European Commission

Horizon Europe-New European Bauhaus Nexus Report

Conclusions of the High-Level Workshop on
'Research and Innovation for the New European Bauhaus',
jointly organised by DG Research and Innovation and
the Joint Research Centre

Independent
Expert
Report

Research and Innovation

Horizon Europe-New European Bauhaus Nexus Report

European Commission
Directorate-General for Research and Innovation
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2022 Directorate-General for Research and Innovation

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CHAPTER 1: EXECUTIVE SUMMARY

The report offers a set of guiding principles that can shape the goals and ambitions of the New European Bauhaus (NEB) initiative.[1] These recommendations are organised on the basis of current and future Horizon Europe organisational structures and timeframes, and include:

1. *Opportunities for the current funding period 2021-22* and potential short-term actions as reflected in Chapter 3 and Annex 1. The approach of 'NEB marking and flagging' applied to the call topics already defined in the Horizon Europe work programme 2021-2022 is necessary at the early stage of NEB but will likely prove insufficient, with the risk of distorting and dismantling otherwise systemic and holistic proposals in order to fit the Horizon Europe cluster-format.
2. *Mid-term goals for the 2023-24 period* that include recommendations (Chapter 4 with 'Precedent Actions' provided in Annex 2) for the formulation of a set of operating criteria, the identification of specific barriers in the form of knowledge gaps, entrenched behaviours and mindsets, existing institutional structures, and policy barriers, and the enumeration of possible research and design actions within the NEB framework.
3. *Long-term actions beyond 2024 that reflect the NEB interdisciplinary, trans-sectoral vision*. Chapter 5 and Annex 3 offer a set of novel approaches and formats designed to drive transformative change, making NEB both a disrupter and a re-uniter of Horizon Europe clusters and a sponsor of new, yet critical missions. In the longer term, the NEB can serve to build and operationalise potential synergies between European Union programmes, agencies, and institutions, maximising the effective use of Horizon Europe opportunities for research and innovation, and creating non-traditional educational structures, innovative curricula, and participatory public outreach programs.
4. Chapter 6 outlines *a set of strategic priorities and associated benchmarks* that describe a path forward for European society and its response to our climate emergency together with our global partners.

These recommendations are intended to support the NEB values of Sustainability, Inclusion and Beauty, while seeking to direct its ethical development, guide the systemic analysis that informs it, sponsor the heterogeneous cultural aesthetics that may arise from it, and operationalise the holistic approach to the built environment that is its mission.

New European Bauhaus
beautiful | sustainable | together

[1] This report focuses primarily on the built environment as a site of urgent climate action but also addresses, to a limited extent, a broader spectrum of industrial/cultural activity and production that represent critical components of the NEB mission. Other crucial sectors such as the textile industry need to be dealt with elsewhere.

CHAPTER 2: WHAT THIS REPORT IS ALL ABOUT

At the beginning of the third decade of the 21st century, the deepening impacts of human activity on the Earth's climate and ecosystems have brought us to an existential tipping point. The built environment, long underestimated as a source of significant perturbation, is now understood to account for at least 40% of anthropogenic greenhouse gas emissions (Pylsy et al. 2020) as well a host of other global ecological and socioeconomic impacts. By 2050, there will be more than 2 billion new inhabitants of global cities. Demand for additional buildings and infrastructures will grow accordingly, placing an increasingly heavy burden on critical resources and vulnerable ecosystems. Resource deprivation will further disenfranchise an ever-larger segment of human population, causing dislocation and degradation in the built environment and creating dangerous demographic pressures that threaten human well-being and pose serious risks to political stability.

To avoid a dangerous destabilisation of our climate and the rupture of already tenuous social fabrics, the European community, in partnership with societies worldwide, must take decisive action to mitigate and, where possible, *reverse* the dynamics of anthropogenic climate change (European Commission 2021-1, 2021-2, 2021-3). The reshaping of our burgeoning global cities – the way we build them, organise them, distribute their services, and inhabit them – will entail a fundamental but crucial transition from an extractive, mineral-based and fossil hydrocarbon-fuelled construction economy to a regenerative bio-economy and circular system of material reuse (Craft, Ding et al. 2017; Hillebrandt 2022). Our cities and rural areas must store rather than emit excess atmospheric carbon (Churkina et al. 2020), generate more energy than they consume, absorb rather than exacerbate the flows of waste from industrial and consumer activity (Xu et al. 2022), promote and incentivise the restoration and expansion of healthy global ecosystems, foster creative participation by citizens and, by extension, reapportion resources and economic power at local, regional, and global scales.

Human settlement and the act of building in cities and rural areas must be transformed from a source of environmental predation into a restorative force for terrestrial health and well-being. We must *re-entangle* human activity with the planet’s natural systems, so that they function in synergy and symbiosis rather than in conflict and exploitation.

The remapping of building production and consumption essential to this transformation will entail fundamental but systemic research, trans-scalar testing and implementation, multi-modal means of demonstration, and innovative platforms for the education of all our citizens and, most critically, of the next generation who will inherit our planet’s dire condition. Interdisciplinary and trans-sectoral alliances must focus on topics and solutions centred on the conception and production of human habitation: on bio- and circular construction economies; on the material, ecological, social, data, and climate sciences; on industrial ecology and waste management; on polycentric and community-oriented urbanisation – all to promote inclusion and social justice, climate restoration, biodiversity, and human health.

A New Bauhaus for Europe and the Planet

One hundred years ago, the ‘Staatliches Bauhaus’ was founded in Weimar, Germany, as a response to the continental cataclysm of the First World War and its corresponding physical destruction and social upheaval. Conceived and implemented as host to new modes of creative experimentation, the pedagogy of the Bauhaus sought to dissolve the orthodox boundaries between art, artisanry, and industry, signalling a potential shift of resources and agency from an elite sector of European society to a much broader swath of its citizenry.

Today, a new Bauhaus initiative offers a similar opportunity – though larger in scale and broader and deeper in its consequence – to respond to the slow-rolling threat of our contemporary global cataclysm: climate

change, mass extinction, resource depletion, social conflict, human degradation. By transgressing the hard boundaries of conventional disciplinarity and departmentalisation and by merging scientific inquiry, technological innovation, and participatory creative process with the original cultural formats of the Bauhaus project, the New European Bauhaus can serve as an instrument and a source of comprehensive architectural, technological, rural, urban, and social transformation.

New solutions to an array of contemporary challenges can be synthesised through the productive alliance of traditional skillsets and deep cultural knowledge with rigorous scientific analysis and the power and reach of advanced digitisation and artificial intelligence.

Creative processes that were once delegated to selective institutions by individual appointment can expand to embrace, respectfully and joyfully, broad community participation, tap unexpected sources of wisdom and inspiration, and acknowledge the contingencies of locality while addressing global concerns. The digital tools of measurement and data collection, dynamic systems analysis, simulation modelling and impact assessment can combine with local empirical knowledge and natural feedback mechanisms to alert us to the sustainable limits of resource consumption (Wang et al. 2021). These, in turn, can profoundly inform the design of our solutions to the constantly evolving grand challenges before us. These approaches, and the values that underpin them, will inevitably transform our perceptions of what is both functional and beautiful as we work to re-form the artefacts and re-calibrate the activities that comprise the making and inhabitation of buildings in both cities and rural settlements.

CHAPTER 3: CONSIDERING NEW EUROPEAN BAUHAUS OBJECTIVES IN HORIZON EUROPE WORK PROGRAMME 2021-2022

The Horizon Europe Strategic Plan (2021-2024) has set key orientations for the targeting of investments in the first 4 years. The objectives of the New European Bauhaus (NEB) are well in line with these orientations:

- Promoting an open strategic autonomy;
- Restoring Europe's ecosystems and biodiversity;
- Making Europe the first digitally enabled circular, climate-neutral and sustainable economy; and
- Creating a more resilient, inclusive and democratic European society.

