studs (wood)	0.10
Interior Finish	Birch Panel	0.010

EXTERIOR WALL

Internal lining for massive historic walls bordering the tunnel.

U=0,217 W/mK

Layer (Outside to Inside)	Material	Thickness [m]
Existing Wall	Massive Historical Masonry	2.300
Thermal Insulation	Expanded Blond Cork	0.100
Vapor Control	Hygro-variable Membrane	0.001
Structural Core	Timber Stud Frame with Service Void	0.050
Interior Finish	Birch Plywood	0.012

ROOF

Vaulted Ceiling

U=0,23 W/mK

Layer (Outside to Inside)	Material	Thickness [m]
Existing Structure	Railway Vault & Infill	1.500
Thermal Insulation	Expanded Blond Cork	0.100
Vapor Control	Hygro-variable Membrane	0.001
Structural Core	Timber Ribs with Service Void	0.100
Architectural Finish	Flexible Birch Plywood	0.003

To ensure the reliability of the vault cladding system, a quantitative analysis of the self-weights was conducted.

The calculation process began with the definition of the radius of curvature R = 6.64 m, derived from the ratio of the chord length of 12.00 m to the rise of 3.80 m, which made it possible to determine a linear development of the arch equal to approximately 14.99 m. It was then possible to estimate the volume of the components by considering the installation of 52 ribs spaced 0.60 m apart along the 30.80 m depth of the vault, each with a cross-section of 5 cm × 10 cm.

The total volume of the wooden substructure was estimated at 6.36 m3, including the primary studs and connecting cross-members required for the double-frame configuration. Assuming a density of 700 kg/m3 for the birch plywood, the weight comes to 4,452 kg. To this value must be added the significant contribution of the 100-mm-thick layer of blond cork insulation, amounting to 5,544 kg (calculated over an area of 462 m² with a density of 120 kg/m³), and the weight of the 3-mm-thick flexible finishing panels (approximately 970 kg). The overall analysis therefore results in a total load of approximately 10,966 kg, which, distributed over the entire vaulted surface, generates a stress of approximately 23.7 kg/m².

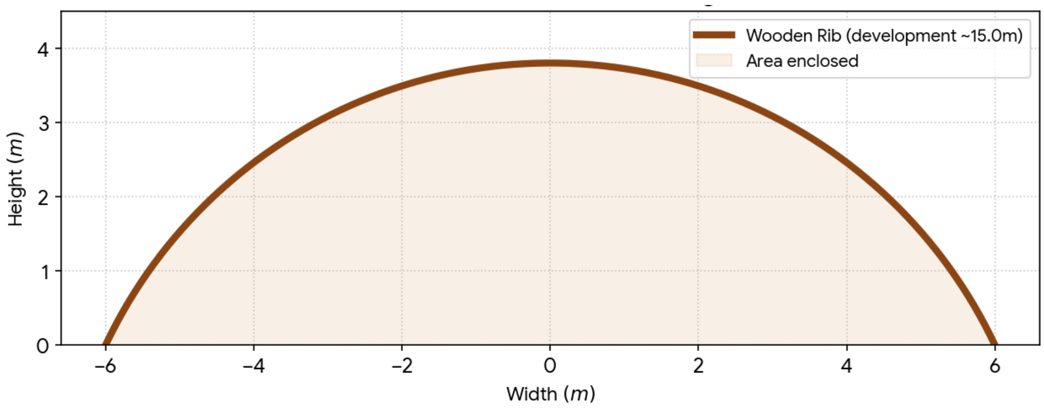


Figure 14. *Vaulted Ceiling geometry*

INTERIOR WALL

Layer (Inside to Outside)	**Material**	**Thickness [m]**
Architectural Finish	Micro-perforated Birch Plywood	0.012
Sound Blocking	High-density Gypsum-fiber board	0.015
Service Void	Technical air space	0.060
Acoustic Insulation	Natural Hemp Fiber board	0.040
Existing Wall	Massive Historical Masonry	0.860

BATHROOMS PARTITIONS

Wet Area Wall System (Public Toilets)

Washable section (0-180 cm) according to Hygiene Regulations.

Layer (Outside to Inside)	**Material**	**Thickness [m]**
Existing Wall	Historic solid masonry	2.300
Thermal Insulation	Timber stud frame with Expanded Blond Cork	0.100
Vapor Control	Hygro-variable Membrane	0.001
Technical Support	Calcium Silicate Board	0.015
Washable Finish	Large format Stoneware / Cement-resin	0.005

Internal Partition System (Toilet Dividers)

Dry-wall system between restrooms (Symmetrical).

Layer (Inside to Outside)	**Material**	**Thickness [m]**
Exterior Finish	Bio-HPL	0.006
Structural Support	Calcium Silicate Board	0.015

Insulating Core	Timber stud frame with Hemp Fiber insulation	0.060
Structural Support	Calcium Silicate Board	0.015
Exterior Finish	Bio-HPL	0.006

FLOOR

U=0,29 W/mK

Integrated with radiant heating and Radon protection.

Layer (Inside to Outside)	**Material**	**Thickness [m]**
Flooring Finish	Linoleum/Gres/Birch	0.003
Load Distribution	Gypsum-fiber board	0.020
Radiant System	Dry Radiant Panel	0.040
Vapor Retarder	Hygro-variable Membrane	0.001
Thermal Insulation	Expanded Blond Cork (	0.100
Gas Protection	Anti-Radon Membrane	0.001
Existing Base	Concrete slab on ground	/

Bill of Quantities

The estimation of the quantities of materials needed for the renovation was based on an Excel spreadsheet that listed, for each layer, the thickness of the material and the surface area to which it is to be applied. For the bathroom fixtures, an estimate of the average weight of the various components was made, since the current stage of the project does not yet involve selecting the final fixtures.

Element	Material	Thickness (m)	Area (m²)	Volume (m³)
Vault	Flexible Birch	0.003	903	2.709
	Clima Control 80 Membrane	0.0001	903	0.0903
	Blond Cork	0.1	903	90.3
	Historic Masonry/Aggregates	1.5	903	1354.5
2.30m Wall	Birch (PureGlue)	0.012	77.6	0.9312
	Clima Control 80 Membrane	0.001	77.6	0.0776
	Blond Cork	0.08	77.6	6.208
	Historic Masonry	2.3	77.6	178.48
Wet Area	Porcelain Stoneware / Bio-HPL	0.006	33.3	0.1998
	Calcium Silicate	0.015	33.3	0.4995
	Clima Control 80 Membrane	0.0001	33.3	0.00333
	Blond Cork	0.05	33.3	1.665
	Historic Masonry	2.3	33.3	76.59
Partition	Porcelain Stoneware / Bio-HPL	0.012	99.5	1.194
	Calcium Silicate (2 sides)	0.03	99.5	2.985
	Natural Hemp Fiber	0.06	99.5	5.97
Central Wall	Micro-perforated Birch	0.012	136	1.632
	Gypsum Fiberboard	0.015	136	2.04
	Natural Hemp Fiber	0.04	136	5.44
	Historic Masonry	0.86	136	116.96
Floor	Birch	0.004	660	2.64
	Linoleum	0.004	67	0.268
	Gypsum Fiberboard	0.03	727	21.81
	Radiant Panel	0.003	727	2.181
	Clima Control 80 Membrane	0.0001	727	0.0727
	Blond Cork	0.1	727	72.7
	Radon Floor Membrane	0.0003	727	0.2181
	Existing Screed	0.003	727	2.181
Facade	Birch Wood	0.003	84	0.252

	Blond Cork	0.15	84	12.6
	Clima Control 80 Membrane	0.0001	84	0.0084
	OSB Panel	0.08	84	6.72
	Solid Bricks	0.003	84	0.252
	Natural Stone	0.003	84	0.252

Components	**Material**	**Thickness/Length (m)**	**Area/Section (m²)**	**Volume (m³)**	**N**
Facade	Glass	0.012	45.72	0.54864	3 x 4 mm
	Wooden frame	74.1	0.008	0.5928	
	Welded wire fabric	42			
Bathroom	wc				4
	sinks				4
	Doors				7

Table 4. *Bill of quantities*

Life Cycle Assessment

Tool used for the calculation	OneClick LCA - Level(s) life-cycle carbon (+A1/+A2)
Time Horizon	50 years.
Fasi	Production and Logistics (A1–A4) replacement (B4-B5) End-of-life care (C1-C4)
Energy Mix	National Energy Mix

Table 5. *LCA parameters*

The LCA inventory was developed in four main phases: the quantitative extraction of materials from a 3D model; the organization of data using Excel files containing bills of quantities; the categorization by material layers; and the linking of components to the environmental databases available within the software.
The results were obtained using OneClick LCA, which made it possible to map the environmental profile according to the "level(s)" criteria and, overall, revealed a rather positive short-term balance (embodied carbon), while placing particular emphasis on long-term management (operational phase).

The value resulting from the design and material choices for the partitions - that is, the embodied carbon - is the main finding of the analysis, and stands at around 100 kg CO_2e/m^2 for phases A1–A4, B4–B5, and C1–C4. This result places the project in the top tier of the reference benchmarks (*Carbon Heroes Benchmark*), demonstrating the effectiveness of the dry-assembly strategy using biomaterials produced by local companies.
The preliminary analysis yielded a total value of 209 $kgCO_2e/m^2$. Reviewing the results via the dedicated interface made it possible to identify the components with the greatest impact on the calculation. In particular, it was observed that a significant portion of the value stemmed from the technical systems and, specifically, from the use of generic average datasets associated with the components available in the software's database. The decision to use datasets containing generic average values was a direct consequence of the system's current stage of development, which does not yet allow for the identification of definitive system components and, therefore, specific technical data sheets, manufacturers, or dedicated EPDs.
The summary of the emissions breakdown showed how this single decision had affected the final result, accounting for more than 40% of total emissions.
This finding has highlighted one of the main limitations of preliminary LCA assessments. In fact, average emission values are often higher than those achievable through the deliberate selection of certified, high-performance products.
It was therefore decided to revisit these choices by using the indicative components suggested by the software to better visualize the potential impact of these choices.

This last procedure yielded a final result of 113 $kgCO_2e/m^2$ of embodied CO_2 equivalent, which is significantly more optimistic than the initial figure.

A distinctive aspect emerges from the analysis of biogenic carbon. The report highlights a sequestration value of approximately -6.83E+04 kg CO_2 associated with naturally occurring materials (birch wood, hemp fiber, and cork). However, this initial "carbon credit" must be interpreted with caution, as it depends largely on the actual end-of-life fate of the material. It is important to note that, even when low-impact choices are made for building systems, the most complex phase of the life cycle is the use phase, given the central role of energy consumption in the final result of the analysis: 88.12% of total life-cycle emissions (50 years) are attributable to phase B6 (Energy Use), for a total of approximately 7.32E+05 kg CO_2e. Although the project incorporates high-efficiency systems and photovoltaics, the steady-state LCA calculation - which was based on a national energy mix - highlights how relying solely on the power grid could actually pose problems for the project and, therefore, underscores the importance of implementing alternative energy generation systems.
This data underscores the need to focus on self-consumption or on certifying that electricity comes from external renewable sources in the event that the system is unable to meet energy demand internally. In fact, every kWh saved has an impact nearly ten times greater than any material change at this stage.

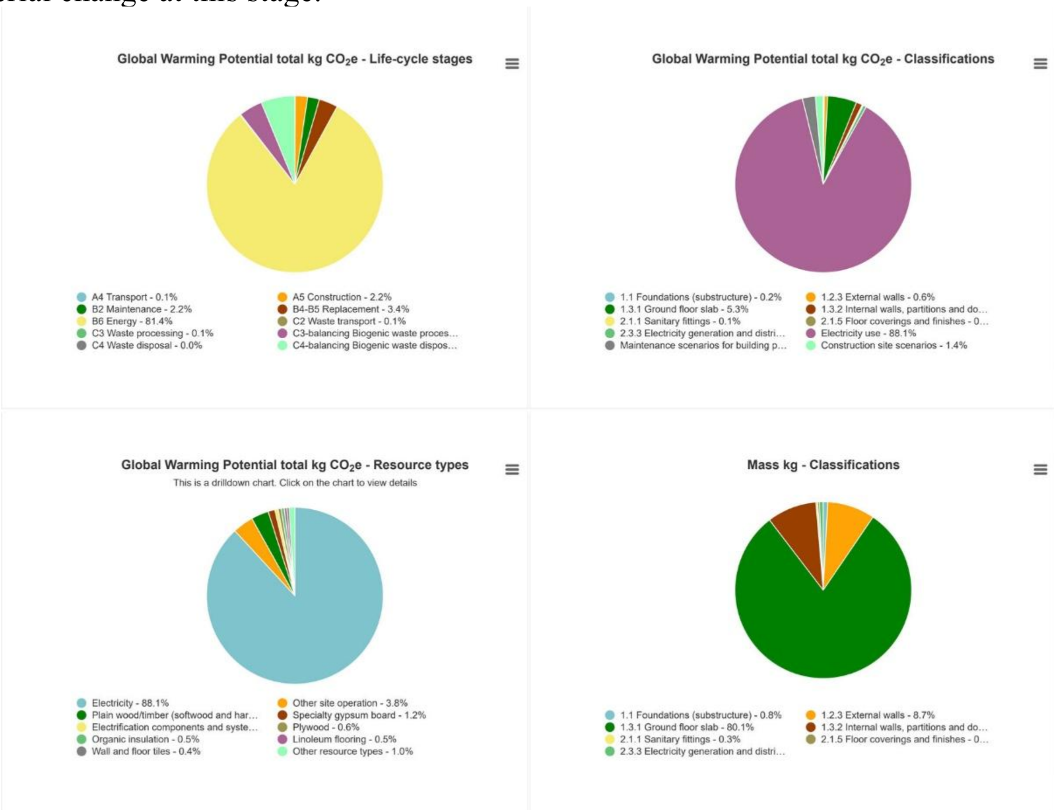


Figure 15. *OneClick results*

It is important to emphasize that this analysis has significant methodological limitations stemming precisely from the preliminary phase in which it was conducted. For certain components - such as equipment and some furnishings - generic data or industry averages were used. Similarly, the logistics phase (A4) is currently estimated at 1%, a very low figure that reflects the effort to establish a short supply chain, but which will need to be confirmed during the implementation phase based on supplier availability.

Figure 16. *OneClick results*

Evaluation of the building's energy consumption	
Tool used for the calculation	Honeybee and Ladybug
Thermal comfort	Winter temperature: 20 °C Summer temperature: 26°C
Occupancy schedules	7 h/day
Limitations of the Simulation	The system's behavior under free-cooling conditions is not simulated

Table 6. *Evaluation of the building's energy consumption parameters*

Calculation of the peak loads for heating and cooling

The estimation of peak loads is useful to know the maximum power required to maintain the building at the set conditions during the worst outdoor climatic conditions.

In Grasshopper software peak loads can be estimated through the output of RoomEnergyResults by deconstructing the obtained data using XData component and then by extract their numeric domain. This process uses the climate file adopted in the energy demand simulation to find the maximum peak loads (maximum value shown in the domain) for heating and cooling throughout the whole year.

In such regards, in the example shown in Figure 27, the total peak loads are for heating and cooling respectively 18.35 kW and 39.10 kW.

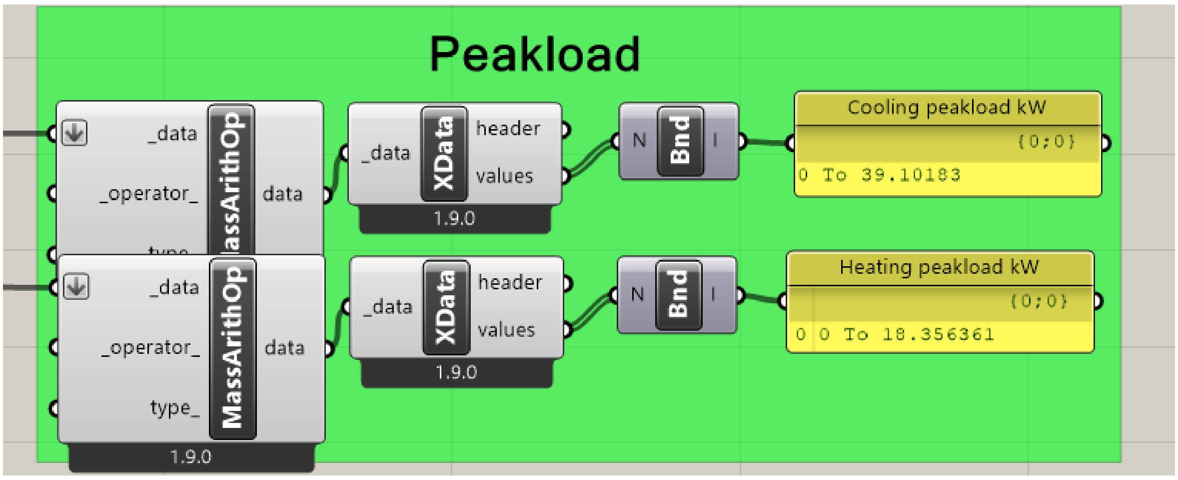


Figure 17. *Peak load results from grasshopper*

Calculation of the overall efficiency of the technical system (ηsyst)

The design of air conditioning systems for the restoration of Magazzini Raccordati required moving beyond the traditional paradigm based on heat exchange with outside air. Analysis of the site's intrinsic critical issues, such as the absence of large ventilation openings, the monumental constraints of the wall facing and the semi-underground nature of the tunnels, highlighted the ineffectiveness of air-cooled condensing units which are subject to 'thermal short-circuiting' and have an acoustic impact that is incompatible with the planned social functions. This design impasse directed the research towards stable heat sources outside the air volume of the tunnels, identifying a high-inertia energy reservoir in the Milanese subsoil.

In particular, the strategic proximity to the *Naviglio della Martesana* water network suggested the existence of a surface water interaction that makes the subsoil an ideal 'thermal lung'.
This insight is scientifically validated in the case study of a Milan project conducted as a result of the EU H2020 REWARDHeat (Renewable and Waste Heat Recovery for Community Heating and Cooling) initiative in collaboration with A2A and that was applied to a three-building complex in 2023. The project defines a 'temperature-neutral' network architecture, in which the heat transfer fluid circulates at temperatures close to ambient temperatures (15 °C - 20°C), acting as a source for decentralised water-water heat pumps (Ciolli, 2024). By adopting this model, the building breaks away from its dependence on the external climate to connect to a closed-loop hydrothermal system: a series of underground exchangers that extract or transfer heat to the Martesana blue network, eliminating any visual impact and ensuring the thermal invariance of the internal corridors.
The stability of the water source temperature allows the enthalpy mechanical ventilation units (VMC) to be supplied with water at strictly controlled temperatures, optimising the active dehumidification necessary for the preservation of historic structures. Thanks to the reduction of the temperature gradient between the source and the user and the elimination of external exhaust fans, it is estimated that the system can operate with efficiency parameters significantly higher than market standards.

Definition of the generation subsystem efficiency (ηgH)

To evaluate the generation subsystem efficiency, firstly it is necessary to define the building peak loads.
Based on the peak loads information is possible to select a generation subsystem (a water-water heatpump) which must have a power rate for heating and cooling higher than the building peak loads estimated previously.

Reversible heating/cooling version (RV)

RV		039	045	050	060	070	080	090	110	120
Heating capacity (EN14511) [1]	kW	51,7	59,0	71,2	80,0	92,5	105,9	120,8	136,1	152,0
Input power (EN14511) [1]	kW	9,8	11,0	12,5	14,3	16,9	19,4	22,2	24,9	28,3
COP (EN14511) [1]	W/W	5,27	5,36	5,69	5,59	5,47	5,45	5,44	5,46	5,37
Energy Class in low temperature [2]		A+++	A+++	A+++	A+++	A+++	A+++	A+++	A+++	A+++
SCOP low temperature [2]	kWh/kWh	5,21	5,52	5,51	5,77	5,60	5,50	5,44	5,44	5,46
ηs,h low temperature [2]	%	200,4	212,8	212,5	222,9	215,8	212,0	209,4	209,5	210,5
Energy Class in medium temperature [2]		A+++	A+++	A+++	A+++	A+++	A+++	A+++	A+++	A+++
SCOP medium temperature [2]	kWh/kWh	4,32	4,50	4,51	4,67	4,54	4,51	4,45	4,47	4,48
ηs,h medium temperature [2]	%	164,6	171,8	172,4	178,6	173,4	172,4	170,0	170,8	171,1
Cooling capacity (EN14511) [3]	kW	42,9	49,0	60,3	67,4	77,5	88,9	101,3	114,3	126,9
Total input power (EN14511) [3]	kW	10,0	11,3	12,9	14,7	17,4	19,9	22,7	25,5	29,0
EER (EN14511) [3]	W/W	4,29	4,33	4,67	4,58	4,45	4,46	4,46	4,48	4,37
Free Cooling capacity [4]	kW	22,8	22,9	36,0	36,3	36,6	49,3	71,0	72,4	73,5
Power supply	V/Ph/Hz	400/3/50	400/3/50	400/3/50	400/3/50	400/3/50	400/3/50	400/3/50	400/3/50	400/3/50
Peak current	A	111,0	132,0	140,0	143,0	199,0	208,0	259,0	265,0	312,0
Max input current	A	32,0	42,0	44,0	50,0	59,0	68,0	74,0	80,0	88,5
Compressors / Circuits	n°/n°	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1	2/1
Capacity steps	n°	2	2	2	2	2	2	2	2	2
Global warming potential (GWP)		2088	2088	2088	2088	2088	2088	2088	2088	2088
Refrigerant charge	kg	5,0	5,0	7,0	7,0	7,5	9,0	10,0	15,0	15,0
Equivalent CO_2 charge	t	10,4	10,4	14,6	14,6	15,7	18,8	20,9	31,3	31,3
Sound power [5]	dB(A)	71	77	77	78	79	80	83	85	87
Sound pressure [6]	dB(A)	55	61	61	62	63	64	66	68	70

Figure 18. *Water-water heatpump technical specifications*

The RV 039 model is selected because it guarantees a nominal cooling capacity (42.9 kW) consistent with the estimated peak load (39.10 kW), while offering a free-cooling capacity

of 22.8 kW. This configuration maximises energy savings during partial load periods by using direct hydrothermal exchange without the aid of compressors.
According to the datasheet the generation efficiencies for heating and cooling can be reported:

- COP (Coefficient of Performance): **5,27**
- EER (Energy Efficiency Ratio): **4,29**

The hydrothermal heat pump system operates on a seasonal switching logic based on the variation of sensible and latent loads, exploiting the thermal inertia of the "Blue Network" as a constant temperature source. During the winter, the system operates exclusively via a vapour compression cycle where the compressor works to raise the enthalpy of the refrigerant fluid taken from the source-side exchanger at approximately 15 °C to the temperature necessary to meet the peak load of 18.35 kW. The high temperature of the source compared to the outside air minimises the work of the compressor, ensuring a nominal COP of 5.27.
During the summer months, the 9.10 kW peak is managed using a two-stage strategy: on days with partial load or low occupancy, Free Cooling mode is activated, in which a bypass valve excludes the refrigeration cycle, allowing the network water at 15 °C to cool the rooms directly with the compressors switched off. However, in the event of high occupancy or humidity peaks, the control unit activates the compressor to lower the fluid temperature to 7 °C, a thermal shock that is essential to bring the coil below the dew point, condensing the water vapour and the active dehumidification necessary for the preservation of historic buildings. In the intermediate periods of April, May and October, the system operates mainly in Free Cooling mode or remains on standby, entrusting air renewal to the enthalpy CMV, which recovers over 85% of the energy from the expelled air, limiting the intervention of the heat pump to the hours of maximum occupancy of the spaces.
The adoption of free cooling mode allows the seasonal EER to be raised well above the nominal value of 4.29, reducing electricity consumption to only the auxiliary pumping during periods of partial load. However, the system control logic will prioritise active dehumidification via a compression cycle if the latent load exceeds the hygrometric reduction capacity of free cooling, ensuring the protection of underground structures.

Definition of the distribution subsystem efficiency (ηdH)

For the definition of the distribution subsystem efficiency a value based on the distribution typology was selected.

System typology	Distribution typology	Number of floors	Efficiency
Centralized system	Vertical distribution	1	0.936
		2	0.947
		3	0.958
		4	0.969
		5+	0.980
Centralized system	Horizontal distribution	up to 3	0.990
		3+	0.980
Autonomous system		-	0.990

Table 7. *Efficiencies for different distribution systems*

Definition of the emitting subsystem efficiency (ηeH)

For the definition of the emission subsystem efficiency, was selected a value based on the emission unit typology assumed.

Emission units typology	Efficiency
Radiators on insulated wall	0.96
Radiators on uninsulated wall	0.95
Fan coils	0.95
Air vents	0.92
Radiant floor	0.96
Radiant ceiling	0.95
Radiant wall	0.95

Table 8. *Efficiencies for different emission systems*

Definition of the control subsystem efficiency (ηcH)

For the definition of the control subsystem efficiency, a value based on the control system and typology was selected.