Horizon Europe work programme 2021-2022 was developed following the key strategic orientations defined before the NEB was announced. To demonstrate the importance of NEB principles, Horizon Europe work programme 2021-2022 was reviewed by the expert group and calls with relevance to NEB were identified. These calls must deliver developments and the new knowledge necessary to ensure a sustainable and inclusive future for our society. The review focused on Pillar II of the programme 'Global Challenges and European Industrial Competitiveness'.

Calls relevant to NEB can be found in all six Clusters as specified in Annex 1.

CHAPTER 4: INTRODUCING CRUCIAL NEW EUROPEAN BAUHAUS TOPICS IN HORIZON EUROPE WORK PROGRAMME 2023-2024

In the 2023-24 period, further development and promotion of synergies between Horizon Europe work programme and the New European Bauhaus (NEB) initiative can promote the NEB as a means to fill knowledge gaps and offer innovative solutions that transcend limits posed by disciplinary and sectoral boundaries.

Regenerative Design Criteria

In order to dismantle the disciplinary and sectoral silos that have proven to diminish or negate the effectiveness of past sustainability efforts, the NEB should function cohesively, across clusters, disciplines, and sectors, as well as modes of ideation and production, with the aim of exploiting the regenerative potential of building sector activities and building artefacts.

A regenerative design approach seeks to leverage the sheer scale of consumption and production we anticipate in the next three decades of global urbanisation – the mass of physical material we will call upon to form or repair the built environment; the vast surface areas of all the buildings that will comprise it; the extent of the resource landscapes and ecosystems we will disturb in the process; the size of the workforces we engage and populations we seek to serve – as a restorative force for the health of the biosphere and stability of the climate (Tainter 2012).

The objective of a regenerative design process is to create buildings, cities, and settlements that:

- Store more anthropogenic carbon than they emit;
- Generate more energy than they use;
- Enhance rather than deplete biodiversity;
- Incentivise the restoration and expansion of natural landscapes as critical preserves or, where appropriate, renewable material sources;
- Take fullest advantage of natural ecosystem services rather than seek to technologically replicate or replace them;
- Siphon off the waste streams of industrial and consumer activities through value-added processes that transform detritus into new forms of ‘raw’ industrial material;
- Prioritise durability – repair, maintenance, upgrade – over the construction of new buildings and the consumption of material and energy it entails (Grillone, Danov et al. 2020);
- Safely and securely house all citizens but especially those underserved populations who continue to struggle for access to the barest of shelters;
- Engage citizens in the transformation of their communities;
- Re-enfranchise communities whose deep cultural knowledge has been at best ignored in an era of global economic exchange; and
- Use the power of digitised data collection, parametric modelling, and systems optimisation to continually reassess and adjust the ways in which our constructed environments perform with respect to the health of the human and terrestrial metabolism.

In order to affect such a fundamental transformation of the built environment and a shift from a vaguely-defined paradigm of sustainability to one of regenerative benefit, the expert group calls for immediate action in the following areas:

- Biogenic Carbon Storage: Buildings and Cities as Carbon Banks;
- Ending Waste: Policies and Practices in a Circular Construction Economy;
- Enhancing Biodiversity: Eco-systemic Decision-making in Design;
- People and Their Communities: User-Centred Criteria/Participatory Design Processes;
- Fair and Just Transitions: Equity and Empowerment for Disenfranchised Populations;
- Impact Assessment: Gathering Data and Tracking Our Footprints;
- Digitising the Building Sector: Applications throughout Building and Urban Life Cycles; and
- Geometries of Human Settlements: Organising the Relationship of Urbanity and Rurality.

Modes of Inquiry and Action

The New European Bauhaus initiative, working in concert with Horizon Europe, should engage and support four modes of inquiry and experimentation to be deployed simultaneously and in synergy:

- FUNDAMENTAL: conducting basic research including systems modelling and analysis, experimentation and testing by both established research institutions and community-based organisations. The sponsorship of open-source networks with curated exchanges among knowledge generators and research partners will compound discovery, promote dissemination, and accelerate innovation.
- APPLIED: promoting the rapid utilisation of fundamental research through technological development and the prototyping and testing of processes and assemblies. Active exchange in a Creative Commons multiplies sites of implementation and fosters the potentially creative discovery of ‘unintended outcomes’, ‘creative misapprehensions’ and ‘innovative hybrids’.
- DEMONSTRATIVE: encouraging the general dissemination of findings and the exhibition and critique of innovation. In addition to promoting both Horizon Europe/NEB objectives and solutions, the demonstrative mode of the NEB projects serves as a feedback mechanism for participants and recipients. Failure is valued as fundamental to innovation.
- EDUCATIONAL: broadening the means to transfer knowledge and actionable information on the objectives, underlying principles, and specific findings and innovations sponsored by the New European Bauhaus. This mode of activity serves to empower a future generation of informed producers and consumers, critical decision-makers, and participants not typically served by traditional educational formats.

In a majority of cases, the following examples of specific NEB actions will engage more than one (and in some cases, all) mode(s) of inquiry as it charts a pathway towards systemic transformation through broad participation (Widera 2018).

Systemic Challenges and New European Bauhaus Actions

Current knowledge gaps, conventional behaviours, institutional barriers, and policy constraints create systemic challenges that can be addressed through NEB programmes and activities. The following examples represent a set of primary challenges and corresponding actions:

Challenge 1: Contemporary cities and human settlements are life-cycle greenhouse gas sources. However, they can become carbon sinks. The global construction sector continues to employ extractive material, energy, and manufacturing technologies, producing significant greenhouse gas emissions. The embodied emissions spike incurred in the production phase of that construction boom will create its own climate force that will take many decades to amortise over the lifecycle of the buildings we will need to construct. Systemic impacts/benefits may result from this strategy to draw down carbon (WBGU 2016).

Actions:

- Promote low-emissions manufacturing. Exploit forest photosynthesis as a material manufacturing energy system, thereby offsetting fossil hydrocarbon-intensive manufacturing of mineral-based structural materials.
- Study the adaptability of varying species and fibre properties resulting from natural and managed forest mortality for mass timber and other building material applications.
- Develop adaptation strategies to reflect and respond to forecasts of increased atmospheric carbon concentrations, the correlated break down of global carbon pools and loss of habitat, and the public health.
- Promote the broad adoption and use of an array of biogenic building materials – agricultural residues, typhas, seaweeds, bamboos, etc. – for new and renovated buildings and create tracking methods for the chain of custody and net carbon flows of bio-material inputs (Widera 2014).
- Facilitate a broad-based transition to biogenic building materials and the adoption of life-cycle carbon assessment and biodiversity impacts of sustainably managed forests and wood utilisation through various forms of engagement of stakeholders all along the building material supply chain. Advance public understanding through stake-holder dialogues, publications, capacity building trainings, remote and classroom coursework, etc.
- Study the impact of increased mass timber demand on minority or marginalised landowners and indigenous communities. Assess economic benefit of increased rural and urban employment opportunities associated with new regional bio-material harvest and production and urban building assembly techniques. Assess non-market benefits and the role forests play to other natural and human capital assets (Dasgupta 2021).
- Provide training protocols for a new urban building workforce collaborating with community organisations and industry partners.

Challenge 2: The construction sector is a major contributor to material consumption but has not yet adapted to the circular economy.

Actions:

- Shift design thinking about buildings as fixed objects to address their potential as future material banks and sources for material reuse and ‘raw’ material for manufacturing.

- Minimise the extraction of new materials from nature and reduce the amount of waste generated by household and industrial consumption.
- Explore and develop strategies of design-for-disassembly and reuse as well as affordable methods for creating reversible connections that allow for the recovery of building materials without damaging their properties and maintain the building component function and performance values (e.g. structural, insulation, appearance) over multiple lifecycles.
- Establish reverse logistics systems that optimise the systemic recovery of material from multiple locations and distributing it to re-processing centres.
- Develop technologies to clean, reprocess, and reintroduce building materials including reclaimed timber to the market in a systemically efficient manner.
- Create regulations defining a ban on substances in building materials that are hazardous to health and hinder reuse and recycling, including deconstruction fees to be covered at the time the building permit is issued.

Challenge 3: There are over 260 tree species in Europe, but only about 60 species have a known (traditional) use as material. Efficient and responsible utilisation of resources from European forests while maintaining their biodiversity and cultural value is needed.

Actions:

- Deepen the science of nature-based materials (chemistry, anatomy, durability, modification, industrial properties).
- Develop new and advanced tools in material research: novel 3D imagery and scanning, digital twins, Artificial Intelligence applications, materials and systems modelling, virtual testing, etc.
- Focus specifically on infrequently used species, especially some hardwood species that are critical to certain forests and their sustainable silvicultural management.
- Develop material treatment and modification methods that exclude and/or replace fossil-based and harmful substances (bio-based alternatives): glues, impregnates, varnishes, insulates, etc.
- Limit the burning of fresh wood: energetic exploitation should be last resort following cascade utilisation in first/second life cycles as sustainable, long-life products (buildings, furniture, etc.).
- Encourage urban forestry and green infrastructure.
- Develop clear and quantifiable methodologies to assess sustainably managed forest carbon pools, streamline the transfer of forest carbon into durable building products and urban building assemblies, and ensure the long-term maintenance of those urban storage banks through circular economy policies.
- Encourage and assess biodiversity by exploring a broader range of habitat provided by the evolving stand characteristics of sustainably managed forests.
- Resist habitat loss through forestland conversion associated with suburbanisation and soil carbon loss caused by mineral extraction.

Challenge 4: Restorative and regenerative design principles that support the health and well-being of occupants and the environment – as well as the evolving relationship between society and the environment – lack a broad enough evidence-base to drive change in building practices, especially related to the use of renewable materials.

Actions:

- Promote interdisciplinary collaboration of material sciences with health, mental, and social sciences in creating evidence-based design principles that lead to human benefits (comfort, well-being, productivity enhancements) through the use of nature-based materials in buildings and indoor environments following the circular principles.
- Design indoor spaces that act as a passive intervention to promote human well-being: Material choices, especially in indoor settings, affect the emission of chemical compounds and moisture, can create antibacterial effects, influence acoustics, and have psychological and physiological impacts on human health. Understanding the role of nature-based materials in eliminating unwanted effects (e.g. noise) and maximising desired effects (e.g. clean air, visual comfort, etc.) is critical.
- Engage with the creative sector, arts, and citizens in exploring design paradigms, like biomimetic, biophilic, eco-design, and circular design in creating inclusive, and affordable living, working, and learning spaces that people want to be in.
- Develop a system for rewarding nature-based building materials through sustainability credits (award no such credits to release for construction).
- Implement biomimetic, bioinspired, bioclimatic principles in the building sector to accelerate the design and development of materials with novel properties and building elements with innovative functionalities (Widera 2015).
- Develop multifunctional treatments for nature-based materials using non-toxic, environmentally beneficial processes for performance improvements, including for application in demanding environments (Mario Cucinella Architects 2021).
- Develop adaptation strategies to reflect and respond to forecasts of increased atmospheric carbon concentrations, the correlated break-down of global carbon pools and loss of habitat, and the public health impacts of anthropogenic changes to geo-biological, chemical, and physical systems.
- Substantiate the public health benefits (biophilia and indoor environmental quality) promoted by the substitution of biogenic alternatives for conventional mineral-based building materials.
- Promote the use of biogenic building materials for new and renovated buildings and create tracking methods for the chain of custody and net carbon flows of bio-material inputs.
- Preserve and renovate the existing building stock to answer contemporary demand for housing while focusing on community participation in decision-making processes and social equity as objectives (United Nations 2019).

Challenge 5: Developments and trends in the built environment over the last 50 to 100 years have ignored traditional crafts knowledge that used material in a resource- and energy-efficient manner for centuries that preceded ours. The rediscovery of craft knowledge in material use and building is critical to not only the preservation of cultural heritage, but also to the development of innovative and environmentally beneficial technologies.

Actions:

- Recover and valorise 'lost' and under-utilised traditional knowledge in architectural design and material, and construction artisanry, through both educational curricula and every-day practice.
- Integrate traditional materials, techniques, and construction assemblies, also through innovative technologies and digital applications.
- Utilise both traditional techniques and new-found knowledge to improve the circularity of the built environment through design for disassembly and reuse, recovery of materials, reversible connections, etc.
- Promote continuing education in the construction sector and encourage qualification in nature-based building products and their installation, renovation/repair and recycling.
- Promote science-based educational excellence for professionals, policy makers, and citizens to ensure the implementation of new developments in the design and production of buildings.
- Provide training protocols for a new urban building workforce together with community organisations and industry partners.

Challenge 6: Despite the ongoing development of sophisticated digital tools, their applications to the unfolding environmental and social crises remains uncoordinated and overly focused on specific problems without an integrated approach to systemic questions and citizen science.

Actions:

- Promote environmental sensing technologies that reflect dynamic environmental health conditions, which can be applied across scales ranging from human physiological metrics, through space and building air quality, to broad impacts on land- and ecosystems.
- Develop datasets applicable to a portfolio of impact assessment tools and techniques (next-generation, integrated Life Cycle Assessment and Material Flow Analysis). This should seek to reflect real-time updates to regional building datasets and create expanded systems boundaries (beyond the stages of the building life cycle) that incorporate land/ecosystems/biological impacts of harvesting/extraction and project material and component reuse scenarios for multiple, cascading, building and product lifecycles.
- Create robust and verifiable, yet dynamic, chains of custody that track specific materials and products from cradle to cradle over multiple life cycles – extraction, production, construction, renovation and repair, end-of life reuse – and that account for net inputs and losses within each stage.
- Develop systems modelling that captures the natural flux (growth and mortality) of biological resources and their respective changes in carbon content, soil health, disturbance risks, etc.
- Develop dynamic digital systems optimisation that reaches beyond applications on the factory floor or for social media content creation to avoid potential environmental impacts, enhance benefits and generally aid decision-makers in the governance of common resources.

- Adopt data-driven circular economy business models for the regionally standardised collection, sorting and reusing of building materials.

Challenge 7: Europe is missing Open Innovation Testbeds for nature-based material innovations and regenerative design approaches. These are necessary for integrating potentially complementary fields of wood and material science, architecture, civil engineering, design, digitalisation and data science, industrial engineering, and innovation management.

Actions:

- Establish Open Innovation Testbeds for nature-based materials and regenerative design that will accelerate research, development, testing, knowledge transfer, and market uptake of novel renewable and sustainable nature-based materials, structural components and envelope systems, such as hybrid engineered wood products (hybrid EWP), to leverage significant opportunities for increasing circularity and decarbonisation in the building sector.
- Facilitate a broad-based transition to biogenic building materials and the adoption of life cycle carbon assessment and biodiversity impacts of working forests and wood utilisation through various forms of engagement of stakeholders all along the building material supply chain. Embed the science and technology of biogenic building material into curricula including Schools of Architecture, Engineering, Material Science, Forestry, Environmental Management, life-long learning, and early education. Advance public understanding through stakeholder dialogues, publications, capacity building trainings, remote and classroom coursework, etc.