Control system	Typology	Radiators and fan coils	Radiant panels
Manual regulation	Thermostat	0.84	0.82
Climatic centralized control	Climatic regulation	0.88	0.86
Single room	ON/OFF	0.94	0.92

	Modulating	0.96	0.94
Single room and climatic	ON/OFF	0.97	0.95
	Modulating	0.98	0.97
Zone control	ON/OFF	0.93	0.91
	Modulating	0.95	0.93
Zone control and climatic	ON/OFF	0.96	0.94
	Modulating	0.97	0.96

Table 9. *Efficiencies for different control systems*

Calculation of the overall efficiency of the technical system (ηsyst)

The overall efficiency of the technical system can be calculated according to the following formula:

$$\eta_{syst} = \eta_{gH} \times \eta_{dH} \times \eta_{eH} \times \eta_{cH}$$

- Generation subsystem efficiency: COP= 5.27 EER= 4.29 (with the water-to-water heat pump selected in Section 2.2.1);
- Distribution subsystem efficiency: 0.936 (with a centralised system for vertical distribution for 1 floors);
- Emitting subsystem efficiency: 0.95 (with a radiant floor system);
- Control subsystem efficiency: 0.95 (with a modulating single-room control system)

Therefore, the overall efficiencies calculated both for heating and cooling are:

$$\eta_{syst\ (heating)} = 5.27 \times 0.936 \times 0.95 \times 0.95 = 4.45$$

$$\eta_{syst\ (cooling)} = 4.29 \times 0.36 \times 0.95 \times 0.95 = 3.62$$

Calculation of building's energy consumption

Finally, the building's energy consumption can be calculated through the following formula:

$$Energy\ consumption_{\ (heating)} = \frac{Energy\ demand_{heating}}{\eta_{syst\ (heating)}}$$

$$Energy\ consumption_{\ (cooling)} = \frac{Energy\ demand_{cooling}}{\eta_{syst\ (cooling)}}$$

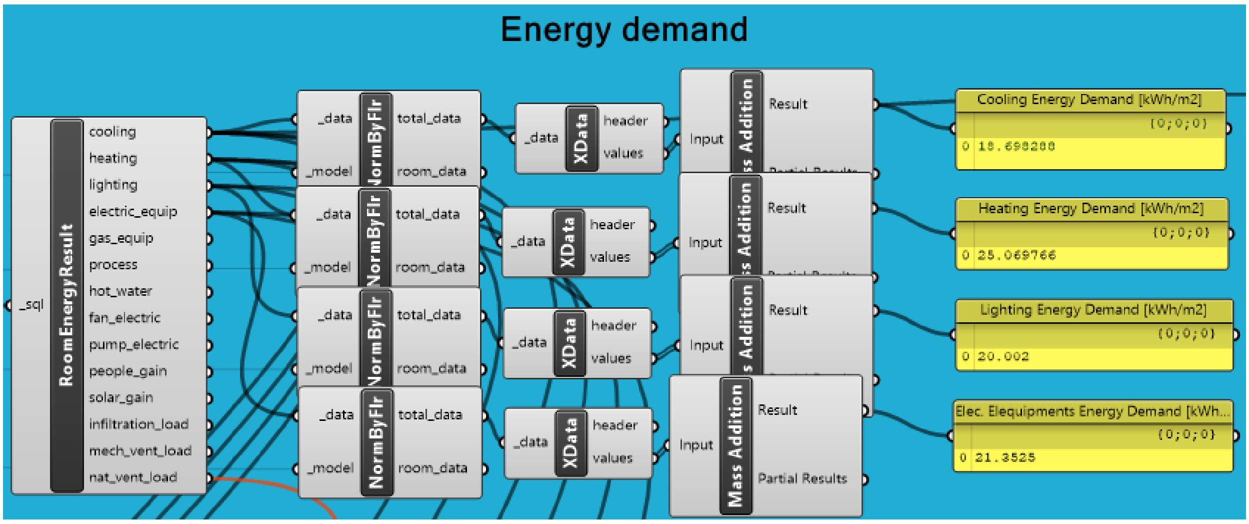


Figure 19. *Building's energy demand*

The specific energy consumption (for each square meter of the building) calculated for heating and cooling are:

$$Specific\ energy\ consumption\ _{(heating)} = \frac{25.06}{4.45} = 5.63\ kWh/m^2\ \ /Year$$

$$Specific\ energy\ consumption\ _{(cooling)} = \frac{18.69}{3.62} = 5.16\ kWh/m^2\ /Year$$

$$Specific\ energy\ consumption\ _{(electrical\ equipment\ +\ artificial\ lighting)} \\ = 40.35\ kWh/m^2\ /Year$$

The absolute energy consumption (for the whole building floor area) for heating, cooling, interior lighting and electrical equipment is calculated by the multiplication of the specific energy consumption and the building floor area, as shown in the following formulae:

$$Absolute\ energy\ consumption\ _{(heating)} = 5.63\ kWh/m^2 \times 700\ m^2 \\ = 3941\ kWh/Year$$

$$Absolute\ energy\ consumption\ _{(cooling)} = 5.16\ kWh/m^2 \times 700\ m^2 \\ = 3612\ kWh/Year$$

$$Absolute\ energy\ consumption\ _{(elec.\ equip.+artif.\ light.)} = 40.35\ kWh/m^2 \times 700\ m^2 \\ = 28245\ kWh/Year$$

$$\boldsymbol{Total\ energy\ consumption\ _{(heat.+cool.+ligh.+equip.)} = 35798\ kWh/Year}$$

Evaluation of the electricity produced by the renewable sources

The structure's semi-underground configuration and the presence of a complex railway infrastructure above the tunnels pose a significant challenge for the installation of renewable energy generation systems. In particular, given the area's central location and the neighborhood's typical urban density, it is difficult to opt for wind power generation; at the same time, the installation of photovoltaic panels on the structure's roof must coexist with the existing network of tracks running above the warehouses. The most feasible solution appears to be utilizing the space between the edge of the embankment and the first set of tracks to install a row of high-efficiency solar panels.

However, a second possibility should be highlighted, one that deserves further and more detailed analysis than is feasible here. As discussed earlier, Milan Central Station has, in fact, undergone various changes in use and technology from the 1930s to the present. The introduction of high-speed trains, the optimization of schedules, and the repurposing and relocation of functions that were originally characteristic of the station (the loading and unloading of freight and mail cars) have rendered much of the original infrastructure as historical remnants with no active role in the station's current logistics. Just as with control and switching stations, some of the external tracks also remain as a reminder of an infrastructure that used to be far more cumbersome and disorganized than the modern one. These unused tracks and switching yards could be identified and mapped as potential sites for installing a rail-mounted solar panel system. The technology in question was patented by Sun-Ways with the aim of being installed on long stretches of track, but it cannot be adopted in switching yards due to the flexibility required in the movable sections of the rails. However, in the case of decommissioned tracks, this issue would not arise, unlike the rest of the infrastructure still in use at Milano Centrale.

Although this possibility opens up interesting scenarios, it is nevertheless important to emphasize that the preliminary mapping should also take into account the shadows cast by historic buildings located at certain junctions along the embankment.

The following calculation therefore focuses exclusively on the possibility of installing the panels in the section between the end of the embankment and the first row of tracks (which also appears to be decommissioned) in order to arrive at a conservative estimate and avoid drawing overly optimistic conclusions.

Photovoltaic system

The calculation of the electricity produced by a photovoltaic system can be done through the following procedure.

Suitable surfaces for photovoltaic systems are those unaffected by shadows and where the exposition to solar radiation is maximised.

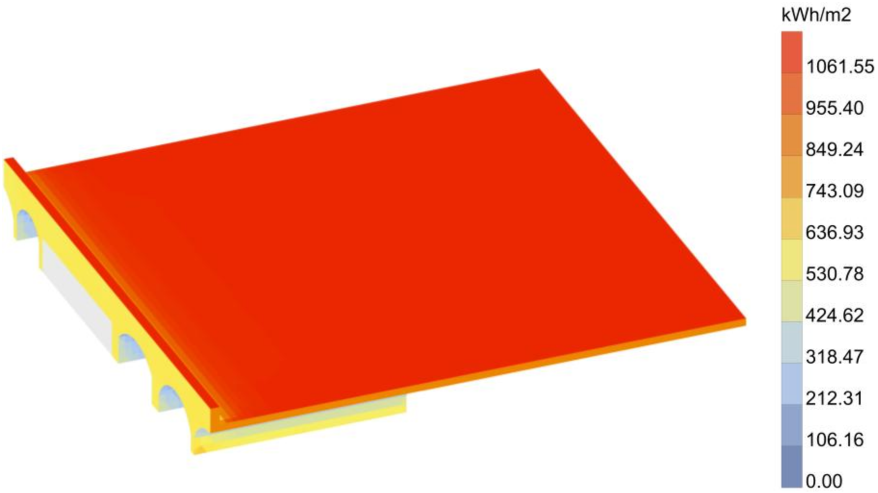
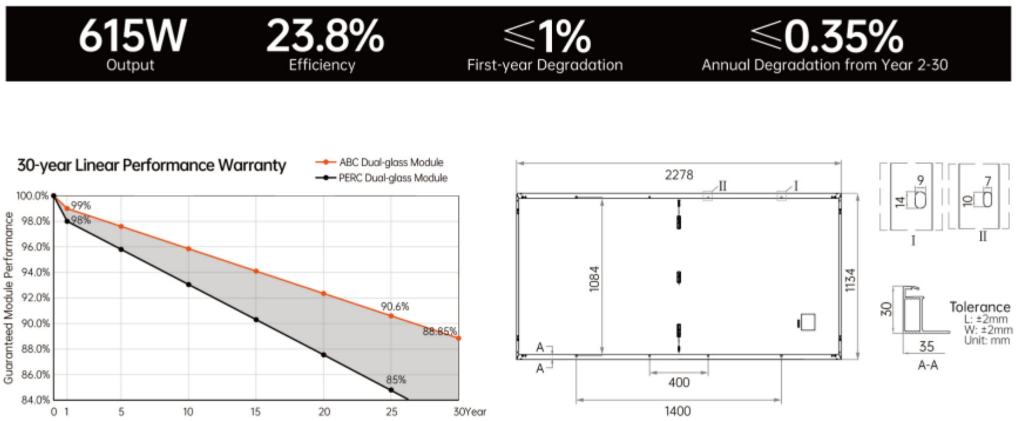


Figure 20. *View of the annual incident irradiation on the building*

To estimate the amount of electricity that can be produced through the solar system it is necessary to find a specific product in the market for the photovoltaic module.

A bifacial double glass module with high efficiency (monocrystalline) has been selected. The dimension of a singular module is 1.14 × 2.28 m and the area is about 2.6 m^2.

The module selected is the one with 615 W.



Electrical Characteristics (STC: AM1.5 1000W/m² 25℃ NOCT: AM1.5 800W/m² 20℃ 1m/s) Power Tolerance:0~ + 3% Max Power Test Uncertainty:±3%

Model	AIKO-A595-MAH72Dw		AIKO-A600-MAH72Dw		AIKO-A605-MAH72Dw		AIKO-A610-MAH72Dw		AIKO-615-MAH72Dw	
Test Conditions	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
P_{max} [W]	595	449	600	453	605	456	610	460	615	464
V_{oc} [V]	53.30	50.20	53.40	50.29	53.50	50.39	53.60	50.48	53.70	50.58
V_{mp} [V]	44.82	42.21	44.92	42.31	45.02	42.40	45.12	42.50	45.22	42.59
I_{sc} [A]	13.79	11.18	13.85	11.23	13.91	11.28	13.97	11.33	14.03	11.38
I_{mp} [A]	13.28	10.64	13.36	10.71	13.44	10.77	13.52	10.84	13.61	10.90
Module Efficiency	23.0%		23.2%		23.4%		23.6%		23.8%	

Figure 21. *Technical characteristics of the PV module*

Afterwards, it is necessary to count the number of modules that can be installed in the available area.
Considering the photovoltaic module shown in Figure 31 a maximum of 40 modules can be installed due to the length of the two renovated spaces, distance to the railways, and the projected shadow on the roof surface. The 40 PV are arranged in five arrays of 8 modules each, configured in a 2x4 layout (two rows of four panels). Therefore, the total power installed is about 24.600 kW.

$$615\ W \times 40\ (modules) = 24600\ W \rightarrow 24.600\ kW$$

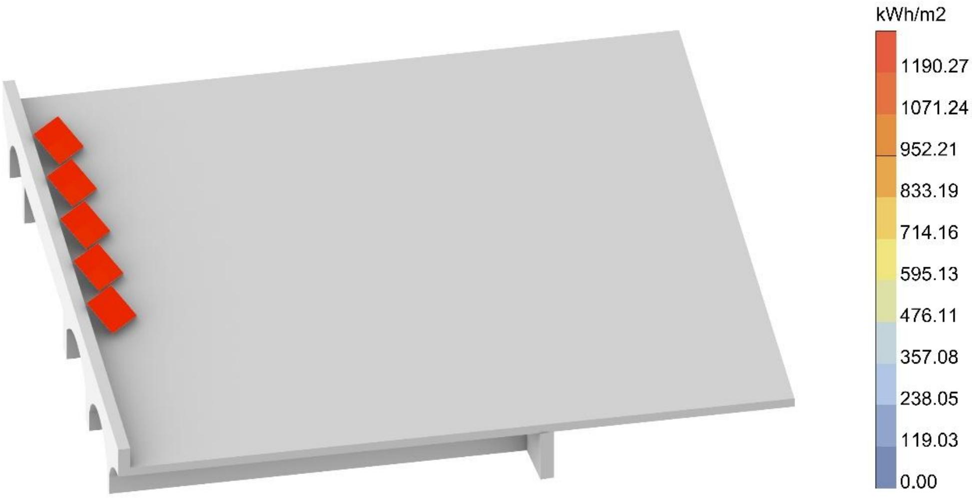


Figure 22. *Irradiation of PV modules installed on the roof*

Calculation of the electricity production of the roof PV panel

The electricity produced by the photovoltaic system installed can be calculated through the following formula:

$$E_{PV} = P_{PV} \times PR \times \frac{H}{ISTC}$$

Where,

- E_{PV} = electricity produced by the photovoltaic system [kWh];
- P_{PV} = nominal power of the module [kW];
- PR = performance ratio, equal to 0.75;
- H = annual irradiation [kWh/m^2];
- ISTC = Irradiation in Standard Test Conditions, equal to 1kW/m^2.

Considered the following data:

- P_{PV} = 24.600 kW$_p$
- PR = 0.75;
- H = 1159 kWh/m^2;
- ISTC = 1kW/m^2.

The electricity produced by the photovoltaic system installed on the roof is equal to 21383,55 kWh/year.
By doing the ratio between the building’s energy consumption and the calculated energy supplied by the renewable sources, the percentage of renewable energy supplied to the building can be calculated:

$$\%\, of\ renewable\ energy\ supplied\ to\ the\ building = \frac{E_{pv}}{C} \times 100$$

Where:

- E_{pv} = electricity produced by the photovoltaic system [kWh];
- C = energy consumption of the building (heating + cooling + interior lighting + electrical equipment) [kWh];

$$Renewable\ energy\ supplied = \frac{\mathbf{21383,5}\ \ kWh/year}{\mathbf{35798}\ kWh/year} \times 100 = \mathbf{59,73}\ \%$$

It is possible to consider a more efficient module that could produce more energy in the same space or a with a slither bigger length. By considering a high and length equal to 2,38m x 1,30m for each panel it could be possible to considerably increase the energy production with bifacial dual glass monocrystalline module with a power of 720W.

$$720\ W\ \times\ 40\ (modules)\ =\ 28800\ W \rightarrow 28.800\ kW$$

The electricity produced by the photovoltaic system installed on the roof considering the more powerful module is equal to 25034,40 kWh/year.

$$Renewable\ energy\ supplied = \frac{\mathbf{25034,40}\ kWh/year}{\mathbf{35798}\ kWh/year} \times 100 = \mathbf{69,93}\ \%$$

Energy demand reduction

Lighting

Another possible intervention could concern the critical review of energy requirements by providing an in-depth analysis of the lighting power density (LPD), initially set at a conservative default value of 8 W/m². This parameter was reconsidered in light of the UNI EN 15193-1 standard, which defines the methodologies for calculating the LENI (Lighting Energy Numeric Indicator) and establishes that overall efficiency does not depend exclusively on installed power, but on the system's ability to integrate high-efficiency sources and dynamic control systems.

$$Lighting\ Power\ Density = \frac{E\ (lux)}{\eta\ \left(\frac{lm}{W}\right) \mu\ MF}\ \ [W/m^2]$$

- η= measured in lumens per Watt (lm/W), defines the efficiency of the light source in converting electrical power into visible light, an high-efficiency LED technology with a source efficacy of 160 lm/W has been adopted.

- μ= dimensionless value that represents the ratio of the luminous flux reaching the task plane to the total flux emitted by the lamps. The adoption of a Utilization Factor of 0.6 is consistent with the technical literature for indoor environments with standard reflectance ratios (Society of Light and Lighting, SLL, 2022).
- MF= Maintenance Factor assumed 0,8

Considering the UNI EN 12464-1 standard, a reference value of 300 lux (average between reading rooms/art classrooms and library shelving) was considered, applying a precautionary assessment given that these spaces are only present in 70% of the internal area.

$$Lighting\ Power\ Density = \frac{300\ x}{160\ x\ 0{,}6\ x\ 0{,}8} = 3{,}90\ W/m^2$$

Taking into account the adaptation of the lighting energy demand suggested be the software the value for the absolute energy demand is considered.

$$Absolute\ energy\ consumption_{\ (elec.\ equip.+\ artif.\ light.)} = (10.00 + 21.35)\ kWh/m^2/year \times 700\ m^2 = 21.945\ kWh/year$$

$$\boldsymbol{Total\ energy\ consumption_{\ (heat.+cool.+ligh.+equip.)} = 29.498\ kWh/year}$$

$$Renewable\ energy\ supplied = \frac{\mathbf{21383,5}\ \ kWh/year}{\mathbf{29489}\ kWh/year} \times 100 = \mathbf{72,51}\,\%$$

Equipment

The critical review of energy requirements required an in-depth analysis of the equipment power density considering a reduction of the available electronic devices considering the possibility of sharing devices not fixed but under requirement.

The transition from a standard 10 W/m² to 7 W/m² for Electrical Equipment is justified by the specific functional nature of the project. While 10 W/m² is a typical benchmark for high-density open-plan offices with permanent workstations and dual-monitor setups, this hub is designed as a flexible public space with low-density occupancy. In this environment, the primary electrical load stems from personal laptops and mobile devices rather than fixed desktop units, significantly lowering the overall power demand. This adjustment aligns the project with the EN 16798-1:2019 European standards for medium-density social and educational spaces, moving away from conservative commercial office defaults. As confirmed by the updated Honeybee simulation, this optimization results in an Equipment Energy Demand of 14.95 kWh/m²/year, providing a more accurate reflection of the building's operational reality without compromising the reliability of the energy model.

$$Absolute\ energy\ consumption_{\ (elec.\ equip.+\ artif.\ light.)} = (10.00 + 14.95)\ kWh/m^2/year \times 700\ m^2 = 21.945\ kWh/year$$

$$\boldsymbol{Total\ energy\ consumption_{\ (heat.+cool.+ligh.+equip.)} = 27.209\ kWh/year}$$

$$renewable\ energy\ supplied = \frac{\mathbf{21383,5}\ kWh/year}{\mathbf{27209}\ kWh/year} \times 100 = \mathbf{78,58}\,\%$$

The percentage of renewable energy supply to the building could be implemented by the use of pv panel with a power equal to 720W with a result of 101% and a positive impact on the total energy balance. This solution would consider a better understanding of the roof composition and the dismissed rails visible from an aerial view on the area.

Renewable Energy Integration and Free Cooling Impact

Based on the latest integrated simulation, the building's total electrical consumption is calculated at 27,209 kWh/year, considering a specific demand of 38.87 kWh/m²/year. With a photovoltaic production of 17,524 kWh/year, the current renewable energy share stands at 64.40%. However, this percentage is considered a conservative estimate as it does not yet fully account for the Free Cooling potential provided by the hydrothermal network. By utilizing the 15°C water source, a significant portion of the 15.22 kWh/m²/year cooling demand can be met through direct heat exchange, bypassing the need for mechanical compression during partial load periods. Implementing this passive cooling strategy would further reduce the cooling electricity consumption by an estimated 15-20%, effectively raising the final renewable energy share.

III. NEB self assessment tool application

The use of the NEB Self-Assessment Tool is preceded by a preliminary screening phase aimed at selecting the indicators deemed valid for the specific project in question. The selection process is guided by the tool through the tables provided at the beginning of each chapter, which summarize the scale (urban, architectural, or local), the type of project (new construction, redevelopment), and the function (residential, public) to which the indicator can be applied. At this stage, however, this study identified the need to further refine the selection criteria for the indicators provided by the European framework in order to adapt the tool to the evaluation of projects in the preliminary phase.
The selection of indicators and the definition of their corresponding evaluation metrics therefore addressed two main criteria:

Relevance to Architectural Scale and Public Function Indicators pertaining to urban-scale interventions or specifically formulated for residential projects were excluded from the assessment. Furthermore, criteria relating to conditions not present within the project due to its specific building typology - such as quantifying the project's impact on the context based on building height - are ineffective or inapplicable. In fact, the project does not and cannot involve any change in height relative to the existing structure, as it is being carried out on a site subject to zoning restrictions. These observations have been reported individually for each indicator in the dedicated section.

Consistency with the Concept Design Phase Since this is a proposal in the preliminary and strategic design phase, the data subject to verification were extracted using predictive simulation models (e.g., Honeybee for thermal loads and OneClick LCA for embodied carbon). Indicators that require post-construction on-site measurements that cannot be predicted through simulation during the preliminary phase (such as monitoring indoor air quality in the completed building or actual energy audits) were excluded from the assessment, with limits defined where possible for future reference protocols.

SUSTAINABILITY

As discussed in the introduction, the New European Bauhaus (NEB) framework bases its system on the need to redefine the paradigm of Europe's ecological transition by moving beyond a purely technocratic approach. This drive is rooted in a broader discussion that recognizes the climate crisis not as a unilateral challenge, but as a systemic and cultural crisis. The approach proposed by the NEB is therefore the promotion of an inseparable integration among three key dimensions: sustainability, beauty, and inclusion. The strength of this vision lies in identifying spatial quality and social equity as key catalysts for the acceptance of the ecological transition, shifting the focus away from the conception of the built environment as merely a system to be made more efficient.
It is precisely through these foundations and its quest to reach the broadest possible audience that the NEB serves first and foremost as a tangible manifestation of European objectives and proposals regarding the future of the built environment, rather than as an independent technical tool. A future in which the ecological transition becomes possible only when linked to inclusivity, spatial quality, and human well-being.
It is precisely within this close, egalitarian relationship, however, that one can identify the risk of an internal logical fragility within the systemic premises put forward. While, on the one hand, the framework derived from the attempt to move beyond sectoral approaches responds to the real complexity of contemporary problems (Sachs, 2015), on the other hand, it risks producing a critical side effect: the loss of hierarchy among the dimensions of sustainability.
While the NEB tool introduces an interesting and necessary element of outreach and cross-cutting integration, it adopts an approach that is intentionally restrained from a methodological and political standpoint. This is reflected in the inclusion of factors related to comfort, inclusivity, and affordability within the "Sustainability" dimension, which should, on the contrary, focus on aspects related to the project's environmental impact. This contributes, in part, to diminishing the decisive role of energy and climate impact and to transforming environmental sustainability from a binding prerequisite into an equal pillar. The interdisciplinary nature of architecture and its role as a mediator between the environment, society, and the economy places it at the center of the epistemological conflict that defines the modern era, marked by accelerated and irreversible climate feedback loops. The choice made by the NEB therefore takes on significance and reflects the growing systemic difficulty in recognizing that the planet's biophysical foundation is non-negotiable and that every other dimension of sustainability ultimately depends on the ecological stability of the system. Continuing to evaluate environmental performance as just one of many components of a project means ignoring the fact that a building is first and foremost an energy- and material-intensive entity, embedded within a context of finite ecological cycles, and situated on the front lines of the impact that the climate crisis will have on diverse and complex urban systems. Environmental justice, quality of space, and inclusivity are not alternatives to reducing climate impact; rather, they are its direct consequences. Without a drastic reduction in emissions and resource consumption, these goals remain mere rhetoric.
An analysis of the criteria proposed by the self-assessment for this sustainability dimension raises the question of whether a holistic approach, if not accompanied by a clear hierarchy of parameters, risks failing to achieve efficient results or to adequately balance the various components. This issue is evident both in certain indicators and in the proposed KPIs as a whole. In the first case, for example, we can cite the three indicators of KPI S.7, which is formally classified under environmental sustainability but assigns significant weight to elements such as stakeholder involvement in the design and verification phases and job creation, in addition to the degree of interdisciplinarity which, among the three indicators, is the one most closely linked to environmental issues. In the second case, however, it is evident

that KPI B.8 is expressed entirely in terms of local economic impact, emphasizing financing models and the economic benefits generated by the project.

This type of evaluative framework, which encompasses multiple aspects under a single, highly specific and significant dimension, generates an operational paradox. It risks promoting projects that, despite demonstrating mediocre energy performance relative to medium-to-long-term climate targets, incorporate green business models or financial mechanisms. Therefore, the risk remains of reverting to the same danger that the NEB primarily aims to elude by separating the three dimensions of Sustainability, Inclusivity, and Beauty at the outset. This attempt remains extremely valid and potentially decisive if applied with more rigor.

The NEB tool for environmental sustainability, in its current form, thus appears to reflect an unresolved tension between the urgency dictated by climate science and the slower pace of politics and society. This temporal discrepancy is one of the most critical aspects of the current crisis.

The concern raised is not intended to call into question the legitimacy of including economic aspects or indicators of comfort and well-being within the framework, but rather concerns their placement within the structure.

Another element that risks being ambiguous has been identified in the definition of reference baselines, which in some cases are anchored to the current state of the European building stock (S.2, S.3). The resulting percentage constitutes an incremental result in and of itself, but it should be assessed in which cases a 20% increase over the current average state is sufficiently significant to be considered acceptable in terms of actual environmental mitigation. This methodological choice aims to propose a pragmatic and flexible approach, allowing for a comparison with the existing situation, the measurement of incremental improvements relative to it, and making the objectives more easily achievable; however, it simultaneously risks obscuring the necessary pace of implementation required to change design parameters in order to achieve global objectives for combating and mitigating the climate crisis.

Europe’s building stock is, in fact, widely recognized as energy-inefficient and environmentally unsustainable (JRC, 2023); therefore, basing assessment thresholds on a system that does not adhere to sustainability limits amounts to normalizing unsustainability rather than establishing a benchmark that starts from the minimum value necessary to achieve decarbonization goals. While this approach allows buildings that adopt high-impact environmental strategies to achieve very high performance ratings, there is a risk of also accepting a “sufficient” score in cases where there is significant room for improvement.

This logic contradicts scientific evidence that underscores the urgency of promptly adjusting our professional and lifestyle habits to avoid exceeding planetary boundaries. Planetary boundaries are not aspirational goals, but conditions necessary for the Earth system’s existence. Exceeding them would trigger nonlinear and potentially irreversible dynamics, with cascading effects on the economy, society, and political stability (Butera, 2021). With this evidence in mind, we should begin to assess contemporary practices by first identifying baselines that reflect the limits necessary to remain within an ecological safety zone.

The decision to continue using the current building stock as a benchmark reflects, once again, the difficulty institutions have in grappling with the radical nature of the transformations required and their tendency to systematically postpone confronting the physical reality of the planet. The timelines for building retrofits and the energy transition are being adapted to the capabilities of the economic and political system, rather than to the timelines dictated by climate processes.

The potential consequences of this adaptation are well documented and highlight how the climate crisis is not merely a threat to ecosystems but ultimately acts as a multiplier of inequality, exacerbating the conditions faced by the most vulnerable communities.
In light of these realities, the European Union could aim to lead the transition and define a strategy that, while proposing ambitious scenarios, acknowledges and communicates the true scope of the necessary change. Similarly, the NEB method for sustainability should enable a full understanding of the extent to which projects contribute to staying within global ecological limits or provide studies and data to identify more ambitious benchmarks than those derived from the analysis of the existing building stock. In doing so, the tool would increase its transformative capacity.
The proposed comparison between the critique of the methodological structure of the NEB self-assessment tool and its defining characteristics does not aim to highlight the presence of a configuration marked by an irreconcilable contradiction, but rather seeks to identify a productive tension. On the one hand, in an effort to provide tools for analyzing cascading impacts, the systemic approach reveals certain weaknesses in the inclusion of irrelevant indicators within separate, purely quantitative dimensions such as the one analyzed here. On the other hand, however, the quantification of cross-cutting criteria represents a first attempt to address the practical impossibility of revisiting an interpretation rigidly oriented toward the needs of the environmental dimension – an approach that risks reproducing some of the same vulnerabilities that have characterized European climate policies in recent decades.
The slow pace at which European regulations and recommendations are implemented demonstrates that proposals for analysis and efficiency-enhancing measures alone struggle to translate into structural transformations unless accompanied by cultural and social change. The critical issue, therefore, does not lie in the adoption of an integrated approach in and of itself, but in the ways in which that vision is put into practice. As suggested by the Safe and Just Space model (Raworth, 2012), just as environmental sustainability represents an insurmountable biophysical limit, the absence of an equitable and inclusive social foundation undermines the political stability necessary to sustain ambitious climate policies over time. The risk posed by the interpretation proposed in this assessment is not so much that of incorporating too many dimensions, but rather that of failing to spell out clearly enough the minimum, non-negotiable conditions under which such integration should take place.
From this perspective, the NEB proposal can be viewed as a strategy for cultural transition even before it is seen as a system of self-assessment based on environmental criteria that critically and objectively sets forth the minimum standards for achieving the objectives identified by the international scientific community. It is important to note, in fact, that most of the proposed KPIs (S.1, S.2, S.3, S.5, S.6) refer to the Level(s) framework, specifically to the calculations it proposes for the detailed design phase, without introducing any innovative elements. The development of this method does not, therefore, aim to focus on proposing new benchmarks for environmental issues; however, it remains essential to highlight the decision to de-emphasize the analysis of energy and climate impacts within the environmental indicators. In light of these Consideratedons, it was interesting to examine the theoretical debate within which this decision is situated and to note how the ever-growing need to introduce binding environmental thresholds, anchored to planetary boundaries that remain unresolved to this day, coexists with an ever-increasing effort to maintain a dimension that is economically and professionally feasible, as well as symbolic, and capable of being socially sustained.
In summary, the value of the New European Bauhaus lies in its ability to challenge the sectoral approach to sustainability, while also highlighting a limitation in that it has not yet fully resolved the tension between the climate emergency and systemic inclusion.