Challenge 8: Contemporary building regulation and review processes, procurement requirements, and restrictive financing systems limit the agency and capacity building efforts of grass-roots community-based organisations.

Actions:

- Empower self-provisioning communities that typically represent disenfranchised and socio-economically distressed populations.
- Embrace the potential agency of those groups marginalised by conventional policy, regulation, and funding streams and who are forced to work against those administrative structures.
- Encourage local innovation and community-based solutions within a given locale with its particular resource pool and place. This form of participation may range from indigenous communities living and working within critical ecosystems and seeking to create regenerative and value-added manufacturing enterprise to urban citizens' movements that seek to self-generate solutions to housing and urban place-making through the institution, for example, of building material banks, sweat equity investment in building renovations, and public space restoration.
- Provide platforms through which funding may be distributed and from which local solutions and build networks for knowledge-sharing can be disseminated.

Challenge 9: Uncontrolled urban sprawl represents a massive and continuous stockpiling of human-made material. Since the Charter of Athens, cities have been zoned to reflect putative functional efficiencies creating a host of unintended consequences including automobile dependency, social dislocation, unintended thermodynamic impacts, atmospheric pollution and reduced urban air quality, and the ongoing conversion of biologically productive landscapes into inert and impervious surface areas.

Actions:

- Remap regional urban growth to reflect densities and geographic dimensions that are convivial for a city's inhabitants and optimised to reduce both first and ongoing impacts to natural systems.
- Prioritise and incentivise the reuse of existing building stock and the development of inner-city brown fields rather than new building and green field development.
- Empower citizens and community-based organisations to inform and control development based on human need and environmental benefit rather than short-term revenue and returns on investment.
- Create dynamic models that measure demographic pressures in the face of environmental stresses and aid in the resettlement of dislocated populations based on metrics of economic opportunity, environmental stability and impact reduction.
- Model new forms and geometries of urbanisation that reflect a sustainable relationship between natural habitat, climate and polycentric constructed environments.
- Ensure the strong role of rural communities in remapping urban growth and citizen empowerment.

Challenge 10: Transforming Europe's built environment into a climate-positive sector is held back by a lack of demonstration projects that showcase novel sustainable construction systems, like hybrid engineered wood products and building systems, and reused or recycled components and assemblies.

Actions:

- Promote the combined use of nature-based materials, like sustainably harvested and processed wood and other bio-based materials with reused and recycled materials in both residential and non-residential buildings, highlighting a variety of building systems (light timber frame, heavy and engineered timber frame, or monolithic components such as cross-laminated timber, etc.).
- Transform buildings from drivers of resource extraction and generators of waste into receptacles and storage banks for reused and recycled materials during the production stage and, in the end-of-life stage, as material resources for cascading uses in buildings and other consumer products.
- Develop strategies and methodologies for renovation of existing buildings using renewable materials.
- Develop innovative façade systems and building structures using solid and/or bio-composite materials that are recyclable and adapted to address challenging climate conditions (heat, snow, rain, wind, insects, etc.).
- Promote regional factory prefabrication to assure building quality, promote safe working conditions, optimise material usage and reduce construction site waste.

- Encourage the inclusion, engagement, and participation of local communities in long-term building strategy development and implementation for new construction, renovation, and community forming, including involvement of artists.

Horizon Europe and the Successful Implementation of the New European Bauhaus

The key principles of the New European Bauhaus (NEB) – sustainability, inclusion, and aesthetics – and the mission of transforming the built environment into an instrument with which to protect and expand the biosphere, stabilise the climate, and ensure human health and well-being can be supported through Horizon Europe in all three main pillars:

- *Pillar I Excellent Science*: generating missing fundamental knowledge for successful implementation of the NEB.
- *Pillar II Global Challenges & European Industrial Competitiveness*: supporting missing NEB related R&D activities and demonstrations.
- *Pillar III Innovative Europe*: enhancing the applied knowledge and its transfer into economy and society following the key principles of NEB.

Successful implementation of the New European Bauhaus initiative across Europe should be supported also through the additional Horizon Europe Pillar 'Widening Participation and Strengthening the European Research Area'.

Note that the European Commission has recently produced several excellent publications relevant for NEB research and innovation. The expert group specifically mention here the JRC report (2021) on forest-based bio-economy.[2]

[2] JRC Publications Repository - Brief on the role of the forest-based bioeconomy in mitigating climate change through carbon storage and material substitution (europa.eu).

CHAPTER 5: NOVEL HORIZON EUROPE FORMATS & ACTIONS FOSTERING NEW EUROPEAN BAUHAUS OBJECTIVES

In the previous chapter, we listed a number of research, development and demonstration challenges that arise from the New European Bauhaus (NEB) perspective and may be accommodated within the existing Horizon Europe structure organising work programme 2023-24 – admittedly, with a bit of tweaking and pruning. Some of these themes however may not fit readily into that framework or might significantly benefit from a broadened playing field with somewhat different rules. Novel structures for calls and applications, selection and funding might catalyse the identification and pursuit of critical topics that can only be tackled in a transdisciplinary manner. For instance, the establishment of a fully bio-based, climate-positive and profitable construction sector within a specific region in Europe requires not only interdisciplinary research and development but also concerted co-creation by a multitude of public and private stakeholders. When it comes to higher training and education, something modelled along the Marie Skłodowska-Curie Actions, yet specifically serving the NEB objectives, might prove expedient.

Such interconnected problems arise whenever entirely new questions emerge from developing intellectual and political discourses. The workshop on 30 November 2021 dedicated much of the available time to envisioning novel formats and actions that might be developed within Horizon Europe in light of the NEB initiative of European Commission President von der Leyen. In this chapter, the expert group sketch out a number of approaches and formats identified in the workshop and during follow-up discussions among the high-level experts who participated. For the purposes of this section of the report, the expert group seeks to draw an explicit distinction between the 2023-24 and post-2024 timeframes.

Horizon Europe work programme 2023-2024

- ***Dedicated Built-Environment Cluster***

  Under careful scrutiny, the transformation of the built environment along the lines the expert group recommends for the NEB in this report touches all six Clusters within Pillar II of the current Horizon Europe framework. Consider, for example, the sustainable development of an old-industrial city in Europe (such as Rotterdam, Torino or Katowice.) This will involve, inter alia, considerations in outdoor and indoor air quality (Cluster 1), preservation of cultural heritage from various epochs (Cluster 2), resilient infrastructures withstanding extreme-event regimes as caused by global warming (Cluster 3), autonomous buildings utilising advanced machine-learning and sensor technology (Cluster 4), urban geometries reducing energy consumption as well as heat-island effects (Cluster 5), and bio-based construction materials produced in the respective region (Cluster 6).

  The transdisciplinary character of a project/action seeking to tackle that broader challenge might be completely lost if an application is forced to dismantle a systemically integrated proposal and re-distribute its component content and participants in order to fit the funding parameters of a particular Cluster. It would make sense then to create an additional Cluster, where adequate systemic innovation could be pursued.

- ***Cross-Cluster Platform***

  If the creation of a new Cluster is difficult to realise for political and procedural reasons, then a reasonable alternative could be the establishment of a novel entity (e.g. a platform) within Pillar II that helps to assemble, develop and launch trans-Cluster topics and activities. This would help to meet directly the built-environment research & innovation challenge (as outlined above), but also benefit

many other sustainability projects that might not fit neatly into the six bins delineated in the incumbent funding structure.