KPI / Indicatore NEB	Stato	Criterio di Esclusione / Note metodologiche
S.1 Minimise the use of fossil fuels	Considerated	S.1.2 does not apply to academic projects without an electricity supply contract S.1.3 not applied due to the lack of reliable estimates
S.2 Maximise the use of sustainable energy	Considerated	S.2.2 Excluded from the evaluation due to the need for data that cannot be processed during the conceptual design phase
S.3 Minimise greenhouse gas emissions	Considerated	-
S.4 Enhance sustainable mobility	Considerated	Calculated for private and bicycle traffic within the relevant area given the impossibility of modifying the supra-urban public infrastructure.
S.5 Minimise non-energy related impacts to air and water	Considerated	S.5.1 not applied due to the lack of reliable estimates Section 5.2 highlights the need of devices with greater water efficiency than the standard
S.6 Minimise non-energy related impacts from built env.	Considerated	S.6.1 highlights a calculation limit that results in a maximum value of 42.8%
S.7 Achieve the best possible greening of the public sector in terms of its economic involvement in sustainability of the built environment	Considerated	At present, the estimate of gross value added appears to be an *concept* that is unrealistic and mathematically strained
S.8 Greening of the private and financial sector	**Not Considerated**	Assessment (e.g., green bonds, ESG standards, ESRS reporting) requires a level of maturity in the construction process and the *business plan* that goes beyond the scope of preliminary design
S.9 Promote circular economy	Considerated	S.1.2 does not apply to academic projects without an electricity supply contract S.1.3 not applied due to the lack of reliable estimates

Table 10. *KPI selection for sustainability dimension*

S.1 Minimise the use of fossil fuels in the built environment

S.1.1 Primary energy demand

The assessment of indicator S.1.1 is based on the calculation of Delivered Energy (Edel) derived from estimated energy needs, taking into account the efficiency of the building's technical systems.The calculation includes the building's technical systems, heating, cooling, and lighting, as specified in the manual for non-residential buildings. Consequently, plug loads (electrical loads associated with building occupancy) were not included in the calculation. Therefore, the 14.95 kWh/m²/year of equipment consumption indicated in Chapter 2 of the project report is excluded from this specific KPI.

$$Specific\ energy\ consumption_{\ (heating)} = \frac{25.06}{4.45} = 5.63\ kWh/m^2/year$$

$$Specific\ energy\ consumption_{\ (cooling)} = \frac{18.69}{3.62} = 5.16\ kWh/m^2/year$$

$$Specific\ energy\ consumption_{\ (lighting)} = 10.00\ kWh/m^2/year$$

$$\mathrm{E}_{del} = 20.79\ kWh/m^2/year$$

Using the national Primary Energy Factors (PEF) for the identified energy carrier, the delivered energy is converted into primary energy:

Energy carrier: Grid electricity.
PEF (Italy): 2.42

$$E_{pri} = 20.79\frac{kWh}{m^2} \cdot 2.42 = 50.31\ kWh/m^2/year$$

At this stage, the contribution of the photovoltaic system is not considered, as the objective is to evaluate the intrinsic efficiency of the building system relative to the potential draw from the grid.
Once the value equivalent to the amount of primary energy required has been obtained, the reference baseline is identified based on the values reported in Table 6 of the manual (Joint Research Centre (JRC), 2024).

Climate zone	Building type	NZEBs benchmark		NZEB targets (kWh/m²y)
		Net primary use (kWh/m²y)	Total primary use (kWh/m²y)	
Mediterranean (e.g., Catania, Athens, Larnaca, Luga, Seville, Palermo)	Residential Non-residential	40-55 20-30	85-100 80-90	35-100 60-175

Oceanic (e.g., Paris, Amsterdam, Berlin, Brussels, Copenhagen,	Residential Non-residential	15-30 40-55	50-65 85-100	15-70 40-150
Continental (e.g., Budapest, Bratislava, Ljubljana, Milan, Vienna)	Residential Non-residential	20–40 40–55	50–70 85–100	20–125 25-125
Nordic (e.g., Stockholm, Helsinki, Riga, Stockholm, Gdansk, Tovarene)	Residential Non-residential	40–65 55–70	65–90 85–100	65–95 95–110

Table 11. *NZEB benchmarks and targets depending on residential and non-residential buildings for different climate zone to set the baseline metric score. (Joint Research Centre (JRC), 2024)*

$$S.1.1 = \frac{T_{baseline} - E_{pri}}{T_{baseline}} = \frac{100 - 50.31}{100} \times 100 = 49.69$$

The performance class is therefore acceptable. However, the choice of a high benchmark value is taken into account, and an improvement to the current model is therefore anticipated. At the same time, it is anticipated that, through the use of more sensitive simulation tools, the potential effect of the hydrothermal free-cooling system, which is not included in this estimate, can be taken into account. The direct use of groundwater at 15°C should result in a significant reduction in energy demand for cooling compared to the calculated values; however, the lack of adequate simulation tools and the current stage of the project suggest a conservative approach that can only be validated through post-occupancy monitoring.
Further analysis could be conducted on the possibility of incorporating double-pane windows filled with argon gas to reduce heat loss due to the large northwestern windows. However, this would impact aspects related to the building's life cycle and would require a new assessment of these impacts.

S.1.2 Energy peak demand

Indicator S.1.2 serves a dual purpose related to technical and urban safety. The decision to use the contracted power (considered to be greater than 30-40 kW for commercial spaces with a floor area similar to the project's 700 m²) as the benchmark is based on the need for safety and stability of the electrical grid, since a building that drastically reduces its peak load relative to the contractual limit minimizes the risk of congestion in the local grid and contributes to the resilience of Milan's urban infrastructure.
The focus is therefore on the difference between the simulated peak and the power specified in the contract. This makes this specific indicator a measure of the system's reliability rather than its energy efficiency.
Since historical data or contracts for the supply were not available, an estimate was established based on selecting a contractual capacity that maintains a 10% margin relative to the simulated capacity. This percentage was chosen to ensure a supply that guarantees security in proportion to the cost specified in the contract, while acknowledging that a conservative estimate of this kind results in a low score in the evaluation.
The value obtained through simulation on Honeybee has been considered, equal to 39.10 kW, and, by applying the margin, is possible to reach a threshold equivalent to 43.01 kW.

The selected contract provides for a supply of 44 kW, which is closer to the simulated peak given the context of the Italian market

$$S.1.2 = \frac{T_{baseline} - E_{p,max}}{T_{baseline}} = \frac{44 - 39{,}10}{44} \times 100 = 22$$

The result of the assessment, using the identified benchmark, is 12.67, which falls within the lowest range. As mentioned earlier, choosing a size so close to the projected peak is not considered sufficiently prudent and would therefore require a reassessment.
To achieve a score of 80, the minimum required to fall within the “excellence” category, a contract providing for more than 195.50 kW should be considered.

$$80 = \frac{T_{baseline} - E_{p,max}}{T_{baseline}} = \frac{x - 39{,}10}{x} \times 100$$

$$T_{baseline} = 78{,}60$$

The result, which is proportional to the difference between the simulated peak and the contracted power, suggests that an increase in the latter yields a proportional benefit in terms of reliability. However, beyond a certain threshold, it would be advisable to assess the ratio between the actual benefit obtained and the increase in system cost to prevent any oversizing.
It should be noted that, given these limitations, the method is not very effective in a purely theoretical scenario without actual contractual constraints.

S.1.3 Smart readiness

Indicator S.1.3 aims to measure a building’s ability to collect data, interact with the network, or be controlled via smart systems. The goal is to assess the building’s “intelligence,” not so much in terms of energy efficiency but rather by considering the impact that data availability, connectivity, and control can have on the system’s overall sustainability by reducing energy consumption and waste. A prime example is classrooms in schools or libraries, where lighting systems are typically controlled on an on/off basis. In fact, this system is managed by staff according to the day’s needs, but if the system could calculate the actual lighting requirements inside the classroom, it would become apparent that as evening approaches, the need for light is not uniform, it would likely decrease as the classroom gets closer to a source of natural light.
Similarly, in many libraries with low foot traffic, it might be decided to install sensors that keep the lighting at a low level when the shelves are not in use and increase it whenever someone needs optimal lighting for reading. Not only do these smart services thus impact the project’s energy consumption and carbon footprint, but they also ensure comfort for end users, ease of maintenance,
and long-term savings, even in the face of a higher initial investment. To ensure maximum transparency in the selection of the services under Consideratedon, the NEB manual refers

to the document “Final Report on the Technical Support for the Development of an SRI” (Joint Research Centre (JRC), 2024), presenting it as the methodological framework necessary to ensure scientific rigor and objectivity for indicator S.1.3.

Through standardized calculation protocols, impact matrices, and catalogs of necessary services, the document seeks to translate the sometimes ambiguous concept of “smartness” into a quantifiable metric and thus serves as an operational validation tool that legitimizes the evaluation process. To this end, the European Union has been working in parallel for years to develop a comprehensive catalog of tools for calculating the impacts and the relative weight that each smart service represents within a building. This impact depends on factors such as the type of building, floor area, users, context, and project objectives. Information on the availability of tools and training programs dedicated to this specific assessment can be found on page 60 of the manual (Joint Research Centre JRC, 2024).

Assessing this indicator presents significant practical challenges during the preliminary design phase, as the structure of the complete analytical calculation conflicts with the objective difficulty of obtaining the necessary granular data. In particular, limitations have been identified regarding Equation 18, which requires the integration of weighting coefficients for each of the seven impact criteria; these coefficients cannot currently be estimated or assumed in a preliminary model. Such an estimate presupposes a definitive plant design, which is incompatible with the flexibility required in the early stages of architectural concept development.

However, understanding the theoretical basis and principles that underpin the equations presented, made possible by consulting the additional documentation indicated in the relevant section, provides an opportunity for a more in-depth understanding of the relationship between the impact of the various services and the weight the project assigns to the other components of the identified system. This leads to a fundamental observation that recognizes the multidimensional nature of the indicator. The internal structure, in fact, conceives of sustainability as the product of environmental protection, user comfort, and economic balance. Although this interpretation is correct and internationally accepted, it is nevertheless necessary to clarify that the assessment of the “Sustainability” dimension of the proposed method, while intended to cover areas related to environmental protection, extends beyond this specific indicator to consider aspects related to other dimensions, thereby confirming the complexity and cross-cutting nature of the regulatory framework to which it refers in many respects.

S.2 Maximise the use of sustainable energy in the built environment

S.2.1 Shared of renewables

The building's design calls for the development and integration of a system powered exclusively by electricity (ventilation with heat recovery, water-to-water heat pump), as outlined in the report available in Chapter II, from which the data necessary to complete the following analysis were drawn, based on 615-W panels and an energy-efficient lighting system.

$$RES_{tot} = \frac{E_{res,tot}}{E_{p,tot}} \cdot 100 = \frac{E_{res,tot}}{E_{heating+cooling+lighting}}$$
$$= \frac{21383{,}5 \ \ kWh/year}{(3941 + 3612 + 6825)kWh/year} = 140\%$$

As specified in the assessment model, the final result depends entirely on the decision made regarding the value of Tbaseline, which is not defined in a binding manner.
The manual provides for two different possibilities: the primary one is the percentage reflecting current European average conditions for clean energy (24.8% / 23.5%), while the more ambitious option involves adopting the values set by European targets (41.2%). In any case, given the positive result, an energy surplus is expected, and thus excellent performance. Nevertheless, considering the use of equipment, the percentage would certainly decrease due to the presence of projectors and computers inside the building, which also contribute to increased energy demand during the summer.

S.3 Minimise greenhouse gas emissions from the built environment

S.3.1 Operational greenhouse gas (GHG) emissions

Indicator S.3.1 analyzes greenhouse gas emissions over the building's useful life. At this stage as well, the assessment again takes into account delivered energy (which was already analyzed by indicator S.1.1 through conversion to primary energy).

1. *Annual delivered energy (Q) sub-metric evaluation*:

$$Q = 20{,}79 \frac{kWh}{m^2}$$

2. *Annual operational GHG emissions (annual OGHG) metric evaluation:*

When considering the use of a heat pump system, a GHG emission factor of 0.258 is used, as shown in Table 18 on page 91 of the NEB manual.

$$Annual \text{ OGHG} = 20{,}79 \frac{kWh}{m^2} \cdot 0{,}258 = 5{,}36\ kgCO_2/m^2 year$$

3. *S.3.1 score evaluation*

As stated in the NEB manual on page 91, the baseline for leased buildings in Italy in climate zone E is 44.7 kWh/m².

$$S.1.2 = \frac{T_{baseline} - E_{p,max}}{T_{baseline}} \cdot 100 = \frac{44{,}7 - 5{,}36}{44{,}7} \cdot 100 = 88{,}00$$

The indicator shows a less-than-excellent score, as previously noted in the analysis of S.1.1. The need to improve the system's efficiency by using higher-performance glazing in therefore emphasized, considering including the system's performance in free-cooling mode during the summer months in the simulation, or by considering the possibility of selecting a more efficient mechanical system. Given the small size of the windows relative to the total volume of the project, the second and third options are expected to have a greater impact.

S.3.2 Embodied GHG emissions

The assessment guided by indicator S.3.2 makes it possible to measure the amount of embedded climate-changing emissions of the project, expressed in kgCO2e/m², by including the entire life cycle of the new products selected for the project in the calculation. The aim is therefore to assess the extent to which the project reduces the carbon footprint associated with the production, transportation, installation, replacement, and end-of-life of building components compared to the proposed or identified baseline value.
The manual specifies that, in the case of retrofitting and repurposing projects, only the materials added by the project need to be considered, since the existing materials are not related to the design choices. The LCA assessment must be conducted in accordance with ISO 14040-44 and EN 15978, adopting a "cradle-to-grave" approach for the components actually included in the project.

As noted in Chapter II of the project report, OneClick LCA software has been used, adopting the Level(s) life-cycle carbon method (EN 15804 +A1/+A2). This choice ensures consistency with the NEB framework methodology, which references Level(s) for defining this KPI, and introduces greater control and ease of management in the assessment. While the calculation certainly has limitations due to the project's current stage of development, it provides a concrete preliminary understanding of the availability of certified materials, components, and suppliers in the region, as well as the impact each component has on the final result.
The use of the software has made it possible to obtain verifiable environmental datasets consistent with the European EPD system, thereby avoiding a purely theoretical or abstract assessment of emissions.
Since this is a redevelopment project that does not involve the structural system but is not limited solely to spatial reorganization, and considering the inclusion of new mechanical and electrical systems that were previously absent (whose impact on these parameters was demonstrated in the report dedicated to Chapter II), a reference value of 150 $kgCO_2/m^2$ was adopted, which is higher than the minimum value of 125 $kgCO_2/m^2$ and lower than the 200 $kgCO_2/m^2$ value indicated by the NEB manual for structural renovation projects.

$$S.3.2 = \frac{T_{baseline} - EGHG_b}{T_{baseline}} \times 100 = \frac{150 - 113}{150} \times 100 = 24\%$$

The indicator therefore falls within a low-to-medium range of increase relative to the identified threshold. This suggests a critical assessment of the level of detail achieved by the project at this stage, which did not allow for a completely precise selection of all construction systems, making it necessary in some cases to apply generic average data that will need to be replaced in subsequent project phases, thereby refining these results and reducing the overall emissions value.
While preserving the existing structure is a fundamental strategy and aligns with best practices, it has no actual impact at this stage, as the proposed comparative analysis highlights the limitations of such comparisons in projects of a similar nature. Similarly, the choice of biobased materials does not affect the calculation, given that the biogenetic component has not been taken into account, since the end-of-life phase is not yet governed by contractual agreements and Phase D, relating to the reuse and recycling of materials, has not been considered.

KPI evaluation

$$S.3 = 0.6 \cdot S.3.1 + 0.4 \cdot S.3.2 = 0.6 \cdot 88 + 0.4 \cdot 22 = 52.8 + 8.8 = 61.6$$

S.4 Enhance sustainable mobility in the built environment

S.4.1 e-Mobility: electric vehicles (EV) parking

S.4.1 assesses the project's ability to create urban conditions that promote the adoption of electric mobility by supporting the infrastructure system through the provision of dedicated vehicle charging infrastructure.
In the NEB framework, this criterion is considered an integral part of the urban decarbonization strategy and is therefore linked to the potential for a gradual reduction in emissions associated with private transportation. The indicator falls within a broader range

of Consideratedons that include public transportation but only at the urban scale, whereas public transportation is not included in the assessment at the building scale. However, the objective for this scale remains valid, focusing on private transportation systems and concentrating on the transition to low-emission private mobility systems, while improving access to charging stations within the project's area of relevance.
The application of this indicator is critical due to the very configuration of the existing structure, whose historic mass occupies 100% of the relevant area, making it impossible to incorporate underground or elevated levels to accommodate the necessary parking space.
Nevertheless, the redevelopment of the space is part of the urban project that would reconfigure the entire Via Sammartini area, which calls for the construction of regulated indoor and outdoor parking spaces to complement the new activities planned for the area. It was therefore decided to use the KPI to calculate the number of electric parking spaces that should be provided near the redevelopment project.
The reverse calculation was performed by considering the threshold for renovated non-residential buildings and assuming the lower value (projects with more than 5 parking spaces), defining a 20% baseline in accordance with Table 25 of the NEB manual.

$$S.4.1. = \frac{\left(\frac{1}{x}\right) \cdot 100 - 20}{20} \cdot 100 = 80\%$$

$$x = 2{,}7 \approx 3$$

To reach an excellent performance the project should at least reach the 33% of EV parking.

S.4.2 Alternative mobility: bicycle

Following on from the previous indicator, S.4.2 also assesses the project's ability to promote forms of active mobility, specifically with regard to bicycle use in this context. The increase in the use of low-impact, "slow" modes of transportation is considered a factor in reducing emissions related to urban mobility and improving the quality of public space.
The assessment at the building scale focuses on quantifying the number of parking spaces within the project's vicinity. The project includes the integration of dedicated bicycle parking spaces at the entrance to the new facility, with a maximum capacity of 14 spaces. Since the project does not include any space designated for private car parking, the category indicated in Table 26 of the NEB framework was adopted to define the benchmark.
A benchmark of 10% of the building's user capacity was therefore adopted. Considering an estimated capacity of approximately 70 people, the project benchmark corresponds to a minimum of 7 bicycle parking spaces.

$$S.4.2 = \frac{\left[\left(\frac{14}{70} \cdot 100\right) - 7\right]}{7} \cdot 100 = \frac{[20 - 7]}{7} \cdot 100 = 180\%$$

The assessment yields an extremely positive result, reflecting, on the one hand, a baseline that may be set too low and, on the other, the project's commitment to dedicating space to this concept of slow mobility. The ability to set aside this interior space also stems from the ample availability of space within the historic building.

S.5 Minimise non-energy related environmental impacts to air and water

S.5.1 Indoor air quality

Indicator S.5.1 assesses indoor air quality and the environmental well-being of occupants, recognizing the central role of the indoor environment in ensuring - or failing to ensure - maximum health safety for users, adequate comfort, and ideal conditions for the use of spaces.

The objective of the indicator is to minimize the presence of indoor pollutants through ventilation control, the identification and reduction of emissions from materials, the quality of air exchange, and the mitigation of pollutants originating from outside.

The assessment of this specific indicator at the project's current preliminary stage presents limitations that prevent its application. In fact, the assumptions to be adopted would not be sufficiently supported by technical evidence, and the procedure would risk failing to meet the procedural requirements outlined in the NEB manual, given the impossibility of entering precise quantitative data or performing fluid dynamics simulations.

In order for the project to be subsequently evaluated by this specific section, it will be necessary to collect traceable and measurable parameters during the execution phase, as well as to employ advanced technical and regulatory tools by dedicated technicians. Specifically, it would be advisable to analyze air exchange rates and create a distribution map of the mechanical ventilation (VMC) airflow, sized in accordance with the UNI EN 16798-1 standard, which must be supported by computational fluid dynamics (CFD) simulations. With regard to materials, the guarantees offered by EPDs can be further explored during the concept phase and, if necessary, the data can be supplemented with additional verifications based on information derived from tests conducted according to the methodologies specified in UNI EN 16516.

It should also be noted that ex-post verification tools and on-site physical monitoring of pollutant concentrations and parameters (CO_2 concentrations, volatile organic compounds, atmospheric particulate matter, formaldehyde, temperature, and relative humidity) can be used to verify the actual consistency between the theoretical model and the actual behavior of the redeveloped area.

S.5.2 Water consumption

Indicator S.5.2 assesses the project's contribution to water resource conservation through reduced water consumption. The main impacts associated with this indicator include increased urban resilience, reduced pressure on water networks, and reduced emissions related to domestic hot water (DHW) supply.
In order to conduct the assessment, a tally was made of the devices connected to the water supply network or that involve water consumption as specified in the project, along with a table listing the consumption rate and usage factor for each of them.

Category	Device / Feature	Technical Details (Consumption Drivers)
Sanitary Devices	4 Accessible Toilets	Dual flush system (e.g., 4.5L small / 7.5L full)
Fittings	3 Bathroom Taps	Max flow rate (e.g., 10 L/min)
Fittings	3 Bidet Sprays	Estimated flow rate (e.g., 6 L/min)
Appliances	Water Refill Station	Flow-controlled dispenser for bottles
Appliances	Electric Kettle	Standard capacity (approx. 1.7 L)
Arch. Feature	Indoor Green Walls	Air-root species (low humidity requirement)
Arch. Feature	Integrated Water Tank	20L capacity - **Manual refill only**

Sanitary Device / Appliance	Consumption Rate	Usage Factor (per occupant, per day)	Reference Source
Toilet (Full Flush)	7.5 L / flush	1 flush/o/day	Table 34
Toilet (Small Flush)	4.5 L / flush	4 flushes/o/day	Table 34
Bathroom Tap	10 L / min	75 seconds/o/day	Table 34
Bidet Spray (Doccino)	6 L / min (Est.)	30 seconds/o/day (Est.)	Designer Estimate*
Drinking / Kettle	2 L / day (Est.)	N/A	Human hydration needs

Table 12. *Bill of quantities, Consumption Rate and Usage factor*

To calculate the occupancy rate; since the peculiar function of the project entitles high users' turnover the full time equivalent (FTE) is considered, assuming that the time a user spends inside the space would be at most half of what an employee or student spends at school or in the office. In the same way the usage factor for each device should be adapted due to the temporary permanence of the occupants.

A baseline equal to 590.0 L/m2/year and a total of 335 operating days (offices) are considered as indicated in the NEB guidelines at page 121.

FTE: 80 x 2 / 8 = 20 FTE.
WC and tap water: 20 FTE consume as 20 people full time (20 x 38 L/o/d = 760 L)
Irrigation: 20L
PWC: 780 L/d
PWC (year): 262300 L/year

PWC(year)/Area: $\frac{262300\ L/year}{700m^2} = 373.29\ L/\mathrm{m2/year}$

$$\mathrm{S.5.2} = \frac{590 - 373.29}{590} \cdot 100 = 36.7$$

The evaluation suggests that the design needs further review, particularly regarding the integration of high-efficiency solutions and a greywater recovery system

S.6 Minimise non-energy related environmental impacts from the built environment

S.6.1 Construction and demolition waste

Indicator S.6.1 quantifies life cycle performance and material circularity by adopting a transparent measurement protocol based on the traceability of materials and their end-of-life. The analysis therefore focuses on Modules C (C1–C4: End-of-Life Phase) and Module D (Environmental Benefits and Impacts Beyond System Boundaries).
The modeling of end-of-life (EoL) scenarios for the technological components and materials selected for the project was conducted while taking into account the limitations associated with the project's current stage of development. These limitations can be identified primarily in the absence of as-built data, which prevents the exact quantification of actual implementation scenarios and logistical variations on-site compared to the specifications outlined at this stage, and in the inability to predict technological developments in the waste treatment sector over the time horizon coinciding with the potential decommissioning of the facility, thus assuming that current recycling and reuse capacities will persist.
The allocation coefficients for the end-of-life stages were extracted from the Environmental Product Declarations (EPDs) prepared by the individual manufacturers and derived from the material characteristics declared in that documentation. Where primary product data was unavailable or required supplementation for secondary assembly components, the calculation model incorporated standard scenario data provided by the Ecoinvent LCA database (v3.8), ensuring alignment with the recovery rates currently validated at the European level for the Construction and Demolition Waste (CDW) sector.
To represent the impact of dry construction that meets Design for Deconstruction criteria, the coefficients were adjusted to a more favorable scenario compared to that assumed in destructive demolition practices typical of wet construction, which result in the irreversible

contamination of substrates. The project's technological approach, which eliminates the use of hydraulic binders and structural adhesives, makes it possible to anticipate a high rate of decomposition across the project's total mass and influences the following four end-of-life streams:

- Reuse: The highest percentages of material subject to direct reuse were assigned to dry-installed or mechanically fastened elements (insulation panels in cavities, wooden frames), whose removal, according to the relevant technical data sheets and EPDs, does not compromise their original physical and mechanical integrity. Even in these cases, it was deemed necessary to apply a deterioration factor that accounts for any breakage and product degradation. It is therefore assumed that the blond cork panels (80% reuse) and the dry-laid porcelain stoneware modules (85% reuse) can be removed in their entirety. Specifically for cork, this assumption is validated by the relevant EPD (HUB-0281), which certifies the absence of synthetic or polyurethane resins, thereby guaranteeing the material's stability. Birch wood structures (60% recycled content) also reflect standard scenarios for the selective dismantling of undamaged elements.
- Recycling: The percentages assigned to this stream reflect the workability specifications listed for Module C3. Materials primarily intended for this stream, even though they cannot be reused in their original form due to permanent fasteners (grouted and perforated gypsum-fiber boards, cork cutting scraps), are free from chemical contamination and are therefore suitable for crushing facilities and reuse in the industrial cycle. For example, the high theoretical reversibility of gypsum-fiber and calcium silicate does not account for the presence of holes from through screws and grouted joints, which results in a high probability of chipping during extraction. The reuse potential of whole panels was therefore reduced to 10%, while for the majority (85% for gypsum-fiber, 80% for silicate, and 90% for flat glass), recycling was considered a viable option.
- Energy Recovery: The analysis of energy recovery scenarios has been limited to polymeric fractions or synthetic composites (e.g., vapor barriers and radon barriers) for which selective separation at the construction site would be impractical. It is therefore assumed that polymeric membranes (vapor barriers and radon barriers) are torn during the disassembly of building envelope packages. Consequently, the majority of these components (70%) have been allocated to waste-to-energy, limiting material recycling (20%) to those portions not contaminated by acrylic sealing tape and not damaged during removal.
- Disposal: In the proposed dry system, this scenario corresponds primarily to the inert fraction or the inherent waste fraction. The mass of material subject to on-site losses, uncollectable processing dust, and metal fasteners has been quantified. The percentages of material disposed of in landfills (ranging from 5% to 10% for each inventory line item) represent a conservative margin applied to account for the generation of uncollectable dust or fragments during construction and the uncontrollable wear and tear of materials at the end of their service life.

Below is the complete quantitative matrix generated using a spreadsheet, which summarizes the project inventory and the breakdown of end-of-life (EOL) streams for each component.

Material	**Volume (m^3)**	**Density (kg/m^3)**	**Mass (kg)**	**Reuse (%)**	**Recycling (%)**	**Recovery (%)**	**Disposal (%)**

Blond Cork	183.47	120	22016.76	80%	15%	0%	5%
Birch Wood	5.52	650	3590.73	60%	30%	5%	5%
Natural Hemp Fiber	11.41	70	798.70	50%	40%	5%	5%
Gypsum Fiberboard	23.85	1150	27427.50	10%	85%	0%	5%
Radiant Panel	2.18	160	348.96	50%	40%	0%	10%
Calcium Silicate	3.48	250	871.13	10%	80%	0%	10%
OSB	6.72	630	4233.60	60%	30%	5%	5%
Vapor/Radon Memb.	0.25	950	239.71	0%	20%	70%	10%
Radon Floor Memb.	0.22	950	207.20	0%	20%	70%	10%
Stoneware / Bio-HPL	1.39	2350	3275.43	85%	10%	0%	5%
Natural Linoleum	2.64	1400	3696.00	10%	50%	30%	10%
Window Glass	0.55	2500	1371.60	5%	90%	0%	5%
Wooden Frame	0.59	500	296.40	40%	50%	5%	5%
TOTAL MASS			68373.71				

Table 13. Data output based on material geometries and EPD allocation coefficients.

Material	Total Mass (kg)	Reuse (kg)	Recycling (kg)	Energy Recovery (kg)	Disposal (kg)
Blond Cork	22016.76	11008.38	9907.542	0.00	1100.84
Birch Wood	3590.73	2154.44	1077.219	179.54	179.54
Natural Hemp Fiber	798.70	399.35	319.48	39.94	39.94
Gypsum Fiberboard	27427.50	2742.75	21942	0.00	2742.75
Radiant Panel	348.96	174.48	139.58	0.00	34.90
Calcium Silicate	871.13	87.11	696.90	0.00	87.11
OSB	4233.60	2540.16	1270.08	211.68	211.68
Vapor/Radon Memb.	239.71	0.00	47.94	167.80	23.97
Radon Floor Memb.	207.20	0.00	41.44	145.04	20.72
Stoneware / Bio-HPL	3275.43	2784.12	327.54	0.00	163.77
Natural Linoleum	3696.00	369.60	1848.00	1108.80	369.60
Window Glass	1371.60	68.58	1234.44	0.00	68.58
Wooden Frame	296.40	118.56	148.20	14.82	14.82
TOTALS	68373.71	22447.53	33766.72	1867.61	5058.21

Table 14. *End of life scenario estimation expressed in kg*

The modeling results quantify a material circularity index (CDWr/CDWg) of 0.89, indicating that 89% of the mass introduced into the project is theoretically suitable for reuse and recycling streams.
Consequently, the evaluation of indicator S.6.1 is estimated by setting a comparison value of 70%, as specified in the guidelines. This choice reflects the European Union's regulatory minimum.

- **Total Generated Waste (CDWg):** 68373.71 kg
- **Total Recovered Waste (CDWr - Reuse + Recycling):** 61447.90 kg
- **Circularity Coefficient (CDWr/CDWg):** 0.89

$$\mathrm{S.6.1} = \frac{(\frac{CDW_R}{CDW_G} \cdot 100) - T_{baseline}}{T_{baseline}} \cdot 100 = \frac{(0{,}89 \cdot 100) - 70}{70} \cdot 27$$

The NEB method rates indicator S.6.1 as "good." Nevertheless, Figure 36 (p. 125) (Joint Research Centre (JRC), 2024) should be taken into account, as it shows that many European countries have reported average CDW recovery rates higher than the European regulatory target. Specifically, for Italy, this value ranges between 90% and 100%. If this threshold were applied, the project would likely be deemed insufficient. In both scenarios, however, it is mathematically impossible to achieve a performance rated as "excellent": assuming a value of 1 in the ratio, which corresponds to the total recovery of the project's mass, the

maximum achievable value would be 42.8% when compared to a regulatory baseline of 70%, and 11% if the project were compared to a CDW recovery rate of 90%.
Given these Consideratedons, the outcome of the evaluation is satisfactory, although it highlights the need to adhere very strictly to the projections made during the preliminary phase, even during the final design phases.

S.7 Achieve the best possible greening of the public sector in terms of its economic involvement in the sustainability of the built environment

S.7.1 Social return on investment

Indicator S.7.1 represents the first attempt to extend the assessment to the economic and social aspects of the project. Specifically, the aim is to bridge the gap between environmental sustainability and social sustainability; however, this particular indicator makes no reference to ecological Consideratedons and is based exclusively on factors of social inclusion and monetary value.
The identified tool is, moreover, fundamentally qualitative, in that the basis for estimating values does not lie in numerical assessments, but rather in the association of actions carried out during the design and implementation phases with a corresponding score. Given the project's current stage and the absence of an implementation scenario that would allow for the evaluation of final outputs, in applying the indicator to the project, an effort was made to select the areas that best reflect the Consideratedons made and the process carried out during the preliminary phase. In particular, it was decided to take into account the active involvement of stakeholders in the development and review of these early stages of the urban and architectural project. At present, the project has provided for a constructive dialogue with local associations, the primary beneficiaries of the spaces, but despite this, it has not been possible to test what the actual resulting benefits would be through dedicated workshops. A value of 20 was therefore selected from Table 42 of the manual.

S.7.2 Degree of inter-disciplinary integration

Indicator S.7.2 aims to introduce the key issue of interdisciplinarity. The need for integration and horizontal collaboration among as many disciplines as possible relevant to the project's development has been confirmed and recognized as central by the NEB, the JRC, and the entire scientific community. In order to identify and implement effective environmental strategies, it is also necessary to involve architects and engineers specializing in various fields, especially when dealing with large-scale projects.
While the redevelopment project for the two warehouses was carried out individually to study other scales of evaluation, the urban project developed within the FARMER group involved a larger number of experts and collaborators. It was therefore decided to also consider the professionals involved in this preliminary decision-making phase, as they contributed to the functional choices, the site selection, and the development of the space allocation system, defining the main mechanisms linking the architectural design to the urban fabric.
Students from the following disciplines were involved in this phase: architecture (1), mathematical engineering (1), communication design (1), landscape design (1), computer engineering (1), and management engineering (1). In addition to being assisted by a team of researchers in architecture, environmental technologies, and urban planning, the workshops and reviews also facilitated dialogue with industry experts who guided and supported the team in actively defining strategies: horticulture and floriculture (1), agricultural, forestry, and food sciences (1), and supply chain management and economics (1). The total number of roles considered is 9; according to Equation 125, the "number of disciplines" (ND) metric is calculated as follows:

$$ND = 9 \cdot 10 = 90$$

The level of engagement (LE) is set at 0.8 in accordance with the guidelines in Table 43. The final score for indicator S.7.2 is calculated as follows:

$$S.7.2 = ND \cdot LE = 90 \cdot 0{,}8 = 72$$

S.7.3 Gross value added to local economy from new business creation

Indicator S.7.3 assesses the project's ability to stimulate local growth in order to promote sustainable economic development by analyzing the gross value added to the local economy. At this stage, this estimate is not very realistic for the project; therefore, the indicator is not applied.

S.8 Achieve the best possible greening of the private and financial sector in terms of its economic involvement in the sustainability of the built environment

The assessment of KPI S.8, which pertains to the economic involvement of the private and financial sectors, requires a level of maturity in the construction process that goes beyond the scope of preliminary architectural design. In fact, indicators S.8.1 and S.8.2 require a tangible measurement of green financial instruments, such as green loans or green bonds, as well as verification of compliance with ESG standards and the European Sustainability Reporting Standards (ESRS) by the parties involved.

The redevelopment project for the Magazzini Raccordati is currently in the concept phase, and its progress, business plan, financial architecture, investment vehicles, and the corporate structure of future private stakeholders have not yet been defined or structured. Consequently, the decision was made not to conduct the assessment, as it is believed that including quantitative estimates regarding the economic structure would be purely speculative, thereby undermining the scientific rigor of the method.

S.9 Promote circular economy in the built environment

KPI S.9 is based entirely on the analysis of indicator S.9.1, which is designed to measure the degree of circularity of the construction project.

The assessment is based on quantitative data extrapolated from the bill of quantities prepared for the Life Cycle Assessment (LCA). The two main phases preceding the application of the parameter were an initial analytical measurement, based exclusively on verified bio-based resources, and a follow-up analysis focused on identifying potential sources of recycled inorganic components. Consequently, only bio-based materials were identified and quantified based on their primary organic matrix, specifically birch wood, blond cork, hemp fiber, and natural linoleum.

The calculation of the indicator in this instance, expressed as the ratio of the mass of the selected elements to the total project mass, yielded a coefficient of 0.50. Since the ratio exceeds 20%, the result of Equation 142 would yield a value greater than 100; however, the manual specifies that in this case, values exceeding the maximum cannot be assigned.

The project would therefore fall into the “excellent” category regardless of whether recycled material is included in the calculation, given the impact of the biobased component. Nevertheless, it was interesting to explore the potential impact that the use of recycled materials for the mineral component would entail.

To complete the analysis, it was therefore decided to assume, for components of mineral or composite origin, such as ceramic tiles, gypsum fiber boards, and calcium silicate, that suppliers would be sought who offer products with a high certified percentage of secondary raw materials or materials derived from on-site recovery during construction. In this case, the circularity coefficient would be around 0.92, or 92%. This target is certainly ambitious, but technically feasible thanks to the use of insulation packages and dry-applied finishes that enable the integration of advanced circular supply chains.

Dimension Score

KPI / Indicatore NEB	Score	Weight	Peso Ricalcolato	W. score
S.1 Minimise the use of fossil fuels	49.69	0.2	0.235	11.68
S.2 Maximise the use of sustainable energy	100	0.1	0.118	11.80
S.3 Minimise greenhouse gas emissions	61.6	0.1	0.118	7.72
S.4 Enhance sustainable mobility	100	0.05	0.059	5.90
S.5 Minimise non-energy related impacts to air and water	36.7	0.1	0.118	4.33
S.6 Minimise non-energy related impacts from built env.	27	0.05	0.059	1.59
S.7 Achieve the best possible greening of the public sector in terms of its economic involvement in sustainability of the built environment	51.20	0.12	0.141	7.22
S.8 Greening of the private and financial sector	**-**	0.15	-	-
S.9 Promote circular economy	100	0.13	0.153	15.20
TOT				**64.99/100**

Table 15. *Dimension score calculation based on weight's recalibration.*

The application of the framework for environmental sustainability places the project in the "good" performance category, with a weighted overall score of 68.62/100. The applicability of indicators and KPIs that rely on contractual and operational data that cannot be estimated necessitated a weighted redistribution of their weights to ensure greater clarity of the results. The result highlights the adequacy of strategies related to the circular economy (S.9), the maximization of renewable energy (S.2), and sustainable mobility (S.4). Conversely, the overall performance is negatively impacted by issues related to water consumption (S.5) and the calculation of theoretical demolition waste (S.6), whose score, as noted in the dedicated section, reveals significant calculation limitations. Subsequent project phases must therefore address the currently unapplied KPIs as soon as possible and focus on selecting more efficient water management systems.

BEAUTY

La dimensione della bellezza nel New European Bauhaus

The concept of beauty as it relates to the built environment and architectural works is extremely difficult to apply to the contemporary world, both because of its subjective nature and because of the complex definition of this concept, whose interpretation has evolved over the course of the entire history of architectural and philosophical thought.
The most important and influential conception of beauty was formulated by Aristotle and later theorized in the field of architecture by Vitruvius, who conceived of it in terms of proportion, symmetry, and definition (Vitruvio, 15 a.C. / 1999). This measurable and objective concept of beauty endured and became firmly established over the centuries until it underwent a rupture linked to the profound epistemological changes of the 18th century. The emergence of new needs and the expansion of technological horizons have led to a profound redefinition of human certainties and the relationship between humans and their external environment, a shift that has been reflected in the search for new interpretive languages. Alexander Baumgarten theorized a new paradigm for understanding this concept in 1750 in his work *Aesthetica*, in which he asserted the existence of sensory knowledge dependent on the subject's perception (Baumgarten, 1750 / 1993). The publication of these two volumes marked the birth of aesthetics as a philosophical field. It was, however, Immanuel Kant who opposed Baumgarten's attempt to reduce taste and perception to an objective science, emphasizing the existence of a disinterested feeling on the part of the subject.
While emphasizing the subjective nature of taste and the characterization of the perceiving subject through the relationship expressed, Kant himself acknowledges an aspect of universality in beauty, which he defines as subjective universality (Kant, 1790 / 1999).
Through the phenomenological and hermeneutic turn, philosophical attention subsequently shifted from the abstract nature of the judging subject to the concreteness of the body inhabiting space (In-der-Welt-sein). From this perspective, the search for that "common sense" and universality posited by Kant abandons claims to a priori absoluteness to be articulated in intersubjective, cultural, and social terms. These epistemological shifts have opened up the speculative horizon within which the discussion regarding the role of beauty in contemporary society unfolds and takes shape.
In the field of architecture, the redefinition of the concept of beauty and the absence of objectivity have certainly contributed to shaping its various manifestations within the modernist context and in the architectural debate of the 20th century. Beauty, precisely because of its subjective and difficult-to-quantify nature, was considered a consequence of the successful realization of the modernist aspiration to base architecture on universal and measurable principles that governed the functional and structural requirements of the building. The famous principle "form follows function" implied, in fact, a subordination of architectural form to technical rationality, performance, and efficiency, progressively reducing beauty to an implicit consequence of good design rather than an autonomous goal of the practice (Sullivan, 1896).
Starting in the second half of the twentieth century, these positions developed further within the context of anti-aesthetic reflections in postmodern thought. Postmodernist thought, in fact, interpreted aesthetics as a cultural and ideological construct, inevitably linked to power relations, social codes, and historically determined systems of representation (Foster H. , 1983). In this context, beauty ceased to be considered a neutral or universally valid category, taking on instead the characteristics of an ambiguous and potentially conservative concept. This transformation has led to a gradual decline in aesthetic reflection, giving rise to a design culture strongly oriented toward clearly measurable and comparable criteria of objectivity

and rationalization. As Renzo Piano pointed out during his meeting with Sam Keller, director of the Fondation Beyeler, at the Renzo Piano Foundation's headquarters at the Politecnico di Milano, as part of a series of lectures included in his teaching program as a university professor, for many authors, discussing beauty today risks falling short of a comprehensive analysis. Consequently, contemporary architectural discourse has progressively prioritized other categories considered more objectively quantifiable, relegating the aesthetic dimension to a secondary or implicit role to avoid engaging with an extremely complex and problematic philosophical legacy.

Piano has repeatedly emphasized the transformative role of beauty in contemporary society, while continuing to acknowledge the importance of architecture's intangible, emotional, and perceptual dimensions. In this regard, Piano has expressed a personal interpretation and proposes the idea of beauty as the extent to which a project or action positively impacts the lives of people and the context it addresses. This vision allows for the inclusion of both subjective and perceptual variations as well as sociological or technical aspects within the concept of impact, embracing a synthesis that yields extremely modern and adaptable components. What Piano seems to be referring to, however, is a systemic impact that can actually offer practical and respectful solutions for positive and lasting change in the daily lives of end users (Piano & Keller, 2025).

The proposal made in 2020 to include a dimension entirely dedicated to beauty within the NEB pillars reintroduces a concept of beauty that seeks to express itself in terms similar to those used by Piano when considering the holistic component, but without the same transformative metric. Here, beauty is considered the measure of the quality of the overall experience.

This perspective also incorporates elements derived from philosophical interpretations, such as those of Crispin Sartwell and Wilfried van Damme, who redefine beauty not as an intrinsic property of the object or an expression of the subject, but as a situated interactive dynamic. From this perspective, "beauty" arises from a design's ability to evoke shared cultural and identity-based associations.

We thus identify dynamic and collective elements that manifest themselves through social participation and perceived well-being within a specific cultural context (Van Damme, 1996) (Sartwell, 2004).

The NEB text reiterates that, after decades in which modernism had "deconstructed" beauty by prioritizing function, discussing aesthetics today means reclaiming the idea of the quality of the perceptual experience.

The objective of the tool presented for evaluating this dimension was therefore not only to update an existing framework (as was done for the Sustainability dimension), but also to define the parameters for calculating this dimension, taking the first steps toward a more comprehensive understanding of the theoretical and practical landscape. Some criteria clearly embody the vision of beauty that the NEB sets forth in the opening pages of the dedicated chapter, while in other cases, indicators are present that do not strictly correspond to this vision. While it is true that seeking an overly narrow definition would fail to capture the complexity of the issue at hand, there is also a clear structural ambiguity in the definition adopted by the NEB: the quality of the experience can, in fact, be considered the end result of every design decision made throughout the process.

At the same time, however, each choice affects different types of experiences to varying degrees: for example, there is a strong focus on perceptual and contextual elements related to physical comfort (materials, light, air) that influence the direct perception of space, but attention is also given to the use of technologies that facilitate recycling, a strategy that improves the building's overall impact on the urban and environmental systems, generating

a benefit in the user's life without, however, affecting the direct perceptual and cultural experience.
While some of these aspects, whose impact is indirect, remain fundamental, their relationship to "beauty" is not effectively explained in the document.
Although these criteria support the NEB's social and environmental objectives, their connection to the dimension analyzed here is not adequately substantiated. The result is a risk of overlap or redundancy with the criteria integrated into the dimensions of social inclusion and environmental sustainability. This outcome risks undermining the conceptual autonomy of the discourse on beauty by creating a heterogeneous collection of best practices rather than a standalone measurable parameter.
The effort made to develop an evaluation based on measurable parameters that identify a shared concept of beauty while preserving its flexibility and multifaceted nature is certainly an interesting and innovative endeavor. However, there remain some unresolved methodological limitations that highlight a tension, not yet definitively resolved, between the desire to measure experiential aesthetics and the recognition that beauty remains a phenomenon largely irreducible to quantitative parameters.

KPI / NEB Indicator	Stato	Exclusion Criteria / Methodological Notes
B.1 Digitalisation in construction	Partially Considered	B.1.2 Cannot be calculated due to difficulties in identifying a definitive prefabrication supply chain
B.2 Quality of design and delivery	Partially Considered	B.2.2 Cannot be calculated given the academic nature of the project and the absence of employment contracts
B.3 Resilience to extreme events	Not Considered	It was not possible to use simulations detailed enough to develop reliable predictive scenarios
B.4 Ensuring occupant health, comfort and wellbeing	Considered	-
B.5 Improving accessibility for everyone	Considered	-
B.6 Maximising durability and service life	Considered	-
B.7 Aesthetic Acceptance and Multisensory Experience	Considered	-
B.8.1 Spatial coherence and urban cohesion	Not Considered	Not applicable. The project is carried out within existing structures without altering their outline or volume. The façade's aesthetic is retained; a numerical calculation would have to account for a condition of ex-ante physical invariance, which would distort the effectiveness of the tool.
B.8.2 Re-use of spaces and buildings	Partially Considered	Considered for the rehabilitation of degraded areas (RDA). Excluded from the "Remediation of Contaminated Sites" (RCA) program due to the confirmed absence of pollutants or toxic soils.
B.8.3 Green urban areas	Not Considered	Mathematical incompatibility due to the absence of associated outdoor spaces, undisturbed soil, and pre-existing vegetation that can be quantified.
B.9 Improving preservation of cultural and natural heritage	Considered	
B.10 Maintaining genius loci and improving sense of belonging	Considered	

B.11 buildings and spaces through comparison to actual 'styles' and tendencies in art and architecture	Considered

Table 16. *KPI selection for beauty dimension*

B.1 Digitalisation in construction

B.1.1 Collaboration and information sharing

Since the project was carried out on various scales, it is possible to consider the architectural development of the two warehouse spaces as part of a broader system: the FARMER project. The initial analysis and the sharing of materials in an interdisciplinary context added value to the project and formed the basis for the development of the architectural space. During this phase, materials were shared among team members, stakeholders such as Exagro and the City of Milan, and researchers involved in the project through platforms like OneDrive, Miro, and Figma, allowing the entire team to access and make changes to the materials. At the same time, the sharing platforms were divided into subsections containing different types of documents (from 3D drawings to spreadsheets to 2D drawings) to facilitate the use of various tools by the different groups of stakeholders involved. As for the execution of the academic architectural project, since it was carried out by a single person, this approach would be difficult to apply unless considered as part of a broader system. It was therefore decided to test the method's applicability by considering the project as part of the overall urban redevelopment of the area adjacent to the connected warehouses. In line with the description provided in the manual, a full level of collaboration (BIM Stage 2) was considered, which is assigned a score of 50 points.

Metric	**Score**[1]
Select a single value from the metrics below:	
Low collaboration	+10
Partial collaboration (BIM stage 1)	+30
Full collaboration (BIM stage 2)	+50
Full integration (BIM stage 3)	+75
If [Full collaboration or Full integration] has been selected, check the additional metrics below (multiple selections allowed):	
[Full collaboration or Full integration] + Virtual or Augmented Reality	+20
[Full collaboration or Full integration] + Parametric or Generative Design	+20
[Full collaboration or Full integration] + IoT	+20
[Full collaboration or Full integration] + Digital Twin	+20
Indicator score = Σ (metric scores)	**≤ 100**

Table 17. *B.1.1 score. (Joint Research Centre (JRC), 2024)*

Premanufacturing and automation (B.1.2)

As the project is currently in the preliminary design phase, a detailed bill of quantities referencing final vendors and supply chains or final construction specifications, is not yet available. Nevertheless, it would be possible to estimate the contribution that each construction package and system would make to the total percentage of prefabrication, as well as to estimate the GCC, based on the Work Breakdown Structure (WBS) or the cost approach (reproduction cost).

Item	Value	Performance class
Collaboration and information sharing	Full collaboration	-
B.1.1	50	(Acceptable)[1]
B.1.2	-	(Acceptable)[1]
B.1	25	Low

Table 18. *B.1 calculation*

In conclusion, the project would be rated as "acceptable" with regard to this indicator only:

$$B.1.1 = 0.5 \cdot \mathrm{B}.1.1 + 0.5 \cdot \mathrm{B}.1.2 = 25$$

B.3 Quality of design and delivery

B.2.1 Competencies of design team and contractors

As the project is a university project carried out by only one student this indicator does not result applicable.

B.2.2 Responsible material sourcing

The Responsible material sourcing indicator quantitatively assesses the percentage of construction products sourced from traceable and certified supply chains, on a scale from 0 to 100. The primary objective is to mitigate environmental, economic, and social impacts throughout the entire product life cycle, from raw material extraction to manufacturing, through the adoption of rigorous principles of sustainable development and transparency in the supply chain.

For the purposes of this study, the legality of the materials' origin is considered a mandatory prerequisite. Specifically, for wood-based products, this requirement means compliance with internationally recognized certification schemes, such as FSC (Forest Stewardship Council) and PEFC (Programme for the Endorsement of Forest Certification), or with the European EUTR regulation.

Given the academic nature of the project and its preliminary planning phase, the assessment protocol has been focused on the analysis exclusively on wooden elements and components. This decision was motivated by the central role of wood in the proposed design strategy.

The methodological approach was supported by the use of the One Click LCA software, which allowed for the precise mapping of potential suppliers and the extraction of data related to specific products. Through a systematic comparison of different product options and their respective certification frameworks, it was possible to calculate the proportion of sustainable materials relative to the total mass (or volume) of the analyzed components.

In line with the parameters defined by the New European Bauhaus (NEB) framework and BRE standards (2016), the assessment aims to evaluate the project's performance relative to the established targets, which range from a minimum accessibility threshold (25%-60%) to excellence targets (70%-90%), thereby providing an empirical basis for optimizing technological choices from a regenerative perspective.

To perform a quantitative assessment of the Responsible material sourcing indicator, the methodology described in the NEB framework has been applied, which defines the indicator as the percentage of construction products sourced from traceable and certified sources relative to the total materials analyzed.

The calculation is performed by weighting the surface areas of the various components to verify whether the project meets the required performance thresholds.

Component Analysis and Prerequisite Verification

The first essential step is to verify the legal origin of all components. According to the indicator, failure to meet this requirement for even a single component would result in a total score of zero. Based on the documentation provided:

- ALPI (Birch Panels): FSC (Forest Stewardship Council) certified.
- PANGUANETA (OSB): PEFC and FSC certified.
- ITLAS (Flooring): Although the company holds system certifications (ISO 14001) and chain-of-custody certifications (FSC, PEFC), for the purposes of this academic

application, it is assumed that the specific product selected does not have a valid chain-of-custody certification for the purposes of the calculation (score = 0 for this element).

Structural Element	Supplier	Surface	Certification	Traceability Status
Wall and Ceiling Cladding	ALPI	1200 m^2	FSC	Traceable
OSB panels for exterior walls	Panguaneta	84 m^2	PEFC/FSC	Traceable
Floor covering	ITLAS	660 m^2	None	Untraceable
TOTAL		1944 m^2		

Table 19. *Certification type and quantity calculation in m^2*

3. Calculation of the Indicator

The responsible sourcing indicator B.2.2 is calculated as the ratio of the sum of the certified quantities Q_{cert} to the total quantity of the materials in question Q_{tot}

$$B.2.2 = \frac{1200 + 84}{1200 + 84 + 660} \times 100 = 66,05\%$$

The resulting score of **66.05%** allows the preliminary design to be classified within the performance categories defined by the international standards cited in the NEB method:

- Compared to GPP (Green Public Procurement) targets: The project far exceeds the “easily achievable” target of 25% and approaches the ambitious target of 70%.
- Compared to the BRE standard (2016): The project exceeds the first performance level set at **60%**, but does not reach the second level (75%).

The analysis shows that the high proportion of certified interior wall coverings (ALPI) partially offsets the use of a non-certified flooring product (ITLAS). To improve the performance class and aim for the 90% target (the highest BRE level), the flooring would need to be replaced with a traceable solution.

Compliance with material efficiency opportunities (B.2.3)

As indicated in the manual, indicator B.2.3 does not apply to renovation projects that do not involve structural changes to the building. It is therefore possible conclude that, for an academic project in the preliminary phase, this KPI is particularly problematic with regard to indicator B.2.1, while it remains a valid tool for analyzing the impact of the material procurement phase and the certifications that regulate and evaluate it.

The final score for the indicator would be 33 (Low) if the assessment is considered in its entirety, while it would correspond solely to indicator B.2.2 if the assessment were adapted to the academic context in which the project was developed, resulting in a score of 66 (Acceptable). However, it must be taken into account that in such a case, the final thresholds for the entire indicator would also need to be revised to align with the threshold specified for B.2.2 on page 186 of the manual, since this would be the only parameter considered. With this adjustment, the project would fall into the “Good” category.

$$B.2 = \frac{0.3 \ \cdot B.2.1 + 0.3 \ \cdot B.2.2}{0,6} = \frac{0.3 \ \cdot 0 + 0.3 \ \cdot 66}{0,6} = 33$$

B.3 Improving building resilience to extreme events

The assessment of KPI B.3, which pertains to resilience to extreme events, reveals a methodological complexity that, at this preliminary stage of the project, precludes a quantitative quantification of the indicators but, at the same time, provides a solid framework for defining future executive design strategies. The inability to produce an analytical calculation of the final score should not be viewed as a gap in information, but rather as a consequence of the very nature of the indicator, which requires structural modeling and operational management plans that are not yet accommodated within the current scope of definition. Nevertheless, the NEB framework proves to be an extremely flexible and adaptable tool, capable of stimulating forward-looking reflection on future climate scenarios and guiding the redevelopment of the Magazzini Raccordati toward safety and functional continuity standards that exceed regulatory requirements.