- ***Updating/Upgrading of EU Mission 4***

  The five current EU Missions are meant explicitly to support strategic European Commission priorities such as the *European Green Deal* and the *New European Bauhaus*. They are nevertheless rather narrowly defined, like Mission 2 ('Beating Cancer') and Mission 4 ('Climate-Neutral and Smart Cities'). The latter, intended to contribute to the transformation of 100 European cities by 2030, considers areas such as operational energy efficiency, digitalised mobility, construction materials, the 15-minute city concept (covered by the Horizon Europe Partnership 'Driving Urban Transition'), and more. There is increasing evidence that certain settlements could even become carbon sinks by smart holistic transition management, as has been indicated by European Commission President von der Leyen in her State of the Union address 2020.

  Therefore, it would be perfectly reasonable to widen the lens of Mission 4 by incorporating critical NEB objectives. In particular, one might raise the ambition for a subset of the 100 Mission target settlements: make 20 of them sustainable, inclusive and beautiful, i.e., turn them into 'New Bauhaus Cities' by 2030.

- ***Using EIT Expertise and Capacities for NEB Purposes***

  Another important entity within the wider Horizon Europe framework is the European Institute of Innovation & Technology (EIT), although its relationship with work programmes and EU Missions is not yet adequately defined. This deficit could be readily answered by directing EIT and its Knowledge and Innovation Communities (KICs) to serve NEB objectives, capitalising on its topical expertise and relevant capacities substantiated in the EIT ecosystem since 2008.

  For instance, while the Climate-KIC already coordinates the Mission Platform, it could become further involved in helping to manage Mission 4 if the Mission were advanced as described above.

Post-2024 Strategy

- ***Integration of EU Missions 1, 4 and 5***

  The expert group has referred to the EU Missions already, emphasising their importance for the overall development of the European Union. Apart from Mission 4, Mission 1 ('Adaptation to Climate Change') and, less obviously, Mission 5 ('Soil Deal for Europe') are directly related to NEB priorities. As for Mission 1, rendering a representative collection of European regions and communities resilient with respect to severe ambient change cannot be achieved without novel thinking about and actions on behalf of the built environment. For example, traditional construction principles (as illustrated by the famous Persian wind towers) may be adopted to provide low-tech solutions to air-conditioning requirements. Similarly, the healthy soils aimed for in Mission 5 could be the result of a paradigm shift in land use, replacing mono-functionality by integrated multi-purpose usage of the same patch of land (WBGU 2021). This would affect positively the generation of bio-based resources for construction and manufacturing, but also re-invent and re-qualify the rural spaces surrounding urban centres.

  As a consequence, it is not only worth considering how the three Missions in question might be developed and recalibrated in light of the NEB initiative, but also whether a whole-systems approach could be realised by a careful, if partial, merging of those Missions.

- ***Sixth Mission***

  As an alternative to the last suggestion, it might be expedient to create an extra Mission that addresses, in a transdisciplinary manner, the means by which the built environment could serve as a powerful tool for the adaption to – or better yet – mitigation and even reversal of climate change (Grubler, Wilson et al. 2018). While Horizon Europe Partnership 'Built4People' ('people-centric sustainable built environment') already works on the built environment and related topics, the creation of a new mission on built environment would advance this work further and produce greater results in the long-term. It would be a powerful statement for Europe and the entire world regarding the critical importance of the long-neglected sustainability issue of embodied energy consumption and emissions and carbon storage, on the one hand, and the necessity of systemic research and innovation, on the other.

  If implemented as such, the optimal governance and management of Mission 6 would be ensured and a leading role of the NEB and its networks in these tasks would make eminent sense.

- ***Master-Plan Competition for EU Transition Super-Labs***

  The *High-Level Panel of the European Decarbonisation Pathways Initiative* proposed in its Final Report (European Commission, Directorate-General for Research and Innovation, Publications Office, 2018, https://data.europa.eu/doi/10.2777/476014) 'to establish a small number of 'Transition Super-Labs', where rapid decarbonisation is conceptualised, implemented, monitored and revised in line with the insights gained on the transformational behaviour of the complex system in question. These are flagship demonstrators where research, business, administration and civil society join for the co-production of integrated solutions'.

  With the new focus on the built environment, this suggestion is adopted (to some extent) in the current Horizon Europe call for NEB lighthouse demonstrators. However, this approach could be elevated to a strategic level with global visibility after 2024. The EU should consider the creation of a full-fledged system of 'reality labs' among its member states in which the ecologically focused transformation of the construction-mobility-energy-land use complex could be conceptualised, tested, revised and implemented.

  Such a grand-challenge and venture would obviously require the combined efforts of several DGs, most notably RTD & EAC, and REGIO, whose Commissioners are active supporters of the NEB. In a first step, a competition could be launched in 2025 for the purpose of identifying the most effective master-plan for the establishment of a Europe-wide 'orchestra' of transition labs.

- ***Worldwide Partnerships Programme***

  Although bending the global curve towards sustainability by transforming the built environment may be initiated in Europe, the bulk of the conceptual and practical work must be done in other parts of the world. For instance, Africa, where most of the overall population growth in the 21st century will occur and where about 80% of the required building stock still needs to be constructed, should be an epicentre of positive change.

  For this reason, trans-continental, resource region-crossing cooperation in multi-lateral projects that pursue NEB goals should be fostered by a post-2024 programme. This would require the ring-fencing of funding pools and the establishment of appropriate management capacities within the Horizon Europe system.

- ***New Bauhaus Initiatives on Higher and Broader Education***

  The original Bauhaus started its world-famous journey as an arts and design school in 1919. Any initiative that strives to co-opt and revitalise that historical approach in the current context of dire environmental straits and ambitious aims of a potentially regenerative 21st century must necessarily acknowledge and exploit the transformative power of education, communication, and social discourse.

  This could be adequately reflected in Horizon Europe by establishing, inter alia, a well-endowed scholarship programme that would not only increase the mobility of European students and scholars interested in NEB themes but could also attract junior and senior researchers from other global regions in sharing with their European counterparts their enthusiasm for and expertise in the built environment. Another option would be the creation of a dedicated grant scheme that allows institutions of higher education in the fields of architecture, design, urban development, spatial planning, etc. to enhance efforts that correspond to NEB principles and objectives. The promotion of research and innovation collaboration with partners outside of the European Community would reflect the planetary nature of both systemic challenges and their potential solutions.

  An abiding principle of the NEB understands research and inquiry as both a fundamental human right and an invaluable source of communal knowledge. There is wide-ranging and urgent need for new and enhanced platforms for joint exploration, experimentation, and education, supported by innovative curricula and educational formats. Powerful NEB University Clusters can expand on existing academic research networks, connecting 10-15 universities from different European regions and countries to enable mutual learning and promote the exchange of practical experience. This will build critical pathways of knowledge exchange and valuable feedback mechanisms between regional front-runners in any given topic area and earnest followers. Unified experimental teaching programs founded in specific areas of expertise, practical experience, and interdisciplinary problem-solving can expand to embrace new teaching formats (online lectures, short-term mobility, inclusive workshops and courses for citizens, professionals, local authorities, younger and older audience participation, collaboration with craftsmen and trade organisations, etc.). Innovative holistic design approaches that represent the core elements of NEB educational curricula (bioclimatic architecture, environmental strategies, life cycle assessment, energy efficiency, renewable energy sources, sustainable construction, circular economy combined with history and theory of contemporary architecture, art, aesthetics, etc.) can create a framework for strong, durable connections with international industry, and research and innovation.