The analysis conducted identifies fire risk and hydraulic risk as the main drivers of vulnerability for the site, supporting this assessment through the use of scientifically reliable databases and institutional maps. Although the hazard characterization does not include a site-specific fluid dynamics or hydraulic simulation, it derives its validity from the integration of hazard maps from the Hydrogeological Management Plan (PAI) and the geological component of Milan's Territorial Government Plan (PGT), which provide a probabilistic estimate of event intensity necessary to inform initial design decisions. From this perspective, indicator B.3.1 serves as a methodological bridge between the current state and the future vision, highlighting how the intrinsic stability of the existing massive structure in its as-built state contributes to the system's overall resilience even before any technological integrations are implemented.

The framework's potential impact on the design phase is clearly evident in its ability to derive technical guidelines from performance tables by adjusting the parameters for consequence mitigation (B.3.3) and component resistance (B.3.2). The extensive use of biomaterials, such as poplar panels and selected wood veneers for the interiors, requires specific attention to fire resistance, which is addressed by selecting products certified to Euroclass B-s1, d0. Similarly, an understanding of flood dynamics suggests immediate spatial requirements, such as positioning systems and electrical outlets above the flood level or integrating digital alert systems through the complex's management application, thereby ensuring the survivability required by the manual. Ultimately, the partial application of KPI B.3 shifts the focus of design from a purely aesthetic or functional approach to one of "predictive architecture", in which the design does not merely withstand the extreme event but internalizes its probability, transforming the technical requirement into an essential component of the quality of public space and the safety of the resident community.

B.3.3 Consequence mitigation

The role of B.3.3 shifts to the functional aspect and user safety, regardless of the specific nature of the hazard.

The analysis conducted using indicator B.3.3 makes it possible to move beyond the purely regulatory aspect of the project (related to the sizing of evacuation routes and signage, which is addressed by KPI B.5.1) to focus on **operational resilience** requirements. Although backup systems have not yet been specified at this stage, the NEB procedure allows for **the identification of critical infrastructure components**, such as early warning systems and off-grid power reserves, necessary to ensure the safety of occupants and the resumption of activities following an incident. Recognizing these needs at this preliminary stage serves as a programmatic constraint for the design phase, ensuring that the architecture is prepared to accommodate the technologies necessary for the functional continuity of the facility.

B.4 Ensuring occupant health, comfort and wellbeing

The analysis of KPI B.4 highlights one of the most problematic aspects present in some of the evaluation parameters, which stems from a methodological tension between the framework's aspiration to serve as a guide to best practice, capable of actively influencing design, and the extremely specific nature of the regulatory foundations on which certain evaluation metrics are based. The criteria adopted, in fact, reflect a rigidity in performance requirements which, while ensuring absolute compliance with European regulations, is difficult to reconcile with the embryonic or preliminary stages of the process, during which there is actually greater room for maneuver and freedom to make changes, and these are easier to implement.
In this specific case, the main challenge lies in the fact that the indicators are tied to international technical standards and voluntary certification schemes, such as **EN 17210, WELL v2, and Fitwel**. These standards require detailed documentary evidence and physical simulations (lux measurements, reverberation times, PMV calculations) that are impossible to apply with the necessary precision during the preliminary design phase. The result is a tool that can "guide" the design process only in certain phases and thus limits the scope of its impact. However, it is possible to recognize the validity of KPI B.4 and its usefulness, especially with regard to its ability to place aspects such as neurodiversity or the promotion of physical activity at the center of the design, offering the opportunity to integrate requirements for perceptual and physical well-being into the design logic.

B.4.2 Thermal comfort

Despite the project being in the conceptual design phase, preliminary data made it possible to perform dynamic energy modeling using the Honeybee plug-in (an EnergyPlus interface), which allowed us to overcome the typical limitations of purely qualitative analysis.
In particular, it was possible to verify the PMV (Predicted Mean Vote) and PPD (Predicted Percentage of Dissatisfied) parameters required to meet targets set by international standards such as ASHRAE 55 and the WELL v2 protocol. The simulations confirmed the effectiveness of the building services system and its thermal performance during both the summer and winter months. The project also includes the use of a dual-flow VCM system integrated with dehumidification modules, as well as an environmental monitoring system that enables compliance with the requirements of criterion T07.
The presence of two large areas that are not separated by partitions but have distinct uses and operating schedules makes it necessary to provide a separate control system for the different activity areas, one that allows for the coexistence of different microclimates or enables separate, energy-efficient management. This strategy could allow the project to further comply with criterion T03. Criterion T08, however, remains relatively significant in this context, given the limited floor area of the glazed section and the volume of the space, most of which is located within the connecting corridor, far from the single facade.
Consistent with the scope of the intervention, the assessment for criterion T09 (Outdoor Thermal Comfort) is also expected to have an extremely limited impact, as it is strictly dependent on external urban microclimatic variables. In fact, the project site does not include any undeveloped square meters.

Metric	Score
Select single value below:	
The project does not comply with any of the following WELL v2 (IWBI, 2020) criteria.	B.4.3 = 0. No further points to be added.

The project complies with the following WELL v2 criteria	*Check next metrics.*
WELL v2 criteria (multiple selections allowed):	
T01 Thermal performance - Part 1	+40
T03 Thermal zoning	+15
T05 Radiant thermal comfort	+15
T07 Humidity control	+15
T08 Enhanced operable windows	+15
T09 Outdoor thermal comfort - Part 1	+15
Indicator score = Σ(metric scores)	**≤ 100**

Source: JRC.

Table 20. *B.4.3 score (Joint Research Centre (JRC), 2024)*

B.5 Improving accessibility of the built environment for everyone

B.5.1 Ease of circulation

The application of indicator B.5 requires compliance equivalent to the TR 1721 criteria and recognizes the provisions of Italian legislation (Ministerial Decree 236/89) as such, emphasizing the importance of ensuring maximum accessibility in the designed spaces. In this case as well, the framework aligns with a definition of beauty that is closely tied to the well-being of users. In the Magazzini Raccordati project, achieving this goal is facilitated by the original layout of the spaces: the absence of corridors, the decision not to introduce new opaque partitions, and the avoidance of varying floor levels have made it possible to minimize any physical barriers.
To complement the architectural aspect, the project also includes the integration of a digital map of the spaces, which will be incorporated into the app developed in parallel with the urban project. The app's primary function is to showcase the projects and organize activities in order to improve accessibility to the entire project and foster greater community participation.

Metric	**Score**	**Non-applicable[1]**
Select single value below:		
The project does not comply with the EN 17210 (CEN, 2021b) sections listed below.	B.5.1 = 0. No further points to be added.	
The project complies with the following EN 17210 sections:[2]	*Check next metrics.*	
9.1.1-2, 9.1.4-6, 9.1.10-11, 9.1.13-14 Entrances		
9.2.1-2, 9.2.4-7 Corridors and passageways	✓	☐
9.3.1-5 Doors	✓	
9.5.1-3 Patios, balconies and terraces		✓
10.1.1-7,10.1.10, 10.1.12-13 Ramps		✓
10.2.1-5, 10.2.10-12 Steps and stairs		✓
10.3.1-3 Handrails		✓
10.4.1-4 Lifts		✓
10.5 Vertical and inclined lifting platforms		✓
10.6 Escalators and moving walks		✓
11.1.1-6 Service counters for information, ticketing and reception	✓	☐
11.2.1-3 Waiting and queuing areas	✓	☐
Compliance with EN 17210 is demonstrated through (single selection allowed):		
Compliance is demonstrated through use of national guidance and regulations with accessible design criteria that are less stringent than TR 17621 (CEN, 2021c).	+20	
Compliance is demonstrated through use of TR 17621, or national guidance and regulations with equally (or more) stringent accessible design criteria.	+40	
The project also complies with the following enhanced design features (multiple selections allowed but a maximum score applies to each category):		
Category: Entrances and doors	(≤15)	
Entrance doors and internal lobby doors have a min clear width of 1.00 m.	+5	
Minimum clear width of internal doors is 0.85 m (including accessible toilets).	+5	
Minimum 0.70 m of clear space is provided at the latch side of the door.	+2.5	
Side-hung gates are self-closing.	+2.5	☐
Where there is risk of crowding, alternative entrances and exits are provided with clear signage, or appropriate management procedures.	+5	✓
Entrance canopy (if provided) extends beyond the door width for at least 1.25 m to accommodate a wheelchair and provide sufficient space to avoid the direct flow of people using the entrance doors.	+2.5	✓

If a large entrance canopy is provided, seating allows a person or people to pause and reset before entering or leaving. Materials used at entrance canopy do not accentuate the sound of rain or similar.	+2.5	✓
Category: Corridors, passageways and other spaces	(≤15)	
Corridors have a minimum unobstructed width of 1.80 m between handrails or other projections.	+5	☐
Minimum turning space of 1.50m · 1.50m is achieved for wheelchair users for a turn of 90 degrees.	+5	☐
Long narrow corridors are avoided, or are broken up using windows on side walls, intersections, and recesses, and if dead-end corridors are provided, they incorporate a seating area.	+5	☐
Places to pause or break a journey are provided, for example with seating, allowing people to reset and recharge before continuing.	+5	☐
Category: Steps and stairs	(≤10)	
There are no spiral, helical or curved stairs.	+5	✓
There are no skewed stairs or stair winders.	+5	✓
Minimum distance of 3.00 m is provided between descending stairs located opposite lift doors and the lift doors.	+5	✓
Category: Lifts, vertical and inclined lifting platforms, escalators and moving walks	(≤15)	
An alternative to escalators and moving walks is provided.	+5	✓
Clear manoeuvring space in front of lift car entrance and inclined lifting platforms is minimum 1.80 m in diameter.	+5	✓
Clear width of vertical lifting platform doors at landing is a minimum of 0.90 m.	+5	✓
Lift cars do not have black or dark floor finishes.	+2.5	✓
A small mirror in a lift is provided to facilitate safe reversing for wheelchair users. A large mirror is avoided as it can be frightening for people with dementia.	+2.5	✓
Category: Service counters for information, ticketing and reception	(≤5)	
Manoeuvring space in front of service counters is minimum 1.80 m in diameter.	+5	☐
Reception/information counters are identifiable from the main point of entry.	+5	☐
Indicator score = Σ(metric scores)	**≤ 100**	

[1] If the non-applicable option is selected (when available), the full metric score is considered in the evaluation of the indicator score. If satisfied and non-applicable metrics result in a score higher than the maximum within a category, then the maximum score of the category is applied.

[2] If the section of EN 17210 does not apply to the project (i.e. non-applicable is selected), then as long as all other stated sections are complied with,

Table 21. *B.5.1 score (Joint Research Centre (JRC), 2024)*

$$B.5.1 = 20 + 5 + 5 + 2.5 + 2.5 + 5 + 5 + 5 + 5 = 50$$

B.5.2 Safe wayfinding

The evaluation of indicator B.5.2 involves analyzing the project strategies related to the user's sensory experience. Given the need to comply with national guidelines and regulations regarding the project's accessibility, the evaluation table provided below was applied. The use of natural materials and a neutral color palette fosters a visual sense of calm. The opportunity to develop, in collaboration with the FARMER project, a digital tool that provides a sensory map accessible remotely also ensures the predictability of the experience and allows users to familiarize themselves with the space prior to their visit. The ability to monitor space occupancy in real time via the occupancy calendar, which covers both the two warehouses and the adjacent spaces, extends the concept of accessibility to the temporal dimension. This allows individuals with specific sensitivities to plan their visit under conditions of optimal acoustic and social comfort.

Metric	Score	Non-applicable[1]
Select single value below:		
The project does not comply with the EN 17210 (CEN, 2021b) sections listed below.	B.5.2 = 0. No further points to be added.	
The project complies with the following EN 17210 sections:[2]	*Check next metrics.*	
6.1 Wayfinding, orientation and navigation		
6.2 Wayfinding information		
6.3.1-3 Wayfinding - visual contrast		
6.4 Tactile information		
6.5 Audible information and hearing enhancement		
6.6 Signage		
6.7 Graphical symbols		
9.1.3, 9.1.7, 9.1.9 Entrances		
9.2.3, 9.2.12-14 Corridors and passageways		☐
9.3.10 Doors		
9.6 Surface finishes and materials		
10.3.6-7 Handrails		✓
10.4.8 Lifts		☐
11.1.7-8 Service counters for information, ticketing and reception		☐
11.2.4-5 Waiting and queuing areas		☐
11.3.11 Seating and resting areas		☐
13.1 User interface, controls and switches - rationale		
13.2 Public ICT information screens		✓
13.3 ICT user interfaces		
Compliance with EN 17210 is demonstrated through (single selection allowed):		
Compliance is demonstrated through use of national guidance and regulations with wayfinding design criteria that are less stringent than TR 17621 (CEN, 2021c).	+20	
Compliance is demonstrated through use of TR 17621, or national guidance and regulations with equally (or more) stringent wayfinding design criteria.	+40	
The project also complies with the following enhanced design features (multiple selections allowed but a maximum score applies to each category):		
Category: Tactile information	(≤5)	
The maximum size of a tactile map is 0.60 m high · 1.00 m wide.	+5	
The height of the relief of raised tactile letters, figures and graphical symbols is 1.00-1.50 mm.	+5	
Category: Signage and public ICT information screens	(≤15)	
Signs are separated from other notices and pictures to avoid a cluster of competing information.	+2.5	☐
Signage has both symbols and words (except for universally accepted or mandatory safety symbols or pictures), is concise and easy to interpret, and contrasts from the surface it is mounted on (light reflectance value (LRV) difference ≥ 70).	+5	☐
Signage uses consistent terminology in the built environment, digitally, and in any other medium.	+5	☐
Directional signage is visible from all directions of approach, where practicable, and repeated at each decision and reassurance point.	+5	☐
Location signs confirm arrival at destinations.	+5	☐
The position of ICT screens above head height are at a minimum height of 2.30 m.	+5	☐
Category: Steps, stairs, lifts, vertical and inclined lifting platforms, escalators and moving walks	(≤10)	
Steps and escalators have a strong visual contrast (LRV difference ≥ 70 points) to the edge of the tread and riser.	+5	☐
Bold or intense patterns are avoided on walkways or stairs.	+5	☐
Category: Wayfinding	(≤15)	
Information and wayfinding are provided in at least two sensory formats, including visual, audible, and tactile.	+5	

Opportunities to preview spaces such as through glazing, from outside or within the building, are provided where appropriate.	+5	
Unique and highly visible features are positioned in strategic locations to assist in wayfinding.	+2.5	
In complex visitor destinations, help points are provided at key intervals.	+2.5	☐
Key amenities (e.g. WCs, baby change, tea points, first-aid, restorative rooms) are located consistently throughout the building so they are found in a similar position on all floors.	+5	
Category: Colours and patterns	(≤10)	
Vivid colours are kept to a minimum (to avoid overwhelm), and if red is used, especially on a white background, it is used sparingly (red causes difficulties for some people).	+5	
Large areas (including floors) of highly contrasting geometric or repetitive patterns (LRV difference ≥ 30 points) and patterns in three dimensional forms (including shadow patterns) are avoided.	+5	
Visual contrast (LRV difference ≥ 15 points) between adjacent floor finishes is avoided, or one or more incremental bands that are ≥ 50mm deep are provided to create a graduated change between the two primary surfaces.	+5	
Category: Information	(≤5)	
Pre-visit preview information provides information about the environment, what to expect during a visit, and journey information. Preview information is available before the visit (e.g. virtual flythrough videos, audio description, building plans) as well as upon arrival.	+5	☐
If crowds are inevitable at predictable times, these timings are publicised so that people can avoid them, alongside provision of well signposted restorative spaces.	+5	☐
Indicator score = Σ(metric scores)	**≤ 100**	

[1] If the non-applicable option is selected (when available), the full metric score is considered in the evaluation of the indicator score. If satisfied and non-applicable metrics result in a score higher than the maximum within a category, then the maximum score of the category is applied.

[2] If the section of EN 17210 does not apply to the project (i.e. non-applicable is selected), then as long as all other stated sections are complied with, then the project is deemed to be in compliance with EN 17210.

Table 22. *B.5.2 score (Joint Research Centre (JRC), 2024)*

Based on the application of the strategies described above, the indicator reaches a score of 65.

$$B.5.2 = 20 + 2.5 + 5 + 5 + 2.5 + 5 + 5 + 5 + 5 + 5 = 60$$

B.5.2 Usability and operation

As previously noted, the identified strategy and the proposed spatial organization do not preclude compliance with the standards defined by EN 17210 (and the related ISO 21542 references); furthermore, they aim to extend their scope to address issues not covered by those standards. Nevertheless, the current level of detail does not allow for the definitive verification of compliance for certain sections involving finer levels of detail. The selection of evaluation criteria for indicator B.5.3 is therefore limited to the aspects addressed at the current stage of the project, with the aim of reaffirming the centrality of the parameters identified as future guidelines for subsequent design phases.

Metric	**Score**	**Non-applicable**[1]
Select single value below:		
The project does not comply with the EN 17210 (CEN, 2021b) sections listed below.	B.5.3 = 0. No further points to be added.	
The project complies with the following EN 17210 sections:[2] 9.3.7-8, 9.3.12-14 Doors 9.4.1-5 Windows	*Check next metrics.*	

10.3.5 Handrails		
10.4.5-6, 10.4.12 Lifts		☐
11.2.6 Waiting and queuing areas		☐
11.3.1-10, 11.3.12 Seating and resting areas		☐
11.4 Storage areas, lockers and baggage storage		☐
11.5 Kitchen areas and kitchenettes		☐
11.6 Facilities for assistance dogs		
12.1.1-7 Accessible toilets		
12.2 Toilets for general use		
12.3 Sanitary facilities for other users		
12.4 Showers and bathrooms		
13.4 User interface, controls and switches - controls and switches		
13.5 User interface, controls and switches - examples of general use elements		
Compliance with EN 17210 is demonstrated through (single selection allowed):		
Compliance is demonstrated through use of national guidance and regulations with usability and operation design criteria that are less stringent than TR 17621 (CEN, 2021c).	+20	
Compliance is demonstrated through use of TR 17621, or national guidance and regulations with equally (or more) stringent usability and operation design criteria	+40	
The project also complies with the following enhanced design features (multiple selections allowed but a maximum score applies to each category):		
Category: Doors	(≤10)	
Operating force of maximum 15 N for manually operated doors without door closers.	+5	
A horizontal supportive grab bar is provided for doors wider than 0.85 m and for the inside face of accessible toilet doors.	+5	
All manually operated door opening hardware is lever action.	+2.5	☐
Category: Lifts	(≤5)	
Lift cars have a min of one handrail on each car wall, only interrupted by the operating panel, with the free space between the wall and the gripping part at least 50 mm.	+5	☐
Category: Kitchen areas and kitchenettes	(≤5)	
Cupboard doors have a 180-degree opening.	+2.5	☐
Pull-out shelves in kitchen areas and kitchenettes are fitted immediately below the work surface.	+2.5	☐
Refrigerators and freezers are fitted as separate units on a plinth with a min. height of 0.20 m.	+2.5	☐
Category: User interface, controls and switches	(≤15)	
Where card slots are provided, they are between 0.80-0.90 m above floor.	+2.5	☐
Minimum distance from control to internal corners is 0.70 m.	+5	
Height of controls above floor surface is between 0.80 m and 1.10 m.	+5	
Fixtures and controls are low noise where practicable (e.g. soft close cupboards and toilet lids, quiet flush WC systems). Where provided, quiet hand dryers (maximum 70 dB) are selected.	+5	
Fittings, switches, controls and technology are intuitive and simple to use. Additional simple directions for use are provided.	+5	
Category: Facilities	(≤20)	
WELL v2 (IWBI, 2020) V04 Facilities for Active occupants - Part 2 criteria are met.	+5	☐
WELL v2 (IWBI, 2020) C09 New mother support - Part 2 criteria are met.	+5	
Sanitary facilities (including WCs, changing rooms and showers where provided) are ambulant-accessible, wheelchair-accessible (including wheelchair-accessible for children), and appropriate for use by obese and bariatric users.	+5	
There is provision for self-contained WCs (with sink inside and within reach from the toilet bowl), baby changing facilities (for all genders), and stoma management within WCs.	+5	
First aid/medical facilities and equipment are provided in sufficient quantities for the number of users.	+5	
Category: Restorative spaces	(≤10)	
WELL v2 (IWBI, 2020) M07 Restorative spaces criteria are met.	+5	
Space(s) for practice of faith and/or contemplation are provided.	+5	☐

Where a large space is provided, smaller areas within the space allow retreat, or variation in ceiling heights is provided, with lower ceiling creating a more intimate quiet space.	+5	☐
Category: Furnishings	(≤5)	
A mix of furniture styles is used to meet a variety of user needs and settings. This includes ergonomic Consideratedons, including sit-stand desks, and different seat heights and support features, giving people options and choices to find the most suitable solution for their requirements.	+5	
Indicator score = Σ(metric scores)	**≤ 100**	

[1] If the non-applicable option is selected (when available), the full metric score is considered in the evaluation of the indicator score. If satisfied and non-applicable metrics result in a score higher than the maximum within a category, then the maximum score of the category is applied.
[2] If the section of EN 17210 does not apply to the project (i.e. non-applicable is selected), then as long as all other stated sections are complied with, then the project is deemed to be in compliance with EN 17210.

Table 23. *B.5.3 score (Joint Research Centre (JRC), 2024)*

$$B.5.3 = 20 + 5 + 5 + 5 + 5 + 5 = 35$$

The score obtained should be considered a preliminary score that reflects the scope of analysis possible at the current stage of the project. However, even at this stage, it is clear that a satisfactorily good score has been achieved, reflecting the attention paid to accessibility in the urban and architectural design – a result that is ensured, in particular, by the integration of digital and physical strategies.

$$B.5 = 0.33 \cdot (50 + 60) + 0.34 \cdot 35 = 48{,}2$$

B.6 Maximising durability and service life

B.6.1 Durability

Indicator B.6.1 once again focuses on aspects related to the project's environmental sustainability, which the NEB considers necessary for people's well-being and is therefore included in this case under the "beauty" dimension. Specifically, it takes into account the ability of building components to maintain their performance over time. The durability of these components reduces the need for extraordinary maintenance, premature replacement, or demolition, thereby decreasing the project's environmental footprint.
In the context described, the objective of the assessment is to evaluate the impact of preliminary design choices on maximizing the overall service life of the building structure. The limitation of this estimate lies in the inability to rely on on-site monitoring data to calculate the Estimated Service Life (ESL) of the components; it is therefore appropriate to determine this value by applying the Factors Method described in the international standard ISO 15686-1. The calculation adjusts the Reference Service Life (RSL), derived from technical databases and sector-specific Environmental Product Declarations (EPDs), using coefficients related to environmental, construction, and usage variables. The Reference Service Life (RSL) of interior wood cladding panels was assumed to be 25 years, a benchmark value derived from data provided in the certifications of manufacturers identified for wood components in air-conditioned indoor environments.
An additional **implementation limitation** was noted regarding the HVAC systems, whose definition lacks essential details necessary for the assessment; therefore, a score of zero was assigned in the fields related to these components.

Element	**Wood wall panelling**
Reference service life (years)	25
Quality of components	1.0
Design level	1.2
Work execution level	1.2
Indoor environment	1.0
Outdoor environment	1.0
In-use conditions	1.0
Maintenance level	1.0
Estimated service life (years)	**36**

Table 24. *Application of the factor method to estimate service life of elements. (Joint Research Centre (JRC), 2024)*

Metric	**Score**	**Weight (w)**
Service life of structural materials (single selection allowed):		
≥ 70 years	100	0.2
Service life of exterior finishes (single selection allowed):		
≥ 70 years	100	0.2
If [non-residential project type] has been selected, service life of interior finishes (single selection allowed):		
≥ 20 years	100	0.2
Select single value below:		
Heating, ventilation, and air conditioning (HVAC) system is present. HVAC system is not present.	√ *Check next metrics.* *x*	
If [HVAC systems is present], service life of HVAC, water supply and drainage pipe systems (single selection allowed):		

At least two out of the top three most used pipe system types (in terms of weight) > 30 years.	0	0.2
Service life of major equipment and services (single selection allowed):		
15 – < 30 years	0	0.2
Indicator score = Σ(metric score · weight)	**60**	

Table 25. *B.6.1 score (Joint Research Centre (JRC), 2024)*

The application framework assigns the project a final score of 60/100. This result, however, is subject to a purely informational - rather than performance-related - distortion due to the weight assigned to sections for which an evaluation was not applicable. The weight is thus equally redistributed among the three components that were actually analyzed.

B.6.2 Design for adaptability

Indicator B.6.2 assesses the building's capacity to accommodate future changes in use through a possible redesign of the interior layout or changes in commercial and social usage patterns over the long term. The purpose of this focus is to promote projects and decisions that minimize the need for large-scale demolition or major structural renovations during the building's life cycle, taking into account the possible changes in use that the building will undergo over the years. Spatial flexibility is identified as a fundamental strategy for countering the obsolescence of the built environment and extending the useful life cycle of the material resources incorporated into the structure.
The project under evaluation is situated within a structure that lends itself well to reorganization, although it is constrained by limited access to natural light and ventilation, which make it unsuitable for any potential reconfiguration into residential units. Similarly, the physical layout, the historical significance of the facades, and the presence of the railway infrastructure overhead make any volumetric extensions unlikely, if not impractical.
Some of the evaluation metrics cannot, therefore, be taken into account for this specific project and this particular type of redevelopment. It is therefore considered necessary to redistribute the weight assigned to metrics such as vertical and horizontal extent.

Metric	**Score**	**Weight (w)**
Changes to the internal space distribution:		
Column grid spans: Minimum spacing of vertical load-bearing elements (single selection allowed):		
free span	100	0.04
Façade pattern: Spacing between openings (single selection allowed):		
1350 – < 1800 mm	33	0.04
Internal wall system (single selection allowed):		
Movable interior walls, require disassembly.	67	0.14
Unit size and access: Average portion of floor area that can be used separately from other spaces (single selection allowed):		
< 200 m²	100	0.10
Changes to the building services:		
Ease of access to service ducts: Location of key service ducts (single selection allowed):		
Below one building layer (ceiling), exposed or easily removable cover.	100	0.04
Ease of access to plantrooms (single selection allowed):		
Located on the ground floor with easy external access.	67	0.04
Longitudinal ducts for service routes (single selection allowed):		

/	0	0.04
Higher ceilings for service routes: If [**non-residential project type**] has been selected, internal height (floor surface to structural surface for at least 95% of the floor area) (single selection allowed):		
3000 – < 3500 mm	33	0.14
Services to sub-divisions: Average portion of floor area that can be serviced by a sanitary facility (single selection allowed):		
≥ 600 m²	0	0.10
Changes to the building façade and structure:		
Façades (single selection allowed):		
Non-bearing façade with bearing obstacles[1]	67	0.14
Futureproofing of load bearing capacity of floors: Imposed loads (at least for 75% of the floor area): (single selection allowed):		
5.00 kN/m²	100	0.14
Structural design to support future expansion: Capacity to add storeys (single selection allowed):		
/	0	0.04
Indicator score = Σ(metric score · weight)	**59.38**	

1 Examples of obstacles include bearing interior walls, columns, elevator shafts or installation ducts.

Table 26. *B.6.2 score (Joint Research Centre (JRC), 2024)*

B.6.3 Design for deconstruction

Indicator B.6.3 assesses the degree to which the principles of reversibility and disassembly of building components at the end of their life cycle are integrated. The objective is to quantify the circularity of material flows, rewarding technological solutions that promote the recovery, pure recycling, or direct reuse of materials, while minimizing the production of unsorted or toxic waste.

The calculation of this indicator is similar to that used for the sustainability dimension and, in particular, for the "Construction and Demolition Waste" indicator.

B.7 Ensuring high level of aesthetic acceptance of buildings and spaces

Indicator B.7 quantifies the quality of the aesthetic experience produced by the interaction between the user and the built environment through the senses. The analysis is divided into a visual component (B.7.1), which maps the static and dynamic factors of formal perception, and a multisensory component (B.7.2), which explores the tactile, acoustic, and olfactory dimensions stimulated by the architecture.

B.7.1 Visual experience of architecture and space

The evaluation focuses on the visual aspects of the project, which were guided by Consideratedon of the constraints and geometric characteristics of the historic building envelope, as the primary vectors of the project's visual order and architectural promenade. The evaluation is based on the tables provided in the NEB self-assessment manual (Paulo, et al., 2024)

The geometric and spatial elements have been arranged symmetrically around the central longitudinal axis, featuring a full-height partition that mirrors the volumes of the façade in both warehouses, two circular elements (the grandstand and the lightweight structure), and two areas furnished with tables and wall-mounted elements, each divided by a building section.

The hierarchical arrangement of the elements reflects the planning of activities and flows by linking the geometric composition to the functional organization.

As mentioned above, the use of façade geometries and distances identified in the existing building as a means of generating internal order is recognized as a design rhythm.

The B.7.1 assessment involves the quantification of two sub-metrics: Visual Richness (VisR) and Attractiveness of circulation at building scale (Acb).

Visual richness

Order principle	Score
Indicate the presence, i.e. yes, or absence, i.e. no, of each of the four order principles below and sum the corresponding 'yes' scores	
The project applies the following four order principles:	
Axis composition [Figure 80a].	If yes, +25. If no, 0
Hierarchy [Figure 80b].	If yes, +25. If no, 0
Transformation [Figure 80c].	If yes, +25. If no, 0
Rhythm/repetition [Figure 80d].	If yes, +25. If no, 0
Order (O) sub-metric score = Σ ('yes', 'no' scores)	**75**

Table 27. *Order (O) sub-metric score. (Joint Research Centre (JRC), 2024)*

With regard to the analysis of contrast via the integration of specific elements, the focus was placed on the presence of a distinct separation between surfaces and openings respecting the historical building, natural materials like birch wood paired with the existing massive structure, and iron elements supporting the green structures integrated within the design.

Contrasting element	Score
Indicate the presence, i.e. yes, or absence, i.e. no, of each of the four contrasting elements below and sum the corresponding four scores.	
The project is characterised by the contrast of the following four elements, i.e. massing, lines/spaces, surfaces and apertures, and materials: 1. Contrast of 'light' and 'heavy' massing [Figure 81a]. 2. Contrast of vertical and horizontal lines/planes, or curved and straight lines/planes [Figure 81b].	If yes, + 25. If no, 0 If yes, + 25. If no, 0
3. Contrast between surfaces and apertures [Figure 81c]. 4. Visually contrasting materials, such as light and dark colour materials, transparent and solid materials, smooth and rough texture materials [Figure 81d].	If yes, + 25. If no, 0 If yes, + 25. If no, 0
Contrast (C) sub-metric score = Σ ('yes', 'no' scores)	**50**

Table 28. *Contrast (C) sub-metric score. (Joint Research Centre (JRC), 2024)*

Given the size of the existing openings, it was possible to make the renovation recognizable from the outside thanks to the contrast in materials between the urban context and the integration of a distinctive design element within the historic building. The openness toward the built environment and the redeveloped urban area is not obstructed by the interior design elements, which feature light, horizontal elements that allow glimpses of the building's exterior even from points far removed from the main façade.

Transparency-related aspects	Score
Indicate the presence, i.e. yes, or absence, i.e. no, of each of the four transparency-related aspects below and sum the corresponding four scores.	
The project is characterised by the following four transparency-related aspects:	
1. Visual contact between the interior and exterior of the building (e.g. particularly desirable transparency of ground floors of buildings located on urban streets [Figure 82a], or - outside the buildings - between separate spaces.	If yes, + 25. If no, 0.
2. Openings towards the landscape, which provide views from a building or neighbourhood/urban layout to natural areas, such as greenery, water reservoirs, fields, meadows, hills, etc. [Figure 82b].	If yes, + 25. If no, 0.
3. Use of 'play of light and shadow', i.e. chiaroscuro, to create the visual richness of the building [Figure 82c].	If yes, + 25. If no, 0.
4. The architectural composition of the building/space considers the following light-shadow effects: (*i*) relationship of light and shadow falling on the interior of the building/space, its partitions or its furnishings, and/or (*ii*) 'chiaroscuro' variation resulting from different times of day/year [Figure 82d].	If yes, + 25. If no, 0.
Transparency (Tran) sub-metric score = Σ ('yes', 'no' scores)	**50**

Table 29. *Transparency (Tran) sub-metric score.(Joint Research Centre (JRC), 2024)*

The creation of dedicated areas for exhibitions and artistic activities involves the temporary display of items created by the community or of common interest. A score of 50 is therefore assigned in the table for the Novelty (N) submetric score.

Novelty-related aspects	Score
Indicate the presence, i.e. yes, or absence, i.e. no, of each of the two novelty-related aspects below and sum the corresponding two scores.	
The project is characterised by the following two novelty-related aspects: 1. The project incorporates meaningfully integrated artwork. 2. The project demonstrates aesthetic pioneering (based on a comparison of the proposed project with existing solutions/realisations).	If yes, + 50. If no, 0. If yes, + 50. If no, 0.
Novelty (N) sub-metric score = Σ 'yes' , 'no' scores	**50**

Table 30. *Novelty (N) sub-metric score.(Joint Research Centre (JRC), 2024)*

$$VisR = 0.3 \cdot O + 0.2 \cdot C + 0.3 \cdot T + 0.2 \cdot N = 22.5 + 10 + 15 + 10 = 57{,}5$$

Attractiveness of circulation at building scale

Although the project could not incorporate new main entrances, designating the primary entrance as the one leading to the warehouse closest to the open space in front creates an entrance that runs parallel to Via Sammartini but is perpendicular to the square and the pedestrian walkways that cross it. The inclusion of activating elements such as workshops, bicycle parking, a reception area, and greenery near the openings facing the street is intended to encourage exploration of the interior space. As noted above, the geometric arrangement of the interior elements corresponds to the main functions and the expected flow of people. At the same time, it was decided to maintain an open layout to preserve the original spatial perception of these large vaulted spaces.

Sub-metric	**Score**
Select single value below.	
The project includes the following design solutions related to the '*form of the circulation space*' element: — **Form of the circulation space** The form and scale of circulation spaces take into account the movement of people, and the opportunity to stop and rest.	0 (Low)
The project includes the following design solutions related to the '*form of the circulation space*' element: - **Form of the circulation space** Differentiated proxemics are included in the building by considering the following distances: public (3.7 m to 7.6 m and more), social (1.2 m to 3.7 m) and personal (0.45 m to 1.2 m) (Hall, 1990) [Figure 90].	*Check the next three groups of design solutions below (select single value)*
The project includes ***at least three*** of the following design solutions related to the five elements of the architectural promenade: — **Approach** Frontal, direct approach, i.e. a straight, axial path terminating in an entrance to the building or a defined space within the building [Figure 85]. — **Entrance** The boundary between the exterior and interior of the building is clear, the location of the entrance is marked by a defined spatial form. — **Configuration of the path** A simple linear layout as an organising/connecting element of a series of spaces (e.g. rooms in a building) [Figure 86]. In the case of multi-level promenades, the levels are vertically connected (e.g. stairs, ramps, lifts) [Figure 88]. — **Path-space relationship** The path is independent and does not cross the space (e.g. it is located tangentially to rooms, spaces) [Figure 89]. — **Form of the circulation space** The path has a closed form and connects to the spaces through entrances in the wall planes [Figure 90].	40 (Acceptable)
The project includes ***at least half*** of all following design solutions related to the five elements of the architectural promenade and further features enhancing the user experience: — **Approach** A diagonal approach that enhances the effect of perspective and allows a wider view of the front of the building and its entrance area [Figure 85]. — **Entrance** The entrance zone encourages exploration of the interior by providing transparency of the partitions/structural arrangement and legibility of the possible directions for further journey.	70 (Good)

— **Configuration of the path** Advanced layouts of segmented lines, either radial or spiral layouts as organising/connecting elements of a sequence of spaces[Figure 86]. Supporting the choice of movement paths [Figure 87]. In the case of multi-level promenades, the levels are vertically connected by semi-open stairs and ramps [Figure 88]. — **Path-space relationship** The path cuts through the spaces, allowing direct views of the interiors [Figure 89]. — **Form of the circulation space** The pathway has a one-side open form to provide visual and spatial continuity with the spaces it connects [Figure 90]. — **Further features enhancing user experience** The length of users' direct exposure to nature is between 25-50 % of the length of the entire promenade.	
The project includes ***at least half*** of all following design solutions related to the five elements of the architectural promenade and further features enhancing the user experience: — **Approach** A spiral approach to the building, guided in a way that emphasises its three-dimensionality [Figure 85].	100 (Excellent)
— **Entrance** The entrance to the building is a real or implied plane perpendicular to the path of approach, and the entrance area encourages exploration of the interior by providing clarity of partitions/structural layout and legibility of possible directions of further travel.	
— **Configuration of the path** Advanced network layouts with hierarchical structured paths [Figure 86]. Nodal spaces that provide opportunities to stop, rest, change direction of movement [Figure 87]. In the case of multi-level promenades, the levels are vertically connected by stairs and ramps, resolved as open interior elements [Figure 88].	
— **Path-space relationship** The location/layout of the spaces determines the path modelling, and their relationship has been planned in such a way as to emphasise the functional or symbolic meaning of the particular interiors/spaces. — **Form of the circulation space** The path has an open form [Figure 90].	
— **Further features enhancing user experience** The length of direct exposure of users to nature exceeds 50 % of the length of the entire promenade. The design of the promenade includes the concept of integrating architecture and art at least in the entrance spaces/zones (WELL v2, IWBI, 2020).	
AC_b metric score = Selected sub-metric score	**100**

Table 31. *Attractiveness of circulation at building scale (ACb) sub-metric score.(Joint Research Centre (JRC), 2024)*

$$B.7.1 = 0.5 \cdot VisR + 0.5 \cdot AC = 0.5 \cdot 57{,}5 + 0.5 \cdot 100 = 28{,}75 + 50 = 78{,}75$$

B.7.2 Multisensory experience of architecture and space

The multisensory nature of the experience involves quantifying qualitative criteria, just as is done for the assessment of visual quality.

The project incorporates natural materials while also leaving the distinctive stone of the historic facade exposed. The integration of textile, metallic, and green materials, along with the option to furnish the central area with armchairs and rugs made of various materials, enhances the potential to create a richer tactile experience.

Complete acoustic isolation of the different zones was not implemented, however, as the design prioritized maintaining an open space that allows visitors to appreciate the grandeur of the area and the natural light. However, separate areas have been provided for activities with different noise levels, as well as zones that can be closed off (using movable curtains) should greater privacy be required. The only element related to the sense of smell is a living wall that could incorporate hypoallergenic plants to purify the air and aromatic species that diffuse a light, natural scent throughout the space.

Sub-metric	**Score**
Select single value below.	
The project provides a neutral tactile experience (i.e. no factor influences the tactile experience negatively) in terms of choice of finishing materials, i.e. floor and wall coverings, and furnishings.	0 (Low)
The project attains the low tactile richness and provides a pleasant tactile experience through the use of the following design solution: - Choice of finishing materials, i.e. floor and wall coverings and other furnishings, specifically designed to enhance the tactile experience.	40 (Acceptable)
The project includes the design solutions to attain the acceptable tactile richness and provides an advanced tactile experience through the use of the following additional design solutions: — Intentional juxtaposition of flat surfaces (i.e. user-accessible floors, walls and partitions) with varying and contrasting textures (i.e. smooth-rough, bumpy-flat, hard-soft, warm-cold, slippery-sticky). — Contact with natural finishes and decorative materials, greenery, and/or water provided to the users.	70 (Good)
The project includes the design solutions to attain the good tactile richness and provides a more advanced tactile experience through the use of the following additional design solutions: — Tactile elements being part of the spatial identification system, such as spatial models, clear texture changes with additional information (e.g. definition of boundaries indicating change of use of the space and access control). — Spaces/elements stimulating tactile perception and encouraging physical contact, such as the provision of adaptive elements that can be changed by the users (e.g. mobile/foldable spatial installations, 'Do It Yourself' objects for self-assembly), digital multi-touch and gesture interactive elements. — Solutions taking into account the needs of different users (i.e. children, people with special needs), such as sensory spaces.	100 (Excellent)
TR metric score = Selected sub-metric score	**70**

Table 32. T*actile richness (TR) metric score.(Joint Research Centre (JRC), 2024)*

Sub-metric	**Score**
Select single value below.	
The project provides a neutral sound experience (i.e. no factor influences the auditory perception negatively).	0 (Low)
The project exceeds the low auditory richness by providing an acoustic experience through the following design solutions: — Creation of spaces with varying sound intensity. — Use of partitions and materials that muffle, absorb or diffuse sound.	40 (Acceptable)
The project includes the design solutions to attain the acceptable auditory richness, and provides an advanced acoustic experience through the following additional design solutions: — Intentional exposure of users to natural sounds. — Use of devices that allow users to adjust sound levels.	70 (Good)
The project includes the design solutions to attain the good auditory richness, and provides a more advanced acoustic experience through ***at least two*** of the following additional design solutions: — Sound stimulation spaces, quiet rooms, or sound experience rooms. — Arrangement of spaces where sound carries additional cognitive information (e.g. regarding the function of rooms/spaces). — Innovative solutions in terms of sound experience (e.g. use of personalised sound technology, implementation of innovations in 3D sound systems).	100 (Excellent
AR metric score = Selected sub-metric score	**40**

Table 33. *Auditory richness (AR) metric score.(Joint Research Centre (JRC), 2024)*

Sub-metric	Score
Select single value below.	
The project provides a neutral olfactory experience (i.e. no factor influences the perception of building/ neighbourhood/urban project negatively).	0 (Low)
The project exceeds the low olfactory richness by providing an olfactory experience through the following additional design solutions: - The intentional use of varied finishing materials with naturally pleasant fragrances (e.g. different types of natural wood).	40 (Acceptable)
The project includes the design solutions to attain the acceptable olfactory richness and provides an advanced olfactory experience through the following additional design solutions: - Intentional use of natural fragrant elements in the design, such as earth, water, greenery and flowers.	70 (Good)
The project includes the design solutions to attain the good olfactory richness and provides *at least two* of the following additional design solutions: — Olfactory stimulation spaces (e.g. scent gardens) in building interiors. — Specific fragrance compositions creating particularly pleasant olfactory experience changing in time (e.g. different flowers or herbs emitting aroma early morning, during the day and at the sunset/after dark) and space (e.g. user can sense different aromas when passing from one floral composition to another). — Innovative solutions in terms of the olfactory experience, unprecedented in architectural and urban design (e.g. the use of digital, personalised olfactory systems).	100 (Excellent)
OR metric score = Selected sub-metric score	**70**

Table 34. *Olfactory richness (OR) sub-metric score.(Joint Research Centre (JRC), 2024)*

$$B.7.2 = 0.5 \cdot TR + 0.3 \cdot AR + 0.2O * OR = 35 + 12 + 14 = 61$$

KPI calculation:

$$B.7 = 0.6 \cdot B.7.1 + 0.4 \cdot B.7.2 = 0.6 \cdot 78{,}75 + 0.4 \cdot 61 = 47{,}25 + 24{,}4 = 71{,}65$$

B.8 Providing spatial coherence in planning and design

B.8.1 Spatial coherence and urban cohesion

Indicator B.8.1 analyzes the morphological, volumetric, and strategic integration of the project within the urban fabric in which it is situated, in order to ensure that spatial transformations contribute to visual order, the continuity of public spaces, and consistency with local planning agendas, while avoiding disruptions to the surrounding urban fabric.
Since the project is developed exclusively within the existing volumes of the Magazzini Raccordati, without any alteration to the building's silhouette, increase in external volume, or use of undeveloped land, the application of the metrics identified by the NEB method is ineffective and conceptually redundant for the following reasons:

- Since there is no variation in height or external physical density, the deviation from the neighborhood average does not depend on design decisions but on the geometry of the existing structure, which imposes constraints. Calculating a numerical score for this factor would mean including in the evaluation the result of a condition of total ex-ante physical invariance.
- Aesthetic integration, visual harmony, and the perception of the built environment (IS) are not generated by the new façade design, but by the inherited historic envelope, which is already the defining element of the aesthetics and morphological memory of the project area.

As a result of the Consideratedons outlined above, it was decided not to apply the proposed calculation for indicator B.8.1 in order to avoid the risk of distorting the effectiveness of the evaluation tool.

B.8.2 Re-use of spaces and buildings

Indicator B.8.2 measures the project's ability to counteract greenfield land consumption by reintegrating abandoned, underutilized, or functionally degraded areas into the city's economic and social cycles, thereby reducing human pressure on peripheral natural systems.
In the case of the Magazzini Raccordati, the entire project focuses on applying a logic of adaptive reuse, aimed at repurposing a conical infrastructure void within Milan's established urban fabric.
The analysis formally excludes the parameter related to the remediation of contaminated soil (Reuse of Contaminated Areas - RCA), since the preliminary investigations did not reveal the presence of pollutants or toxic soil requiring treatment.
The entire weight of the KPI is therefore concentrated on the RDA (Reuse of Disused and Functionally Devalued Areas) parameter, which quantifies the recovery of the original covered areas. Unlike the previous indicator (B.8.1), in this case the value obtained does not result from the passive Consideratedon of a constraint, but reflects the outcome of the initial project strategy, which chose to focus on the recovery of these spaces rather than on seeking extensions or interstitial areas in which to develop new volumes.

Achieving the maximum score reflects the value placed on an approach that recognizes the comprehensive revitalization of a neglected area as the primary strategy for urban spatial circularity.

B.8.3 Green urban areas

Indicator B.8.3 assesses the level of integration of nature-based solutions within spatial transformations in order to monitor the project's ability to increase climate resilience, prevent or mitigate the heat island effect, and promote local biodiversity. The three specific

metrics considered are expressed as a percentage of the project area and include the increase in shaded areas generated by tree canopy cover (Canopy Cover - IC), the level of soil permeability achieved through green infrastructure (Green Infrastructure - GI), and the enhancement of biodiversity through the introduction of native plant species (Biodiversity Enhancement - BE).
The application of the framework's evaluation formulas to the physical characteristics of the project under Consideratedon revealed a mathematical incompatibility due to the absence of outdoor spaces (Equation 188), the absence of undisturbed soil that could be preserved (Equation 189), and the absence of areas with pre-existing vegetation (Equation 190).
In light of the limitations described, it was determined that indicator B.8.3 is not applicable to the scenario under Consideratedon.

B.9 Improving preservation of cultural and natural heritage

B.9.1 Historical fabric preservation

Indicator B.9.1 assesses the project's ability to preserve the character and visual identity of historic infrastructure.

The Magazzini Raccordati redevelopment project is being carried out in an area of historical significance for the city of Milan, which has served as an important urban center and gathering place over the past century. Although not an internationally protected historic monument, the spaces involved in the project are subject to preservation restrictions under Legislative Decree 42/2004 (Code of Cultural Heritage and Landscape), under the supervision of the Superintendence of Archaeology, Fine Arts, and Landscape. The application of this indicator is therefore necessary to understand the project's actual impact on the existing structure.

The intention is thus to preserve the patina and original geometry of the facade and exterior walls so as not to disrupt the rhythm of the street frontage, and to make the most of the interior space by utilizing the original internal volume to reinforce its uniqueness.

$$PP = \frac{192.65}{192.65} \times 100 = 100$$

$$PSE = \frac{192.44}{192.44} \times 100 = 100$$

$$PO = \frac{6}{6} \times 100 = 100$$

Sub-metric	**Score (points)**
Rate each sub-metric below according to a scale of points (0-5, where 0 corresponds to absence of feature, 1 to very weak, 2 to weak, 3 to moderate, 4 to strong, and 5 to very strong presence of features) and sum the three scores.	
Representativeness: evaluate how the heritage site represents a particular period, style, or cultural aspect?	+ 5
Ambient value: evaluate the heritage site environmental and aesthetic qualities, consider its natural surroundings, landscape, and overall atmosphere.	+ 4
Aesthetic coherence: evaluate the architectural significance, innovation, and craftsmanship of the buildings within the heritage site.	+ 3
Heritage value (HV) metric score = Σ sub-metric scores	**HV = 12**

Table 35. *Heritage value (HV) evaluation.(Joint Research Centre (JRC), 2024)*

$$HV = \frac{12}{15} \times 100 = 80$$

The selection and evaluation of these three parameters reflect the project's conservative approach.

The final calculation of the indicator results in a score that fully reflects the objectives of the architectural and urban redevelopment project.

$$B.9.1 = (0.25 \cdot PP + 0.25 \cdot PSE + 0.25 \cdot PO + 0.25 \cdot HV) \cdot 100 = 25 + 25 + 25 + 20 = 95$$

B.9.2 Integrated heritage/natural landscape conservation

Indicator B.9.2 evaluates integrated strategies for the conservation, restoration, and enhancement of traditional cultivated landscapes and historic green spaces subject to statutory protection.

Similar to what was noted for indicator B.8.3, the application of this criterion is hindered by physical constraints of the project related to the absence of outdoor spaces outside the historic warehouse structure, which render the proposed formula inapplicable.

B.10 Maintaining genius loci and improving sense of belonging

B.10.1 Sense of place harmony

The assessment of B.10.1 (Sense of Place Harmony) considers two main factors: the rarity of the site from a landscape and monumental perspective (RS) and the community's perceived attachment to it (SA).

Analysis of the Site's Rarity and Protection (RS)

The Magazzini Raccordati complex is subject to a protection regime that certifies its historical value. As highlighted in the site analysis, the structures are protected under Legislative Decree 42/2004 (Code of Cultural Heritage and Landscape), under the supervision of the Superintendence of Archaeology, Fine Arts, and Landscape. This state protection is supplemented at the local level by Milan's Territorial Governance Plan (PGT). In accordance with the procedure defined in the NEB manual (Table 143), the site was assigned an RS score of 70/100, corresponding to a cultural asset protected at the regional level and integrated into local spatial planning.

Sub-metric	**Score**
Select single value below.	
Landscape or site not recognised as a cultural or natural landscape	0 %
Landscape having features of one out of the three categories of cultural landscape: 'clearly defined landscape', **or** 'organically evolved landscape', **or** 'associative cultural landscape'	20 %
Landscape having features of two out of the three categories of cultural landscape	30 %
Landscape having features of all the three categories of cultural landscape: 'clearly defined landscape', **and** 'organically evolved landscape', **and** 'associative cultural landscape'	40 %
Landscape protected by a spatial plan at local level	50 %
Landscape protected by a spatial plan at regional level	60 %
Landscape or heritage site protected at local level	70 %
Landscape or heritage site protected at regional level	80 %
Landscape or heritage site protected at national level	90 %
Landscape or heritage site protected at international level	100 %
RS metric score = Selected sub-metric score	**RS = one of the fixed value above**

Table 36. *Rareness of landscape/heritage site types (RS) metric score.(Joint Research Centre (JRC), 2024)*

Assessment of Attachment and Social Well-being (SA)

Alongside the material dimension, the tool recognizes the importance of the local community's social perception of the project site through the application of the "Sense of Attachment" sub-indicator (Table 144). Despite its inherently subjective nature, the assessment followed criteria derived from the needs analysis phase involving local stakeholders and citizens. The project was rated 8 out of 10 (SA = 80%) based on two main factors and project drivers: the restoration of the arcades restores spaces to the public that are linked to the historical memory of the social and commercial activities of Central Station; the provision of flexible communal spaces managed by local associations aims to counteract the isolation typical of high-density urban areas and the scarcity of currently available public spaces.

Sub-metric	**Score (points)**
Rate each sub-metric below according to a scale of points (0-5, where 0 corresponds to absence of feature, 1 to very weak, 2 to weak, 3 to moderate, 4 to strong, and 5 to very strong presence of features) and sum the two scores	
Community's sense of identity and belonging: evaluate the extent to which the project takes into account the context and unique local character that is characterised by its distinctiveness, authenticity and identity, considering both tangible (e.g. architectural features, landscaping and surroundings, functional features, etc.) and intangible aspects (e.g. cultural practices, social interactions, etc.), thus fostering a strong sense of connection and contributing to a sense of belonging.	4
Quality and well-being of the inhabitants: evaluate the extent to which the use of building or space is consistent with the carrying capacity of the area and ensures the preservation or improvement of the spatial quality and well-being of the inhabitants of the area.	4
Sense of attachment (SA) metric score = Σ sub-metric scores	**8**

Table 37. *Sense of attachment (SA) metric score.(Joint Research Centre (JRC), 2024)*

KPI application

$$B.10.1 = 0.5 \cdot 70 + 0.5 \cdot 80 = 75$$

The evaluation results in an overall score of **75/100**, placing the project in the **“Excellent”** performance category.

B.11 Understanding aesthetic perception of buildings and spaces through comparison to actual 'styles' and tendencies in art and architecture

B.11.1 Cognitive experience

Indicator B.11.1 refers to the aesthetic experience of architecture as an expression of models developed within contemporary stylistic trends. Style is understood here as an expression and consequence of society, manifested through a set of formal principles, linguistic codes, and theoretical frameworks that reflect its artistic preferences, values, or priorities.
The objective is to measure the extent to which the project demonstrates an understanding of or application consistent with the language of the identified style.
The manual therefore specifies that the first step is to identify a single architectural movement to which the project refers. For the redevelopment project of the Magazzini Raccordati (FARMER system), the style of Eco-architecture is formally selected.

Sub-metric	Score
*If the **eco-architecture** style has been identified as the most used style of the project, select single value below.*	
The new building project does not demonstrate any features of the eco-architecture style.	0 (Low)
The new building project is characterised by the following basic features of the eco-architecture style: — **Shape** - Bio-based forms, shapes or patterns revealing reference to natural forms, shapes, organisms. — **Colour** - Colours of natural materials (e.g. clay, earth, limestone, granite, wood). — **Textures and materials** - Use of natural building and finishing materials. — **Spatial organisation** - Arrangement of spaces are determined by light and weather conditions.	40 (Acceptable)
The new building project is characterised by the following basic features of the eco-architecture style: — **Shapes** - Shapes, patterns and composition show references to self-generating biological systems. — **Colour** - Colour palette based on bright colours with gradation of their shades, and colours of natural materials. — **Textures and materials** Use of natural building and finishing materials. Wood, stone, bamboo, recycled materials, re-used materials and elements of buildings exposed in visually appearing way, often rammed earth, hempcrete, compressed earthen blocks, adobe and 'super-adobe'. Use of chiaroscuro to create building forms. — **Composition** - Shapes and patterns are arranged into integral whole similar to a biological organism (e.g. plant) or non-organic natural structure (e.g. crystal, rock). — **Spatial organization** - Space arrangements are defined by computer-based analyses of natural conditions (e.g. humidity, temperature, winds). — **Technological solutions** Implementation of natural ventilation systems, whenever possible combined with advanced blue-green infrastructures. Green roofs and walls. Applying rules of bioclimatic design with primary focus on proper adjustment of buildings and spaces to local biological and climatic conditions with aim to use available contemporary technology to provide user with the highest level of comfort at the minimal environmental costs without compromising the rights of future generations to benefit from the same level of comfort.	70 (Good)
The new building project complies with the features of the eco-architecture style to attain the good performance and reflects ***at least three*** of the following additional features related to the 'semantic and theoretical framework' category: - **Semantic and theoretical framework** Idea of the need to adopt a sustainable style of life. Design of built environment as an aesthetic, technological and moral issue. ReConsiderated on of vernacular architecture as a model for sustainable architecture.	100 (Excellent)

Table 38. *Cognitive experience metric score.(Joint Research Centre (JRC), 2024)*

Since this is a preliminary design phase applied to an interior space, the AS metric score is set to a fixed value of 40 (Acceptable class). This result reflects the project's limited adherence to a defined architectural movement. At the same time, a limitation in application is noted that stems from the very structure of the evaluation framework: some of the parameters identified for achieving "Good" performance are, in fact, inapplicable to the project.