  As a further step, the European Commission could initiate in the post-2024 period the genuine revitalisation and reformation of the original Bauhaus, expanding its synthesis of cultural creation and artisanal tradition to incorporate natural and social scientific research and environmental technologies, offering digital educational platforms to students and participants across Europe. Given the drastically different circumstances and challenges prevailing some 100 years after the establishment of the ‘Staatliche Kunstschule’ in Weimar, a *New European Bauhaus Academy* (NEBA) should take shape as a multi-site, continent-wide institution of hybrid character, working within areas across Europe that represent both critical need and iconic character. These NEBA sites would form multiple nodes within a vibrant network of digital linkages and interactions. In other words, NEBA could have a first ‘boots on the ground’ life in the ‘real’ world of architecture, design, urban planning, arts, etc. and a second life in a virtual reality that is accessible to practically everyone in the EU and worldwide (Wu and Li 2022). This aspiration should be the focus of an in-depth feasibility study by Horizon Europe.

CHAPTER 6: A ROADMAP TO THE FUTURE

The ultimate objective of the New European Bauhaus (NEB) is to develop a vision of how 10 billion people can be accommodated on Earth in a sustainable, inclusive, and aesthetic way. The latter means that the planetary boundaries (such as the Paris guardrails for the climate system) must not be violated and that settlements be established, maintained, and recomposed within the framework of a bio-based, near-circular, and just economy. This, in turn, requires a focus on the holistic co-transformation of the construction sector and the land-use complex (forestry, agriculture, ecosystem services, etc.) within the next few decades - in order to achieve a dynamic equilibrium of full regeneration and the elimination of waste generation and virgin resource extraction by the end of the 21st century. It is critical to start the immediate actions addressing the challenges defined in Chapter 4:

- Biogenic Carbon Storage: Buildings and Cities as Carbon Banks
- Ending Waste: Policies and Practices in a Circular Construction Economy
- Enhancing Biodiversity: Eco-systemic Decision-making in Design
- Engage People and Their Communities: User-Centred Criteria/Participatory Design Processes
- Fair and Just Transitions: Equity and Empowerment for Disenfranchised Populations
- Impact Assessment: Gathering Data and Tracking Our Footprints

The following table an initial proposal for an action plan required to meet this grand challenge with the NEB serving as a critical motive force:

	2022-2027	2028-2034	2050	2100
Research and innovation (R&I) in the European Union	EU adopts specific NEB Mission NEB-dedicated Cluster established in Pillar II of HE European Research Council creates NEB Panel Pillar III earmarks >30% of funds for NEB-relevant actions Planning place-specific, creative and exploratory NEB settlements initiated throughout Europe	NEB becomes an integrative focus of Research and Innovation Program 2028-2034 Total EU R&I spending increased by >25%, market ROI by >50% Specific R&I programs to catalyse NEB transformative research and initiatives in other parts of the world and share knowledge about successes and failures Global (UN supported) decade of science, technology and innovation for NEB	NEB paradigm motivates and guides systemic innovation, broad up-scaling and rapid diffusion of transformative action across all sectors in Europe Optimal cascade-utilisation schemes for biomass have been developed, tested and implemented in the EU	Starting from the NEB initiative, a 'New Narrative of Modernity', where civilisation and nature form a stable partnership, has been established in Europe

	2022-2027	2028-2034	2050	2100
Co-Transformation of the Built Environment and Land Use	Adoption of holistic land-use strategy connecting the rural-urban environment for human health, climate resilience and biodiversity in Europe and unifying all relevant EU and national programs Renovation Wave implementing NEB principles continent-wide through EU building sector coalition and national NEB platforms >40% of European new built environment climate-neutral with regenerated and renewable materials Adoption of Urban Green Index by European Commission	Up-scaling of sustainable land-use strategy through a global discourse initiated by EU >80% of European new built environment climate-neutral >10 % of European built environment climate-positive > 25 NEB follower countries have become co-creation partners NEB-led legal and regulatory reforms across EU Aggressive adoption of advanced digital methodology/technology in construction and forestry sector Cities adopt Urban Green Index	Completion of transformation plan for managed forests and stewardship scheme for natural ecosystems 100% of EU land use climate-resilient and regenerative 100% of European new built environment climate-neutral >30% of European built environment climate-positive NEB principles become part of UN Charter and program guidelines >50% of urban areas are 'approved' by the Green Index	NEB narrative for rural and urban living widely adopted across the globe 100% of European built environment climate-positive Managed ecosystems in EU and worldwide supply sufficient harvested biomass (food, timber, fibre, etc.) in a sustainable way 100% of urban areas in EU are 'approved' by the Green Index
	2022-2027	**2028-2034**	**2050**	**2100**
Behavioural Change	NEB goals known to all Europeans NEB principles widely adopted in education and skills-development systems	Society demanding only climate-neutral or climate-positive construction and operation Post-industrial lifestyle sensitive to sustainable land, resource use and mobility	European civil society accepting only climate-positive built environment NEB has triggered a global cultural movement	>50% of world population demanding climate-positive built environment and lifestyles

	Review of trade agreements between EU and partners worldwide in light of bio-resources management and ecosystems restoration Emergence of NEB transformative science, educational programs, citizen science, and inclusive stakeholder participation	Ownership to usership transformation to enhance regeneration and NEB collective movement Global responsibility culture widely embraced in EU Numerous NEB-inspired EU-Global South partnerships	Emergence of NEB norms and behaviours throughout EU and diffusion to the rest of the world	

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ANNEXES

Annex 1: Marking of NEB-relevant calls in Horizon Europe work programme 2021-2022

Cluster 1 'Health'	
Destination – Staying healthy in a rapidly changing society	
Call: Staying healthy 2021 (closed)	
Relevant topic	Relevance to NEB
HORIZON-HLTH-2021-STAYHLTH-01-03: Healthy Citizens 2.0 – Supporting digital empowerment and health literacy of citizens	Adopting healthy lifestyles at home, in the community and at work, including the digital tools for health monitoring, Internet of Things, etc.
Call: Staying healthy (Two stage - 2022)	
Relevant topic	Relevance to NEB
HORIZON-HLTH-2022-STAYHLTH-01-05-two-stage: Prevention of obesity throughout the life course	Identification of socio-economic and lifestyle factors influencing consumer behaviour, and their association to overweight/obesity prevention including the lifestyle factors, habits, opportunities, barriers related to the built environment: homes, public spaces, work places
Destination – Living and working in a health-promoting environment	
Call: Environment and health (2021) (closed)	
Relevant topics	Relevance to NEB
HORIZON-HLTH-2021-ENVHLTH-02-02: Indoor air quality and health	Development of cost-effective, environment-friendly and scalable technologies to improve indoor air quality to reduce disease burdens; Preparation of guidelines and training materials for interventions, supporting health promotion and disease prevention in various sectors, e.g. construction and transport, and in various socio-economic settings. Relevant guidelines should be directly linked to the design of the built environment
HORIZON-HLTH-2021-ENVHLTH-02-03: Health impacts of climate change, costs, and benefits of action and in action	Development of training materials and guidelines to educate relevant actors in citizens' daily life on climate change health impacts and to facilitate adaptation of health systems and practices. Relevant guidelines should be directly linked to the design of the built environment
Call: Environment and health (Single Stage - 2022) (open)	
Relevant topic	Relevance to NEB