Dimension Score

KPI / Indicatore NEB	Score	Weight formula	Weight	W. score
B.1 Digitalisation in construction	25.00	1/m	**0.01**	**2.50**
B.2 Quality of design and delivery	33.00	1/m	**0.01**	**3.30**
B.3 Resilience to extreme events	-	1/m	-	-
B.4 Occupant health and wellbeing	70.00	1/m	**0.01**	**7.00**
B.5 Improving accessibility	48.20	1/m	**0.01**	**4.82**
B.6 Durability and service life	59.38	1/m	**0.01**	**5.94**
B.7 Aesthetic acceptance	71.65	(1/m)x1.5	**0.150**	**10.75**
B.8 Spatial coherence	50.00	(1/m)x1.25	**0.125**	**6.25**
B.9 Preservation of heritage	95.00	1/m	**0.01**	**9.50**
B.10 Maintaining genius loci	75.00	(1/m)x0.2	**0.025**	**1.88**
B.11 Tendencies in art/architecture	40.00	1/m	**0.01**	**4.00**
TOT			**1**	**55.94 / 100**

Table 39. *Dimension score calculation based on weight's recalibration.*

The evaluation yields a final weighted score of 55.94/100. The application of the weighting formula provided for in the framework (Equations 146 and 147) was calibrated based on the number of indicators actually considered for the project (m=10), thereby allowing for the exclusion of indicator B.3. The project shows improved performance in the preservation of historical heritage (B.9), confirming the validity of the conservation approach adopted. Conversely, indicator B.10 has a relatively limited impact, mitigated by the restrictive multiplier (0.25) specified by the NEB method. Aesthetic and sensory quality (B.7) emerges as the central axis of the evaluation (weight: 15%), playing a significant compensatory role.

INCLUSIVENESS

As discussed in the introduction, the New European Bauhaus (NEB) framework bases its system on the need to redefine the paradigm of Europe's ecological and spatial transition by moving beyond a purely technocratic approach. The introduction of the Inclusivity dimension brings the third NEB pillar into the evaluation framework, whose main objective is to spatialize and measure social justice. Inequality is presented as a permanent and structural feature of contemporary society, rooted in the division between those who own the means of production and those who can only sell their labor power on the market. This definition reveals the profoundly systemic value of interventions that address it.
The late 1970s and 1980s, marked by the rise of neoliberal ideas and the collapse of state-run socialist regimes, coincided with the dismantling of welfare policies and a growing political focus on attracting private investment, leading to a further widening of social inequalities (Harvey, 2007). The macroeconomic dynamics, resulting from the unchecked growth of these disparities and the gradual retreat of the welfare state, have manifested, in the fields of architecture and urban planning as profound spatial segregation, the financialization of the real estate market, and the commodification of land, where the production of the built environment has progressively subordinated use value (the right to housing) to exchange value (financial rent) (Madden & Marcuse, 2016). Today, these issues represent an extremely complex obstacle to achieving a sustainable future and constitute the central field of action for effective agents of transition.
Based on these premises, the New European Bauhaus primarily asserts itself by recognizing the need to bring social issues back to the forefront of the construction landscape, thereby facilitating the acceptance of new proposals for systemic reform even at the local level. Inclusivity within the NEB is thus conceived as a practical means of outreach and an essential tool for the implementation of systemic sustainability.
The concept of "togetherness" , the third pillar of NEB, focuses on diversity, equality, and accessibility, with a particular emphasis on the affordability of residential housing, with the aim of establishing guidelines that can help remove discriminatory barriers by prioritizing the needs of marginalized groups.
Despite the theoretical clarity and straightforwardness of its objectives, there is a risk of logical and methodological weaknesses in the development of the self-assessment tool regarding the stage of refining metrics that are truly quantitative and applicable to the conceptual design phase. This weakness may be attributed to the lack of previous attempts to identify criteria suitable for assessments of this kind.
Although the quantification of the indicators is not, overall, sufficiently rigorous, a significant contribution is evident in the selection of the proposed criteria and the establishment of clear methodological definitions. An example illustrating this tension between loosely structured quantification and clear conceptual definition can be found in KPI 1.9. The section on indicator 1.9.5 proposes a fundamental distinction between the simple "involvement" of stakeholders (which measures the adoption of democratic procedures) and their actual "contribution" (which measures their effectiveness). It is acknowledged, in fact, that numerical presence does not automatically translate into influence on the decision-making process. However, the process and tools for quantifying this contribution are not suggested in a structured manner, and the resulting score can only be determined by using a table that associates a list of participatory actions with a numerical range.
Similarly, the attempt to quantify the diversity and representativeness of social groups, or the effectiveness of including marginalized individuals such as the homeless or undocumented migrants (KPI 1.7. 1), requires the project team to map cultural,

socioeconomic, and cognitive barriers without providing or suggesting the use of tools and procedures suitable for evaluation purposes, making the process difficult to compare.
An analysis of the proposed criteria also raises a further fundamental question regarding the ability of the holistic approach adopted to adequately balance its components and serve as an effective tool for comparison across radically different national contexts. The manual itself acknowledges the need to adapt the assessment based on contextual variations to avoid rewarding projects that benefit from local or national regulations and directives. This mechanism is necessary given that, in Europe, housing systems, welfare policies, and rent regulations vary greatly across countries. The same dynamic was identified in the definition of certain baselines for the Sustainability dimension. There is, however, a fundamental difference between these conditions: social equality, while a fundamental objective and a necessary driver for achieving a stable long-term transition, does not constitute an area of intervention directly linked to the potential overshoot of planetary boundaries and, consequently, to the progressive increase in extreme weather events that would quickly lead to a drastic change in the sociopolitical and everyday dynamics of our species. As noted above, moreover, the structure of this dimension lacks significant precedents, resulting in a less defined framework that is still under development. Contextual standardization risks normalizing systemic injustice; for example, when assessing affordability (KPI 1.2), it is recognized that ensuring affordable housing is much easier in systems oriented toward the right to housing (with strong protections and extensive public housing stock) compared to systems where housing welfare is residual, but it acknowledges the need for a project that aims to incrementally improve the proposal relative to the context by encouraging private initiative to intervene even in contexts where rules and regulations are absent or insufficient. Although this encouragement is now insufficient in the context of environmental actions, given the presence of tools such as level(s) that had already proposed this same application and the biological urgency of the crisis in the dimension referred to, the absence of a methodological framework for applying criteria and identifying more restrictive metrics in the inclusivity dimension can more easily be interpreted as parameters to be enhanced in future developments of this specific dimension.

KPI / NEB Indicator	State	Exclusion Criteria / Methodological Notes
I.1 / I.4	Not Considerated	Automatically excluded because the FARMER Project falls under the category of non-residential public projects.
I.2 Affordability	Partially Considered	I.2.1, I.2.2, I.2.3 Excluded as housing metrics. The analysis is based entirely on indicator I.2.4 (Affordable access to non-residential services and amenities).
I.3 Inclusive Quality, Equality, and Accessibility	Considerated	-
I.5 Impact on Social Cohesion in the Neighborhood	Considerated	
I.6 Needs and Resources for Social Accessibility	Considerated	-
I.7 Needs of Vulnerable and Marginalized Groups	Considerated	Calculated using an estimate based on discussions with local associations (e.g., Centro Sammartini), to compensate for the lack of a statistically significant number of *social workers*.
I.8 Anti-Discrimination Initiatives	Considerated	The monitoring plan (I.8.2) is managed by partner organizations in the third sector.
I.9 Stakeholder Engagement (Governance)	Considerated	-

Table 40. *KPI selection for inclusivity dimension*

I.2 Affordability

Since the FARMER project does not include residential housing, its assessment of KPI I.2 is based entirely on indicator I.2.4, which concerns the impact of non- residential services and activities on the local community through equitable and non-discriminatory access to adequately served urban areas.

I.2.4 Affordable access to services and amenities

The neighborhood is characterized by a concentration of low- and lower-middle-income families, with a high proportion of people in low-skilled occupations and individuals in precarious employment situations or who are unemployed. It was therefore decided to select category [c] Low and lower-middle income. The project ensures accessibility through various channels:

- 10% of daily production is allocated to social purposes, such as, for example, food redistribution through organizations like Caritas.
- The space remains accessible during time slots when organizations schedule activities involving only one section of the area and can be reserved for educational workshops or events at a capped rate, as defined for spaces designated for public functions in the master plan.
- Non-price-capped paid functions consist of rentals for private events for the entire space or for one of the two sections, which will in any case be limited to specific days and times agreed upon with the main local organizations to ensure a fair distribution of activities.

As a precautionary measure, it has therefore been proposed to set a percentage of accessible activities ranging from 20% to 50%, as shown in column 4 of the table. However, it should be noted that this estimate may be improved upon, and such improvements may be proposed and implemented during the final planning phase.

.Contextual variance: *In the context of the project, how can the neighbourhood be classified based on the prevailing economic status of local households? (single selection allowed)*					
a. High and middle-to-high income. b. Mixed. c. Low and low-to-middle income.					
Metric: *Does the project ensure an affordable access to services and amenities? (single selection allowed)*					
1. Less than 20% of the provided services are accessible for free or at an affordable cost for all. 2. At least 20% but less than 50% of the provided services are accessible for free or at an affordable cost for all, but their provision in the long term cannot be guaranteed. 3. At least 50% of the provided services are accessible for free or at an affordable cost for all, but their provision in the long term cannot be guaranteed. 4. At least 20% but less than 50% of the provided services are (and will be) accessible for free or at an affordable cost for all. 5. At least 50% of the services provided services are (and will be) accessible for free or at an affordable cost for all.					
Indicator score	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
[a]	0	30	55	70	85
[b]	0	20	45	75	90
[c]	0	10	30	85	100

Table 41. *I.2.4 metric score. (Joint Research Centre (JRC), 2024)*

$$I.2 = I.2.4 = 85$$

I.3 Inclusive quality, equality and accessibility

I.3.2 Maintaining the quality of spaces and services

The urban project of which this redevelopment is a part calls for a comprehensive strategy that includes a plan and a budget for the long-term maintenance of the UVF and public spaces (PPP Governance), and provides for users to coordinate through a digital platform regarding the routine maintenance of the spaces they use. Long-term extraordinary maintenance must be factored into the management plan for the entire area, which calls for the establishment of a Project Company (SpV) to centralize responsibilities on behalf of all private partners. The SpV establishes a restricted renewal fund, constantly replenished by a fixed portion of public fees and commercial revenues from the area. This system allows for planning interventions based on the life cycle of the materials, rather than waiting until interventions become necessary, which would lead to inefficiency and unusability. The public entity is responsible for monitoring operations and imposing financial penalties in the event of service failures.
The indicator is evaluated according to the question and the score provided in Table 42.

Metric: *Is a strategy[1] in place for maintaining the quality of project spaces and services in the medium to long term? (single selection allowed)*				
1. A strategy is not included for the long-term maintenance of project spaces and services. 2. A strategy for the long-term maintenance of project spaces and services exists but it is limited to some aspects only (e.g. management of common spaces), with or without a budget. 3. A strategy for the long-term maintenance of project spaces and services is fully integrated into the project but no budget is allocated. 4. An overall strategy that includes a plan and an appropriate budget is allocated for the long-term maintenance of project spaces and services.				
Indicator score	**[1]**	**[2]**	**[3]**	**[4]**
	0	50	70	100

1 Strategy is affected by scale according to Section 5.6.3.

Table 42. *I.3.2 metric score. (Joint Research Centre (JRC), 2024)*

I.3.7 Pedestrian accessibility to public transport

The new public transportation line was planned as part of the master plan, with new stops along the entire street adjacent to the sites to ensure maximum accessibility. Stops were planned every 600 meters to guarantee that every warehouse, including the one in question, is no more than 300 meters from the nearest stop.

Metric: *What is the level of pedestrian accessibility[1] to public transport? (single selection allowed)*				
1. The average distance to public transport stops is more than 800 m. 2. The average distance to public transport stops is between 500 and 800 m. 3. The average distance to transport stops is between 300 and 500 m. 4. The average distance to transport stops is less than 300 m.				
Indicator score	**[1]**	**[2]**	**[3]**	**[4]**
	0	50	70	100

1 Pedestrian accessibility to public transport evaluated according to Section 5.6.8.

Table 43. *I.3.7 metric score. (Joint Research Centre (JRC), 2024)*

I.5 Impact on neighbourhood social cohesion

KPI I.5 assesses the project's impact on social cohesion, focusing on preventing gentrification and promoting an integrated social fabric. In the case of the public project at the building level, the only proposed indicator is I.5.4.

I.5.4 Outreach activities for project-related social and cultural services

This indicator aims to assess the project's ability to reach marginalized communities that are distant from major cultural or civic activities. The project is primarily aimed at asylum seekers and immigrant individuals and families in need of housing, incorporating flexible, adaptable, and high-quality spaces as recommended by the organizations that represented this segment of the population during the design phase.

The master plan's outreach and inclusion strategy finds its place precisely in the warehouses dedicated to public welfare functions, such as those discussed here. This strategy involves engaging educational services, collaborating with schools, partnering with local associations, and organizing workshops on agricultural preservation. The reception area adjacent to the entrance serves as a freely accessible buffer space that can be used by all stakeholders involved in managing the site. Given the level of detail in this study, it was decided to assign a conservative score of 50, while acknowledging the achievement of a strategy whose final development could realistically result in a level of excellence.

. **Metric**: *Are diverse outreach activities planned to spread the knowledge of and secure recruitment for existing or project-related social and cultural services? (single selection allowed)*			
1. Activities are not planned. 2. Yes, to some extent: an outreach strategy exists, but covers only some of the services offered. 3. Yes, an overall strategy is in place: a comprehensive outreach strategy exists, covering all services offered, identifying specialised target groups, methodology and communication plans for each service.			
Indicator score	**[1]**	**[2]**	**[3]**
	0	50	100

Table 44. *I.5.4 metric score. (Joint Research Centre (JRC), 2024)*

I.6 Needs and resources for social accessibility

KPI I.6 assesses the identification of the local population's needs and accessibility strategies, such as resource allocation and diversification of services, defined in response to those needs.
The project conducted an in-depth contextual analysis and stakeholder mapping, as described in Chapter 2. The project phase drew on these findings to develop a project strategy that directly addressed local needs for integration, training, and safety.
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I.6.1 Active accessibility needs in the project strategy

The accessibility strategy, based on mapping existing bike and pedestrian routes as well as analyzing current public transportation services, focused on the need to build a new bike path that would connect to existing routes, reduce car traffic, and propose a rerouting of the existing bus line, which currently does not serve the areas in question.

Metric: *Are active accessibility needs included in the project strategy? (single selection allowed)*			
1. Active accessibility needs for offered services are not taken into account. 2. The project partially addresses the issue of accessibility through a preliminary plan. 3. The project includes an accessibility strategy based on the analysis of local needs.			
Indicator score	**[1]**	**[2]**	**[3]**
	0	55	100

Table 45. *I.6.1 metric score. (Joint Research Centre (JRC), 2024)*

I.6.2 Mapping of assets and resources

The mapping of the territory focused on identifying human assets, such as representatives of historical associations and organizations, and physical assets, such as educational institutions, businesses, libraries, parks, and public spaces. However, representatives of the local community were not included in this process, except through the collection of indirect testimonies. A score of 50 is therefore assigned.

Metric: *Are assets and resources mapped? (single selection allowed)*			
1. Mapping of assets and resources is not integrated or planned. 2. A partial preliminary mapping is included in the project without the involvement of the local community. 3. A complete mapping of assets and resources is integrated through the involvement of the local community.			
Indicator score	**[1]**	**[2]**	**[3]**
	0	50	100

Table 46. *I.6.2 metric score. (Joint Research Centre (JRC), 2024)*

I.6.3 Diversification of activities in response to local needs

The project involves the local community in planning activities, allowing each participant to reserve their own spaces and usage times online, as determined through a series of meetings designed to establish the timing and terms of this partnership.

Metric: *Are assets and resources mapped? (single selection allowed)*			
1. Mapping of assets and resources is not integrated or planned. 2. A partial preliminary mapping is included in the project without the involvement of the local community. 3. A complete mapping of assets and resources is integrated through the involvement of the local community.			
Indicator score	**[1]**	**[2]**	**[3]**
	0	50	100

Table 47. *I.6.2 metric score. (Joint Research Centre (JRC), 2024)*

I.7 Needs of vulnerable and marginalised groups

The project did not involve a sufficient number of social workers, even though it sought out and maintained contact with key stakeholders. This did not provide adequate means to confirm that the project meets the needs of extremely small vulnerable groups that have not yet been identified.

I.7.1 Acknowledgement of cultural and social barriers to accessibility

The area has a very high need ([a]) for social support (refugees, severe marginalization), but the strategies to address the current conditions were established by first identifying the most vulnerable groups and then confirming this information through interviews with organizations dedicated to serving those groups ([3]).

Contextual variance: *What is the level of existing vulnerabilities and precariousness (presence of homeless, undocumented migrants, people with mental health problems and/or addictions, unemployed people, etc.) [1]? (single selection allowed)*				
a. The percentage of vulnerable groups is above the average percentage in a broader context. b. The percentage of vulnerable groups is equal to the average percentage in a broader context. c. The percentage of vulnerable groups is below the average percentage in a broader context.				
Metric: *To what extent are cultural and social barriers to accessibility acknowledged by the project? (single selection allowed)*				
1. Cultural and social barriers to accessibility are not identified. 2. Cultural and social barriers to accessibility are identified by the project team through a desk review and based on assumed vulnerable groups in the area. 3. Cultural and social barriers to accessibility are identified by using various methods (desk review, interviews, surveys, etc.) and based on identified vulnerable groups in the area. 4. Cultural and social barriers to accessibility are identified through a co-production process involving relevant stakeholders to promote an intersectional analysis.				
Indicator score	**[1]**	**[2]**	**[3]**	**[4]**
[a]	0	25	65	100
[b]	10	30	70	90
[c]	20	45	75	85

Table 48. *I.7.1 metric score. (Joint Research Centre (JRC), 2024)*

I.7.2 Local support networks and trained social workers

The project recognizes this need and offers related activities (UVF training), but the evaluation matrix criticizes the lack of dedicated, qualified support (I.7.2) when the need is so great.

Contextual variance: *Considering the level of existing vulnerabilities and precariousness (presence of homeless, undocumented migrants, people with mental health problems and/or addictions, unemployed people, etc.), what is the need for support networks? (single selection allowed)*
a. Very high need for support networks: when the percentage of vulnerable groups is much above the average percentage in a broader context[1]. b. High need for support networks: when the percentage of vulnerable groups is above the average percentage in a broader context [1]. c. Moderate/low need for support networks: when the percentage of vulnerable groups is equal to or below the average percentage in a broader context[1].
Metric: *Does the project involve local support networks or trained social workers? (single selection allowed)*

1. The project does not employ trained social workers and does not involve any existing local support networks. 2. The project acknowledges the importance of relying on qualified assistance through the employment of trained workers, or the use of a local support network, or both.		
Indicator score	**[1]**	**[2]**
[a]	0	100
[b]	30	90
[c]	50	85

Table 49. *I.7.2 metric score. (Joint Research Centre (JRC), 2024)*

I.7.3 Needs of vulnerable and marginalised groups covered by activities

These needs are partially met by the project (reintegration, training) and, for the remainder, by targeted local services ([3]).

Contextual variance: *What is the level of existing vulnerabilities and precariousness (presence of homeless, undocumented migrants, people with mental health problems and/or addictions, unemployed people, etc..)[1]? (single selection allowed)*				
a. The percentage of vulnerable groups is above the average percentage in a broader context. b. The percentage of vulnerable groups is equal to the average percentage in a broader context. c. The percentage of vulnerable groups is below the average percentage in a broader context.				
Metric: *Are the needs of vulnerable and marginalised groups targeted and covered by planned activities? (single selection allowed)*				
1. Needs of vulnerable groups are not specifically targeted and activities are open to all. 2. Needs of vulnerable groups are in part covered by the project activities. 3. Needs of vulnerable groups are in part covered by the project activities and for the remainder by other targeted local servic es. 4. Needs of vulnerable groups are totally covered by the project activities.				
Indicator score	**[1]**	**[2]**	**[3]**	**[4]**
[a]	0	30	90	100
[b]	10	45	80	100
[c]	30	65	80	90

Table 50. *I.7.3 metric score. (Joint Research Centre (JRC), 2024)*

$$I.7 = (0.4\,x\,65) + (0.3\,x\,0) + (0.3\,x\,90) = 26 + 0 + 27 = 53$$

I.8 Anti-discrimination initiatives

KPI I.8 assesses the project’s commitment to preventing discrimination and monitoring safety and inclusion.
The area is perceived as unsafe and is situated in a context of significant social conflict; therefore, the framework recognizes the need to integrate strategies to combat prejudice alongside those related to physical safety.

I.8.1 Anti-discriminatory action

The Redevelopment Project is located in an area with large zones where different social groups live separately and do not actively share the same spaces ([a]). Since the project is designed to accommodate people from diverse backgrounds, it has provided for the implementation of non-discriminatory restrooms and spacious, shared access areas to allow for visibility and interaction, so that the integration of spaces that can be easily adapted by users can encourage dialogue among different groups. Therefore, provision 4 “Such action is necessary, and it is implemented at the project level” was taken into account.

<table>
<tr><td colspan="6">Contextual variance: To your knowledge, can the neighbourhood be described as conflictual? (single selection allowed)</td></tr>
<tr><td colspan="6">a. If [Renovation project] has been selected – Yes: e.g. discriminatory episodes on regular basis; tensions among neighbours or residents that affect daily life; specific social groups excluded by public or common spaces; social groups with no mixing in public spaces or public spaces like schools, community centres, public services).
b. If [Renovation project] has been selected – Yes, to some extent: there is respect towards diversity, and positive relationships are being developed, even though discriminatory episodes may occasionally occur in different places, e.g. public spaces, schools, community centres, public services).
c. If [Renovation project] has been selected – No: people are usually respectful towards diversity, and groups from different backgrounds and circumstances intermingle and build strong and positive relationships in different places. d. If [Newbuild project] has been selected, check the metric below.</td></tr>
<tr><td colspan="6">Metric: Does the project plan anti-discriminatory action? (single selection allowed)</td></tr>
<tr><td colspan="6">1. Such action is not planned.
2. Such action is not necessary at the project scale because it is sufficiently developed at a higher level by public authorities, and the users are knowledgeable about it.
3. Such action is not necessary at the project level, but it is planned as an important issue.
4. Such action is necessary, and it is implemented at the project level.
5. Such action is planned (irrespective of context).</td></tr>
<tr><td>Indicator score[1]</td><td>[1]</td><td>[2]</td><td>[3]</td><td>[4]</td><td>[5]</td></tr>
<tr><td>[a]</td><td>0</td><td>65</td><td>-</td><td>100</td><td>-</td></tr>
<tr><td>[b]</td><td>0</td><td>65</td><td>-</td><td>100</td><td>-</td></tr>
<tr><td>[c]</td><td>50</td><td>85</td><td>100</td><td>-</td><td>-</td></tr>
<tr><td>[d]</td><td>0</td><td>-</td><td>-</td><td>-</td><td>100</td></tr>
</table>

Table 51. *I.8.1 metric score. (Joint Research Centre (JRC), 2024)*

I.8.2 Monitoring plan of safety and non discrimination conditions

A specific monitoring plan for safety and non-discrimination has not been developed, but given the collaboration with the Sammartini Center, the Milan Welcome Center, and Caritas Ambrosiana, it is expected that non-discrimination education courses will be incorporated and that compliance with relevant social standards will be monitored on a regular basis (Metric [2]).

Metric: *Does the project include a monitoring plan of safety and non-discrimination conditions of the places where activities are carried out? (single selection allowed)*			
1. A monitoring plan is not included. 2. A monitoring plan is not elaborated but some measures are planned. 3. Yes, a monitoring plan is included.			
Indicator score	**[1]**	**[2]**	**[3]**
	0	55	100

Table 52. *I.8.2 metric score. (Joint Research Centre (JRC), 2024)*

$$I.8 = 0.65\,x\,100 + 0.35\,x\,55 = 65 + 19.25 = 84.25$$

I.9 Involvement of stakeholders

KPI I.9 assesses democratic participation, integration, and the contribution of local stakeholders (civil society, public, and private sectors) in the design and implementation of the project.

This was a fundamental component of the analysis and design phase of the urban project. These discussions and interviews then guided the principles for the redevelopment of the welfare spaces covered by this evaluation. The preliminary analysis was expanded upon, and the governance structure was designed to include key stakeholders (Municipality, RFI, Hexagro, Associations). KPI I.9 consists of seven sub-indicators (I.9.1 - I.9.7), each with a specific weight that determines its contribution to the final score.

The calculation is based on Equation 267 in the NEB document.

Indicatore	Weight	Score	Reference	Score
I.9.1 Involvement of local stakeholders in project meetings	0.18	35	Active and regular involvement of profiles ii and iii, and occasional (or no) involvement of profile i.	6.3
I.9.2 Involvement of public and private sector stakeholders in project meetings	0.10	70	An active and regular involvement of public and/or public-private partnerships and an occasional (or no) involvement of corporate entities.	7.00
I.9.3 Contribution of local civil society stakeholders to project design	0.20	35	Significant contribution of profiles ii and iii, and minor (or no) contribution of profile i.	7
I.9.4 Contribution of public and private sector stakeholders to project design	0.10	75	Significant contribution of profiles i and iii, and minor (or no) contribution of profile ii.	7.5
I.9.5 (Diversity and representativeness of the stakeholders in project design	0.12	70	quite diverse and representative (most local social groups are present, only a few are missing).	8.4
I.9.6 Contribution of stakeholders from vulnerable groups to project design	0.18	100	Significant contribution.	18.00
I.9.7	0.12	/	Not considered	/

Project budget allocated to engagement events		
Totale	1.00	46,7

Table 53. *I.9 metric score.*

Dimension Score

KPI / Indicatore NEB	Score	Weight	Peso Ricalcolato	W. score
Funding and land value	-	0.08	-	-
Affordability (non-residenziale)	85.00	0.16	0.1905	**16.19**
Inclusive quality and equality	70.00	0.16	0.11905	**13.33**
Rent regulation	-	0.08	-	-
Neighbourhood social cohesion	50.00	0.10	0.119	**5.95**
Needs for social accessibility	85.00	0.13	0.1548	**13.15**
Needs of vulnerable groups	53.00	0.13	0.1548	**8.20**
Anti-discrimination initiatives	84.25	0.8	0.952	**8.02**
Involvement of stakeholders	46.70	0.8	0.952	**4.45**
TOT		**100%**		**69.29 / 100**

Table 54. *Dimension score calculation based on weight's recalibration.*

The assessment of the inclusivity dimension stands at 69.29/100. The exclusion of KPIs I.1 and I.4, which pertain to residential construction, necessitated a proportional redistribution of the weights, which was not provided for in the structure shown in Table 155 of the manual. The project responds positively to strategies for affordability regarding the planned functions and for identifying local needs, confirming a good response to the socioeconomic vulnerabilities of the analyzed context. Greater attention is needed for protocols related to the regulated and documented involvement of stakeholders and vulnerable groups, which are not yet adequately structured at the project's current stage (I.9; I.7). The actual transformative impact of the intervention with regard to this dimension will therefore depend, during the implementation phases, on the ability to establish legally binding participatory governance mechanisms that enable the permanent consolidation of local support networks.

Conclusions

Regulatory instruments and government outreach platforms reflect the strategies that the European body has decided to adopt - and is seeking to implement - in response to the undeniable need to accelerate the sustainable transition; they therefore serve as an important measure of the resilience that institutions are able to provide. As the foundation and roadmap for the future development of citizens' daily and professional lives, these instruments deserve closer examination.

This research was conducted with the aim of contributing to this context through an analysis of the evolution of European environmental policies and the role of new performance measurement protocols in the construction sector as tools that influence architectural and urban design practices.

In light of these Consideratedons, the objective of this thesis is clearly defined as a critical examination of the New European Bauhaus (NEB) Self-Assessment Tool, both as a synthesis of the European vision for a sustainable transition and as a means of disseminating the criteria identified from this community-based perspective.

The outcome of this research was not merely the application of the method, but rather a critical examination of the evaluative framework for methodological consistency in relation to the stated objectives. Architectural design was not conceived solely as the object of evaluation, but as the analytical tool through which to examine the *framework*'s ability to translate the spatial, social, and energy-related complexity of the transition into objective metrics.

In order to achieve the identified objective, it was necessary to select a case study characterized by a high density of programs and relationships.

Consequently, the FARMER project was launched, developed within the framework of the Alta Scuola Politecnica (ASP), with the primary goal of pursuing, in an integrated and multidisciplinary manner, objectives of environmental sustainability and social integration within the urban context of the Magazzini Raccordati in Milan.

The integration of the issues that emerged from consultations with local associations contributed to the definition of this scenario as the ultimate focus of the analysis; these associations explicitly linked the effectiveness of social inclusion and neighborhood *welfare* strategies to the presence of high spatial, perceptual, and aesthetic quality. The coexistence of objectives related to the need for climate resilience strategies, the construction of a new collaborative social infrastructure, and the achievement of a shared formal quality as a means of urban dignity has shaped the project into a sufficiently complex context of inquiry to test the holistic evaluation method promoted by the NEB.

An initial understanding of the framework's overall structure revealed the need for further analysis at the architectural level, including detailed simulations. The spatial configuration was therefore supported by a technical framework that included 3D modeling, energy simulations, and life-cycle assessments of materials.

The report provided the quantitative data necessary to conduct the assessment process, demonstrating that the measurement of environmental impacts must proceed in close correlation with the preliminary project design.

The development of technical calculations and simulations served as the basis for verifying the application of the Key Performance Indicators (KPIs) set forth in the *European framework* and thus constitutes the necessary foundation for conducting the comprehensive analysis.
The use of the NEB Self-Assessment Tool made it possible to identify the indicators best suited to evaluating the project and to exclude from the process those tasks that require access to contractual data or technical simulations - which are not available for a conceptual design project.
The main consequence of this distinction turned out to be the need to make significant changes to the mathematical weighting where no reorganization of the indicator weights had been anticipated or guided, depending on the areas considered in the application. This shortcoming is, in fact, contradictory given the JRC members' stated intention to provide a tool that could support the decision-making process even when it was not possible to apply the entire protocol. (Joint Research Centre (JRC) - European Commission, 2025)
The redistribution of weight percentages, aimed at achieving a result focused on the scope of the analysis, therefore involved adjustments within the Sustainability and Inclusivity dimensions. The Beauty dimension, on the other hand, applied the stated programmatic framework differently, formally incorporating variability coefficients to account for the exclusion of indicators not considered through a standardized proportional recalculation.
Of the three dimensions, therefore, the one that has resulted in a more flexible and adaptable structure is the dimension of Beauty.
Overall, applying the method even to a project in the conceptual phase is therefore effective, although it highlights the need to incorporate appropriate variability coefficients in the two dimensions of Sustainability and Inclusivity as well.
Although the numerical results obtained serve as an effective metric for evaluating the design choices made, they play a secondary role here compared to the methodological analysis undertaken and the resulting deconstruction of the rating tool.
In fact, while it is true that the application demonstrated the operational feasibility of the *framework* even during the conceptual phase of the project scenario, the analysis and review of the procedures carried out also raised a fundamental methodological question: Is the structure of the NEB Self-Assessment Tool actually capable of capturing the complex, interconnected nature of the sustainable transition - recognized by the European Union as the only effective means of combating the climate crisis?

Critical discussion

To understand the central importance of this question, it is necessary to briefly review the theoretical foundations upon which the entire European initiative is based, as already outlined in the introduction to this paper. At the core of the NEB vision lies the recognition that strategies to combat the climate crisis limited to technological optimization have historically revealed significant systemic inadequacies, demonstrating the inability of single-sector interventions to trigger structural transformations. The urgency of a holistic approach and the consequent assertion of the absolute inseparability of Sustainability, Beauty, and Inclusivity are thus established as the objective and driving force of the entire initiative. The validity of these dimensions is measured solely through their mutual interaction rather than by the individual impact of each one.

However, the analysis conducted through the progressive application of individual indicators has revealed that the holistic approach - which is strongly emphasized in the manual's theoretical principles - risks being reduced to a one-dimensional breakdown during the quantitative assessment phase.

The reason for this perception can be attributed primarily to the decision to structure the evaluation survey into three separate macro-categories. The fact that the three pillars correspond to three independent evaluation dimensions - which do not reflect the strong collaborative component as theorized - made it necessary to seek out distinct components that would capture this characteristic. This attempt resulted in the forced inclusion of inherently cross-cutting indicators within each of the three evaluation areas, leading to operational redundancies and conceptual overlaps.

Observation of these practical applications of the method has highlighted the paradox of a structure that aims for ecosystem integration but, in reality, results in the segregation of parameters without investigating their mutual impacts. This mismatch between theoretical principles and structural reality constitutes the method's primary systemic weakness.

The critical analysis conducted in this study focused on highlighting the main redundancies in the cross-cutting criteria within the method, the resulting weakening of the dimensional structure, and proposing a potential alternative structure to the current configuration.

The taxonomic segregation observed gives rise to two main structural issues. The forced inclusion of cross-cutting *Key Performance Indicators* (KPIs) within individual categories not only leads to methodological redundancies but also prevents a thorough examination of the implications that design choices relevant to that evaluation area would have on the remaining dimensions.

The presence of systemic factors inherent in cross-sectional indicators warrants a more in-depth analysis of correlation vectors that would help avoid inconsistent or repetitive assessments within separate chapters.

One example of this issue is the fragmentation of the life-cycle analysis of materials or the assessment of the interdisciplinary nature of the *project team*, parameters that are mentioned repeatedly within the *framework,* but for which there is no synthesis that measures their overall impact.

Consequently, the system is inefficient at measuring the cause-and-effect relationships of design choices: the tool's algebraic structure is limited to a sum of independent scores for each dimension, without incorporating multipliers or coefficients that calculate how optimizing a parameter belonging to one of the three macro-categories directly affects the project's impact on the other two.

On a theoretical level, it is perceptible a profound semantic weakening and a consequent theoretical weakening of the individual evaluative dimensions caused by the framework's strategy of expansive inclusion.

This trend is particularly evident in the analysis of the Sustainability dimension. In the context of this assessment, in particular, the inclusion of parameters related to local economic impact, affordability, or financing and *governance models (*Performance Indicators S.7 and S.8) - within a framework intrinsically linked to the measurement of energy and environmental impacts - results in a dilution of the assessment's rigor.
In fact, the framework assigns a significant weight - 27% - to factors related to these areas of influence, making it mathematically possible to obtain positive overall ratings even in the presence of poor or mediocre energy performance, thereby running counter to the systemic urgency of decarbonization and the principle that the planet's biophysical limits are non-negotiable.
A similar dynamic can be observed in the "Beauty" dimension, presented as a unit of measurement for the quality of the perceptual, cultural, and emotional experience of space. The inclusion of indicators related to the digitization of the construction process (B.1) or to strategies for the adaptability and physical durability of materials (B.6) does not reflect the primary phenomenological and sensory characterization underlying this macro-category. This overlap weakens the conceptual autonomy of the NEB pillar, reducing the reflection on spatial quality to a mere heterogeneous collection of *best practices*.
The analysis of the KPIs, summarized in the tables below, delves into the taxonomic fragmentation discussed, highlighting operational redundancies within the current structure of the *framework* and identifying, for each one, what additional dimensions might be considered in addition to the one assigned.
The analysis includes observations regarding specific evaluation criteria, such as, for example, the reference to and fragmentation of themes such as the interdisciplinary skills of the project team - considered in both S.7 and B.1 - or the presence of key issues such as psychological and physical well-being and spatial accessibility, both in the Inclusivity dimension (specifically with indicator I.3) and in the Beauty dimension through KPIs B.4, B.5, and B.7. Further issues arise from the allocation of design strategies with a clear ecosystemic impact within dimensions that are not strictly environmental, such as the redevelopment and reuse of spaces (B.8.2) or the implementation of urban green spaces (B.8.3). Although these criteria are defined by the method as measures of aesthetic and perceptual quality, they generate direct and measurable impacts on the mitigation of heat islands and the reduction of climate-altering emissions, as well as on the improvement of social cohesion and public health.

Sustainability KPIs	**Dimensions that may be affected**	**Note**
S.1 Minimise the use of fossil fuels	S	
S.2 Maximise the use of sustainable energy	S B I	Integrated high-tech or low-tech architectural solutions could also be considered in terms of their impact on the dimension of beauty, as an expression of an important aspect of contemporary society
S.3 Minimise greenhouse gas emissions	S	
S.4 Enhance sustainable mobility	S B I	
S.5 Minimise non-energy related impacts to air and water	S	Considering the dimension of beauty in terms of the quality of spaces, air quality and low concentrations of pollutants can also be evaluated as criteria for assessing this dimension
S.6 Minimise non-energy related impacts from built env.	S I B	
S.7.1 / S.7.2 Greening of the public sector / Inter-disciplinary	S I	
S.7.3 Gross value added to local economy	S I	
S.8 Greening of the private and financial sector	S I	
S.9 Promote circular economy	S	-

Beauty KPIs	Dimensions that may be affected	Note
B.1 Digitalisation in construction	S I B	
B.2 Quality of design and delivery	S B	The topic of team competence is also introduced here
B.3 Resilience to extreme events	S I B	
B.4 Ensuring occupant health, comfort and wellbeing	B I	-
B.5 Improving accessibility for everyone	B I	-
B.6 Maximising durability and service life	B S I	Extending the product life cycle leads to lower costs and greater stability, which should be guaranteed to all users and communities to prevent the gap between different segments of the population from widening.
B.7 Aesthetic Acceptance and Multisensory Experience	B I	Aspects related to initiatives aimed at improving accessibility for neurodivergent individuals are taken into account, and this therefore also impacts the dimension of inclusivity.
B.8.1 Spatial coherence and urban cohesion	B	
B.8.2 Re-use of spaces and buildings	B S	The redevelopment of urban spaces and land results in a reduction in environmental impacts compared to new construction
B.8.3 Green urban areas	B S I	Green spaces have a positive impact on heat islands and, more broadly, on individual well-being, and are therefore central to discussions on sustainability and inclusion.
B.9 Improving preservation of cultural and natural heritage	B	

B.10 Maintaining genius loci and improving sense of belonging	B I	
B.11 buildings and spaces through comparison to actual 'styles' and tendencies in art and architecture	B	

Inclusivity KPIs	**Dimensions that may be affected**	**Note**
I.1 / I.4	I	
I.2 Affordability	I	
I.3 Inclusive Quality, Equality, and Accessibility	B I	The quality of space is one of the main evaluation factors for the "Beauty" dimension
I.5 Impact on Social Cohesion in the Neighborhood	I	
I.6 Needs and Resources for Social Accessibility	I	-
I.7 Needs of Vulnerable and Marginalized Groups	I	
I.8 Anti-Discrimination Initiatives	I	
I.9 Stakeholder Engagement (Governance)	I S B	-

Table 55. *Possible interdimensional implication of each KPI.*

In order to address the methodological weakness identified and restore consistency to the evaluation framework, it is necessary to move beyond the current linear, funnel-shaped architecture in favor of a structural reorganization that incorporates dependency relationships between an indicator and multiple dimensions.

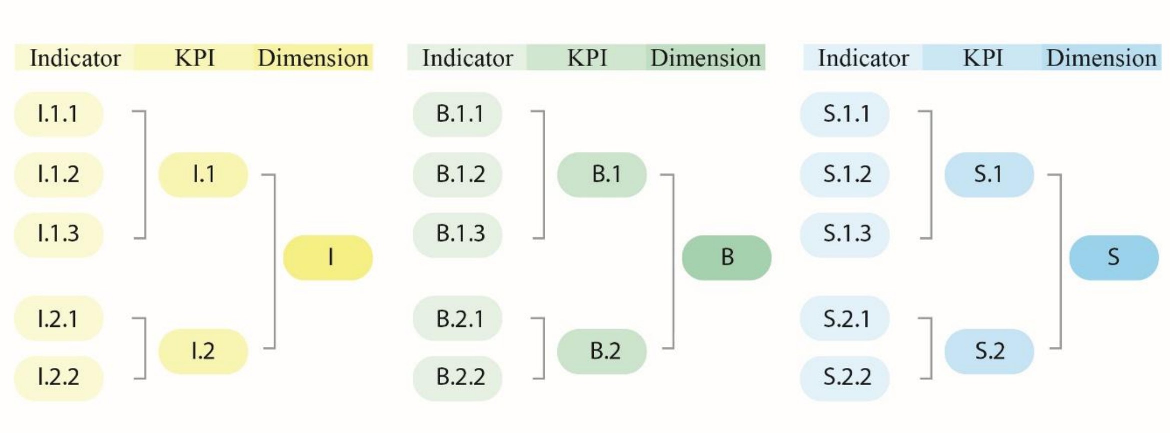

Figure 23. *Current evaluation structure*

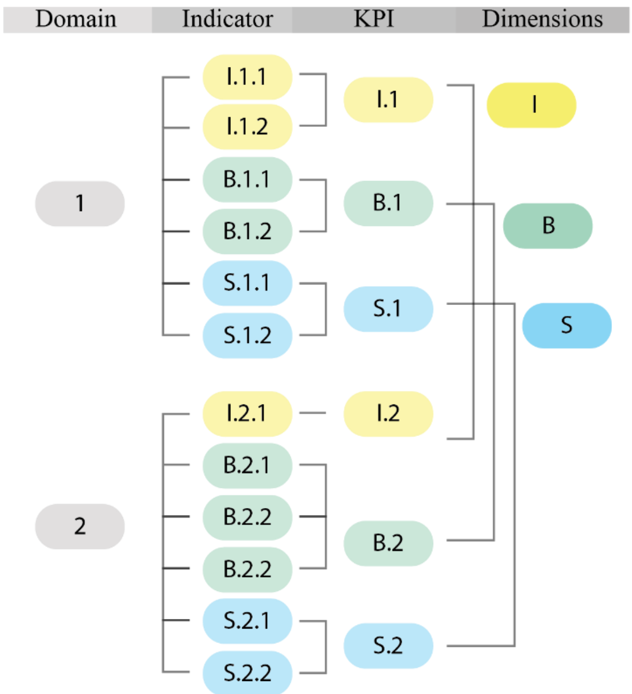

Figure 24. *Proposal for an alternative interconnected structure*

As illustrated in the conceptual diagram redefining the *framework*, the new theoretical model replaces the unidirectional hierarchical aggregation - in which indicators are aggregated into a single KPI and, consequently, into a single dimension - with an interconnected network system.

This alternative configuration calls for the single baseline indicator (represented by primary operational nodes) to be evaluated based on its technical or spatial performance, and then for its value to be distributed across the relevant KPI, as already provided for in the original structure. The key difference lies in the assignment of three distinct weighted values for each

KPI, whose impact is simultaneously distributed across the three respective dimensions (Sustainability, Beauty, Inclusivity) through cross-derivative vectors. The proposed structural reconfiguration would make it possible, for example, to calculate a parameter related to the presence of green infrastructure at the base and then radiate its impact by assigning it a balanced score that contributes to the assessment of environmental balance, experiential quality, and social inclusivity.

This outlines an evaluation algorithm that is concretely aligned with the holistic paradigm proposed by the New European Bauhaus and capable of measuring architecture's true potential impact on a sustainable transition.

The ability to unambiguously quantify a specific design choice - while simultaneously measuring its concurrent impacts - would also allow designers to manage systemic complexity in a far more straightforward manner. This simplification would not stem from a reduction in the number of alternatives considered, but rather from a methodological approach focused on identifying solutions with high cross-cutting performance and on calibrating performance *trade-offs*. This approach is fully aligned with the ambitious holistic goals of the European transition.

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Source/Note: Author's elaboration (geometric calculation diagram for the vault curvature and wood rib framing).

Figure 17. OneClick LCA results

Source/Note: Software output from OneClick LCA simulation (Level(s) life-cycle carbon method).

Figure 18. OneClick LCA results

Source/Note: Software output from OneClick LCA simulation (emissions breakdown by building element).

Figure 19. Building's energy demand

Source/Note: Software output from Honeybee simulation.

Figure 20. View of the annual incident irradiation on the building

Source/Note: Software output from Honeybee simulation.

Figure 21. Technical characteristics of the PV module

Source/Note: N-Type ABC Mono-glass Module AIKO-A-MAH72Mw

Figure 22. Irradiation of PV modules installed on the roof

Source/Note: Author's elaboration

Figure 23. Current evaluation structure

Source/Note: Author's elaboration

Figure 24. Proposal for an alternative interconnected structure

Source/Note: Author's elaboration

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Source/Note: Author's elaboration (proportional weight recalculation matrix following the exclusion of non-applicable indicators).

Table 16. KPI selection for beauty dimension

Source/Note: Author's elaboration (preliminary screening checklist mapping architectural scales and conceptual phase constraints).

Table 17. B.1.1 score

Source: Joint Research Centre (JRC), 2024.

Table 18. B.1 calculation

Source/Note: Author's elaboration (preliminary digitalization score synthesis matrix).

Table 19. Certification type and quantity calculation in m2

Source/Note: Author's elaboration.

Table 20. B.4.3 score

Source: Joint Research Centre (JRC), 2024.

Table 21. B.5.1 score

Source: Joint Research Centre (JRC), 2024.

Table 22. B.5.2 score

Source: Joint Research Centre (JRC), 2024.

Table 23. B.5.3 score

Source: Joint Research Centre (JRC), 2024.

Table 24. Application of the factor method to estimate service life of elements

Source: Adapted utilizing ISO 15686-1 reference service life methods and Joint Research Centre (JRC) evaluation tables.

Table 25. B.6.1 score

Source: Joint Research Centre (JRC), 2024.

Table 26. B.6.2 score

Source: Joint Research Centre (JRC), 2024.

Table 27. Order (O) sub-metric score

Source: Joint Research Centre (JRC), 2024.

Table 28. Contrast (C) sub-metric score

Source: Joint Research Centre (JRC), 2024.

Table 29. Transparency (Tran) sub-metric score

Source: Joint Research Centre (JRC), 2024.

Table 30. Novelty (N) sub-metric score

Source: Joint Research Centre (JRC), 2024.

Table 31. Attractiveness of circulation at building scale (ACb) sub-metric score

Source: Joint Research Centre (JRC), 2024.

Table 32. Tactile richness (TR) metric score

Source: Joint Research Centre (JRC), 2024.

Table 33. Auditory richness (AR) metric score

Source: Joint Research Centre (JRC), 2024.

Table 34. Olfactory richness (OR) sub-metric score

Source: Joint Research Centre (JRC), 2024.

Table 35. Heritage value (HV) evaluation

Bibliography

Averill, J. (2026, March 5). *BREEAM Certification Guide: Ratings, Costs & Process*. Retrieved from levelworkspace: https://www.levelworkspace.com/post/breeam-certification-complete-guide

Bagnacani, M. (2021). *Spazi Alba: riconversione degli ex-Magazzini Raccordati di Milano in un centro polifunzionale per il reinserimento sociale di persone fragili e in stato di grave emarginazione.* Tesi di laurea magistrale, Politecnico di Milano.

Baumgarten, A. G. (1750 / 1993). *Estetica.* Milano: Vita e Pensiero.

Borsotti, M., & Pistidda, S. (2020). *Abitare i rilevati ferroviari. Strategie innovative di rigenerazione. Il caso dei Magazzini Raccordati di Milano.* Maggioli Editore.

Butera, F. M. (2021). *Affrontare la complessità.* Milano: Edizioni Ambiente.

Caruso, N., & Datola, G. (2023). Temporary housing in Turin: the Ma.Ri. House case study. *Valori e Valutazioni*.

Ciolli, V. (. (2024, May 13). *Reti innovative a bassa temperatura per un uso circolare dell'energia termica.* Retrieved from Ingenio: https://www.ingenio-web.it/articoli/reti-innovative-a-bassa-temperatura-per-un-uso-circolare-dell-energia-termica/

Commission, E. (2010). *Directive on the Energy Performance of Buildings* . Retrieved from https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en (accessed on 30 September 2021)

Ding, G. K. (2008). Sustainable construction - The role of environmental assessment tools. *Journal of Environmental Management*, 451-464. Retrieved from https://doi.org/10.1016/j.jenvman.2006.12.025

Dorbolò, C. (2020, March 6). *We Participate, They Profit.* Retrieved from Failed Architecture: https://failedarchitecture.com/we-participate-they-profit/#:~:text=The%20story%20of%20Rhapsody%20in,their%20liveability%20and%20prevent%20ghettoisation

European Commission . (2021). *New European Bauhaus: Beautiful, Sustainable, Together; COM(2021) 573 final.* Brussels: European Commission .

European Commission. (2019). *The European Green Deal.* Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1588580774040&uri=CELEX%3A52019DC0640

European Commission. (2019). *The European Green Deal, , COM(2019) 640 final.* Brussels: European Commission.

European Commission. (2019). *The European Green Deal, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. COM(2019) 640 final.* Brussels.

Fondo Ambiente Italiano (FAI). (2025). *Dal 1975 il FAI difende la bellezza d'Italia. Per sempre per tutti*. Retrieved from https://fondoambiente.it/

Foster, H. (1983). *The Anti-Aesthetic: Essays on Postmodern Culture.* Port Townsend: Bay Press.

Foster, S. R., & Iaione, C. (2017, Agosto 20). *Ostrom in the City: Design Principles for the Urban Commons.* Retrieved from The Nature of Cities: https://www.thenatureofcities.com/2017/08/20/ostrom-city-design-principles-urban-commons

Gehl, J. (1987). *Life Between Buildings: Using Public Space.* (J. Koch, Trans.) New York: Van Nostrand Reinhold.

Grazuleviciute-Vileniske, I., Viliūnas, G., & Daugelaite, A. (2021). *The role of aesthetics in building sustainability assessment.* Spatium.

Harvey, D. (2007). *Breve storia del neoliberismo.* Milano: Il Saggiatore.

Jacobs, J. (1961). *The Death and Life of Great American Cities* . New York: Random House.

Jiménez-Pulido, C., Jiménez-Rivero, A., & García-Navarro, J. (2022). Improved sustainability certification systems to respond to building renovation challenges based on a literature review. *Journal of Building Engineering, 45*. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S2352710221014339#bib3

Joint Research Centre (JRC) - European Commission. (2025). Technical Workshop on the New European Bauhaus (NEB) self-assessment method and tool. *Technical Workshop on the New European Bauhaus (NEB) self-assessment method and tool.* Brussels: Joint Research Centre.

Joint Research Centre (JRC). (2024). *A practical guide to the New European Bauhaus self-assessment method and tool.* Lussemburgo: Publications Office of the European Union.

JRC. (2023). *2023.* Luxembourg: Publications Office of the European Union: Updates on the Energy Performance of Buildings Directive implementation in the EU Member States.

Kant, I. (1790 / 1999). *Critica della facoltà di giudizio.* Torino: Einaudi.

Klinenberg, E. (2002). *Heat Wave: A Social Autopsy of Disaster in Chicago.* Chicago: University of Chicago Press.

Klinenberg, E. (2018). *Palaces for the People: How Social Infrastructure Can Help Fight Inequality, Polarization, and the Decline of Civic Life* . New York: Crown.

Macchi, L. (2022, June 1). *Milano | Centrale – Nasce Dropcity nei Magazzini Raccordati*. Retrieved from https://blog.urbanfile.org/2022/06/01/milano-centrale-nasce-dropcity-nei-magazzini-raccordati/

Madden, D., & Marcuse, P. (2016). *In Defense of Housing: The Politics of Crisis.* Londra: Verso.

Meadows, D. H. (1972). *The Limits to Growth.* New York: Universe Books.

Paulo, L., Thomas, M., Matthaios, S., Barbara, W., Francesca, A., Costas, B., . . . ORCID-Logom, G. K. (2024). *A practical guide to the New European Bauhaus self-assessment method and tool.* Luxembourg: Publications Office of the European Union. doi:10.2760/9581060

Piano, R., & Keller, S. (2025, Novembre 27). Laboratorio Arte del Costruire_Fondation Beyeler.

Progetto Arca. (2024, February 5). *Progetto Arca - Il primo aiuto, sempre*. Retrieved from https://www.progettoarca.org/

Raworth, K. (2012). A safe and just space. *Oxfam Discussion Paper*.

Sachs, J. D. (2015). *The age of sustainable development.* Milano : Università Bocconi.

Sartwell, C. (2004). Six Names of Beauty. New York: Routledge.

Sendra, P., & Sennett, R. (2020). *Designing Disorder: Experiments and Disruptions in the City.* Londra : Verso.

Sennett, & Richard. (2012). *Together: The Rituals, Pleasures and Politics of Cooperation.* New Haven & London: Yale University Press.

Sennett, & Richard. (2018). *Building and Dwelling: Ethics for the City.* New York: Farrar, Straus and Giroux .

Serck, L. (2024, January 24). *It's not easy, being green – are green building certifications just greenwash?* Retrieved from University College of Estate Management (UCEM): https://www.ube.ac.uk/whats-happening/articles/are-green-building-certifications-greenwash/

Silva, V. (. (2020, November 9). *Rhapsody in West Residential Development / TANGRAM architecture and urban landscape.* Retrieved from Archdaily: https://www.archdaily.com/950961/rhapsody-in-west-residential-development-tangram-architecture-and-urban-landscape

Society of Light and Lighting, SLL. (2022). *The SLL Code for Lighting.*

Stavrides, S. (2010). *Towards the City of Thresholds.* Trento: professionaldreamers.

Sullivan, L. H. (1896). The tall office building artistically considered. *Lippincott's Magazine.*

Van Damme, W. (1996). *Beauty in Context: Towards an Anthropological Approach to Aesthetics.* Leiden: Brill.

Vitruvio, M. P. (15 a.C. / 1999). *De Architettura.* (L. Migotto, Trans.) Edizioni Studio Tesi.

World Commission on Environment and Development. (1987). *Our Common Future.* Oxford: Oxford University Press.