HORIZON-HLTH-2022-ENVHLTH-04-01: Methods for assessing health-related costs of environmental stressors	Application of experimental approaches addressing the potential link of quality of life and the burden of disease indicators with more integrative impact indicators (e.g. reflecting subjective well-being, health, work-life balance, education, housing, etc.) and identification of how national contexts can impact on health-related costs of the same environmental and occupational exposure
Destination – Tackling diseases and reducing disease burden	
Call: Tackling diseases (2021) (closed)	
Relevant topic	Relevance to NEB
HORIZON-HLTH-2021-DISEASE-04-03: Innovative approaches to enhance poverty related diseases research in sub-Saharan Africa	A great number of the poverty related diseases in sub-Saharan Africa could be avoided by improving the quality of the living and working conditions, including the quality of the built environment

Cluster 2 'Culture, Creative & Inclusive Society'	
Destination – Innovative research on the European cultural heritage and the cultural and creative industries	
Call: Research and innovation on cultural heritage and CCIs – 2021 (closed)	
Relevant topics	Relevance to NEB
HORIZON-CL2-2021-HERITAGE-01-01: Green technologies and materials for cultural heritage	Fully relevant
HORIZON-CL2-2021-HERITAGE-01-02: New ways of participatory management and sustainable financing of museums and other cultural institutions	Ensure better access to cultural heritage and engagement with local communities, to preserve and strengthen social cohesion through inclusive and participatory procedures. Strengthen the sense of belonging to a common European space while respecting cultural and ethnolinguistic diversity, as well as developing an awareness of cultural pluralism
HORIZON-CL2-2021-HERITAGE-01-03: Cultural and creative industries as a driver of innovation and competitiveness	Fully relevant
HORIZON-CL2-2021-HERITAGE-01-04: Preserving and enhancing cultural heritage with advanced digital technologies	Fully relevant
Call: Engagement with stakeholders (closed)	
Relevant topic	Relevance to NEB

HORIZON-CL2-2021-HERITAGE-02-02: Coordination of European cultural heritage research and innovation among Member States	Fully relevant
Call: Research and innovation on cultural heritage and CCIs – 2022	
Relevant topics	Relevance to NEB
HORIZON-CL2-2022-HERITAGE-01-02: Europe's cultural heritage and arts - promoting our values at home and abroad	Fully relevant
HORIZON-CL2-2022-HERITAGE-01-03: The role of perceptions, formed by traditions, values and beliefs, in shaping European societies and politics in the 21st century	Fully relevant
HORIZON-CL2-2022-HERITAGE-01-04: Traditional crafts for the future: a new approach	Fully relevant
HORIZON-CL2-2022-HERITAGE-01-08: Effects of climate change and natural hazards on cultural heritage and remediation	Explore innovative and sustainable ways to protect cultural heritage and cultural landscapes from climate change, disaster risks and pollutants
HORIZON-CL2-2022-HERITAGE-01-10: The New European Bauhaus – shaping a greener and fairer way of life in creative and inclusive societies through Architecture, Design and Arts	Fully relevant
Destination – Innovative research on social and economic transformations	
Call - A sustainable future for Europe	
Relevant topics	Relevance to NEB
HORIZON-CL2-2022-TRANSFORMATIONS-01-01: Public policies and indicators for well-being and sustainable development	The NEB inclusive co-creation platform, sustainability-oriented living and working spaces, citizens' engagements and other factors specific to NEB can help to answer the following questions: How is social and economic inclusion and inequality affected? How can we drive the transition from a carbon-based linear, not sustainable economy to a carbon-free circular, sustainable well-being economy? Research may develop a platform in collaboration with relevant stakeholders to promote integrated thinking by combining financial, social and environmental returns, including disciplines as finance, economics, sustainability and environmental studies, strategic management, sociology and law
HORIZON-CL2-2022-TRANSFORMATIONS-01-02: The impact of spatial mobility on European demographics, society, welfare system and labour market	Identify effective policies to promote rural development and sustainability and address regional inequalities
HORIZON-CL2-2022-TRANSFORMATIONS-01-05: Gender and social, economic and cultural empowerment	Inclusive, affordable, beautiful space for all are necessary to help reverse socio-economic and cultural inequalities and promote gender equality,

	thus supporting the realisation of the global 2030 Agenda's Sustainable Development Goal 5 on achieving gender equality and empowering all women and girls
HORIZON-CL2-2022-TRANSFORMATIONS-01-06: Overcoming discrimination for an inclusive labour market	Inclusive, accessible workplaces. Research to identify barriers for increasing inclusiveness in the labour market, covering elements such as disability and health, age, gender, language, racial or ethnic origin, sexual orientation, civil and family status including caring responsibilities (e.g. mothering) and religious belonging, with regard to both quantity and quality of employment. Research activities should take a holistic approach (e.g. taking into account increasing accessibility across-the-board; availability of assistive technologies, the level of provided reasonable accommodation and supported employment for persons with disabilities, etc.)
HORIZON-CL2-2022-TRANSFORMATIONS-01-10: Socio-economic effects of ageing societies	Inclusive, healthy, affordable and beautiful living spaces contribute to longer healthy life expectancy; active citizens' engagement help exploring ageing related phenomena, including cultural factors, fertility, migration, family care, fight against ageism, active ageing, upskilling and reskilling policies, etc.

Cluster 3 'Civil Security for Society'	
Destination – Resilient Infrastructure	
Call: Resilient Infrastructure 2022	
Relevant topics	Relevance to NEB
HORIZON-CL3-2022-INFRA-01-01: Nature-based Solutions integrated to protect local infrastructure	Integrated Nature-based solutions (NBS) into overall concepts for the protection of infrastructures and existing integrated risk management plans for cities and urban areas with a view of complementing existing methods for protection and resilience
HORIZON-CL3-2022-INFRA-01-02: Autonomous systems used for infrastructure protection	Concepts for the use of advanced materials, smart technologies and built-in monitoring and repair capabilities to reduce the destructive potential of natural disasters and (terrorist) attacks on infrastructures. This issue should be embedded in NEB toolbox and education portfolio
Destination – Disaster-resilient society for Europe	
Call: Disaster-Resilient Society 2021 (closed)	
Relevant topic	Relevance to NEB
HORIZON-CL3-2021-DRS-01-02: Integrated Disaster Risk Reduction for extreme climate	Strengthening of disaster risk reduction and resilience building through innovative use of media means, namely by examining the potential of new

events: from early warning systems to long term adaptation and resilience building	communication tools and apps for better preparedness and response. NEB could be a part of this solution

Cluster 4 'Digital, Industry and Space'	
Destination – Climate neutral, circular and digitised production	
Call: Twin green and digital transition 2021 (closed)	
Relevant topics	Relevance to NEB
HORIZON-CL4-2021-TWIN-TRANSITION-01-05: Manufacturing technologies for bio-based materials (Made in Europe Partnership)	Bio-based materials, e.g. for the construction and textile sector, are very relevant to NEB
HORIZON-CL4-2021-TWIN-TRANSITION-01-10: Digital permits and compliance checks for buildings and infrastructure	Fully relevant
HORIZON-CL4-2021-TWIN-TRANSITION-01-11: Automated tools for the valorisation of construction waste	Develop holistic and replicable solutions for more circular and climate neutral construction materials and activities involving upstream and down-stream actors
Call: Hubs for circularity, a stepping stone towards climate neutrality and circularity in industry (closed)	
Relevant topic	Relevance to NEB
HORIZON-CL4-2021-TWIN-TRANSITION-01-14: Deploying industrial-urban symbiosis solutions for the utilisation of energy, water, industrial waste and by-products at regional scale (Processes4Planet Partnership)	Propose and develop new production modules that cover processes that are not currently readily available on the market and go beyond the current state of the art with a clear alignment of customer and workers' needs including taking into consideration biases and gender dimension. Thus understood modular production is relevant for construction and building sector and should be linked to NEB
Call: A new way to build, accelerating disruptive change in construction	
Relevant topic	Relevance to NEB
HORIZON-CL4-2022-TWIN-TRANSITION-01-09: Demonstrate the use of Digital Logbook for buildings	Fully relevant. Provided link to Built4People should be extended also to NEB
Call: Hubs for circularity, a stepping stone towards climate neutrality and circularity in industry	
Relevant topic	Relevance to NEB
HORIZON-CL4-2022-TWIN-TRANSITION-01-10: Circular flows for solid waste in urban environment (Processes4Planet Partnership)	Fully relevant

Call: A digitised, resource-efficient and resilient industry 2022	
Relevant topic	Relevance to NEB
HORIZON-CL4-2022-RESILIENCE-01-16: Building and renovating by exploiting advanced materials for energy and resources efficient management	Fully relevant. Existing link to Built4People should be extended also to NEB.

Cluster 5 'Climate, Energy and Mobility'	
Destination – Climate sciences and responses for the transformation towards climate neutrality	
Call: Climate sciences and responses	
Relevant topic	Relevance to NEB
HORIZON-CL5-2022-D1-02-05: Let nature help do the job: Rewilding landscapes for carbon sequestration, climate adaptation and biodiversity support	Assess the perception and acceptability of citizens and stakeholders on rewilding and rewilding options and identify potential conflicts and trade-offs in governance and decision-making. This should be achieved in close relation to the sustainable built environment co-creation and therefore link to NEB initiative is recommended
Destination – Efficient, sustainable and inclusive energy use	
Call: Highly energy-efficient and climate neutral EU building stock (closed) This call has been already linked with NEB	
Relevant topics	Relevance to NEB
HORIZON-CL5-2021-D4-01-02: Industrialisation of deep renovation workflows for energy-efficient buildings	Fully relevant
HORIZON-CL5-2021-D4-02-01: Demonstrating integrated technology solutions for buildings with performance guarantees (Built4People**)**	Fully relevant
HORIZON-CL5-2021-D4-02-02: Cost-effective, sustainable multi-functional and/or prefabricated holistic renovation packages, integrating RES and including re-used and recycled materials (Built4People)	Fully relevant
HORIZON-CL5-2021-D4-02-03: Strengthening European coordination and exchange for innovation uptake towards sustainability, quality, circularity and social inclusion in the built environment as a contribution to the new European Bauhaus (Built4People)	Fully relevant
HORIZON-CL5-2022-D4-01-01: Demand response in energy-efficient residential buildings	Fully relevant

HORIZON-CL5-2022-D4-01-02: Renewable-intensive, energy positive homes	Fully relevant
HORIZON-CL5-2022-D4-01-03: Smarter buildings for better energy performance	Fully relevant
HORIZON-CL5-2022-D4-02-01: Designs, materials and solutions to improve resilience, preparedness & responsiveness of the built environment for climate adaptation (Built4People)	Fully relevant
HORIZON-CL5-2022-D4-02-02: Solutions for the sustainable, resilient, inclusive and accessible regeneration of neighbourhoods enabling low carbon footprint lifestyles and businesses (Built4People)	Fully relevant
HORIZON-CL5-2022-D4-02-03: Sustainable and resource-efficient solutions for an open, accessible, inclusive, resilient and low-emission cultural heritage: prevention, monitoring, management, maintenance, and renovation (Built4People)	Fully relevant
HORIZON-CL5-2022-D4-02-04: Smart-grid ready and smart-network ready buildings, acting as active utility nodes (Built4People)	Fully relevant
HORIZON-CL5-2022-D4-02-05: More sustainable buildings with reduced embodied energy / carbon, high life-cycle performance and reduced life-cycle costs (Built4People)	Fully relevant

Cluster 6 'Food, Bioeconomy, Natural Resources, Agriculture and Environment'	
Destination – Circular economy and bioeconomy sectors	
Call: Circular economy and bioeconomy sectors	
Relevant topics	Relevance to NEB
HORIZON-CL6-2021-CIRCBIO-01-04: Increasing the circularity in textiles, plastics and/or electronics value chains	Relevant for the textile industry which presence in NEB should be accentuated
HORIZON-CL6-2022-CIRCBIO-01-01: Circular Cities and Regions Initiative's project development assistance (CCRI-PDA)	NEB is fully relevant for Circular Cities and Regions Initiative
HORIZON-CL6-2022-CIRCBIO-02-01-two-stage: Integrated solutions for circularity in buildings and the construction sector	Fully relevant
Call: Resilient, inclusive, healthy and green rural, coastal and urban communities	
Relevant topics	Relevance to NEB

HORIZON-CL6-2022-COMMUNITIES-01-01: Boosting women-led innovation in farming and rural areas	Improved understanding, awareness and recognition of women's role in the future of the farming sector (in particular ecological transitions) is strongly linked to the co-creation of the living and working built environment in rural, coastal and urban areas. Link to NEB is recommended
HORIZON-CL6-2022-COMMUNITIES-01-02: Assessing and improving labour conditions and health and safety at work in farming	In relation to this topic the role of heathy, inclusive and beautiful built environment is strongly underestimated. Link to NEB is therefore recommended
HORIZON-CL6-2022-COMMUNITIES-01-04: Social innovation in food sharing to strengthen urban communities' food resilience	Very relevant to NEB due to the new model of resilient urban communities
HORIZON-CL6-2022-COMMUNITIES-01-05: Assessing the socio-politics of nature-based solutions for more inclusive and resilient communities	Very relevant to NEB due to the new model of resilient urban communities
HORIZON-CL6-2022-COMMUNITIES-02-01-two-stage: Smart solutions for smart rural communities: empowering rural communities and smart villages to innovate for societal change	Fully relevant
HORIZON-CL6-2022-COMMUNITIES-02-02-two-stage: Developing nature-based therapy for health and well-being	In relation to this topic the role of heathy, inclusive and beautiful built environment is strongly underestimated. Link to NEB is therefore recommended

The 'NEB marking' related to certain calls that are already closed was added in purpose to highlight the opportunities arising from linking similar calls and topics to NEB themes in the future.

Note that the largest number of the most important topics relevant to NEB can be found in Clusters 2 and 5. However, the budget allocated to Cluster 2 is not sufficient to cover the needs of the NEB initiative. While the budget allocated to Cluster 5 is much higher, the way the NEB is associated with the calls does not reflect the importance of this initiative. The main stress of the calls is on 'hard' effects related to climate, energy and mobility. The building-sector transformation is addressed in many adequate ways, but some elements critical for NEB, such as co-creation, education, aesthetics, architecture, art and design, are only broadly mentioned, or even omitted. There is a risk that the links to the NEB declared in the successful proposals will remain very generic. Only if NEB becomes a core of future actions, the applicants will be able to address this initiative in a productive way.

Moreover, to fully embrace the opportunities created by the NEB, it is usually needed to combine several policy priorities. The relevant recommendations are formulated further in the report part related to the Strategic Plan 2024-2027.

Finally, it is important to note that the NEB initiative is directly linked to one of the European Missions, namely '100 Climate-Neutral and Smart Cities by 2030'. In that Mission there is the specific topic 'Collaborative local governance models to accelerate the emblematic transformation of urban environment and contribute to the New European Bauhaus initiative and the objectives of the European Green Deal', yet multiple other topics are relevant for the NEB.

Annex 2: Introducing crucial NEB topics in Horizon Europe work programme 2023-2024

The following represent examples of potential topics related to NEB for inclusion in Horizon Europe work programme 2023-2024:

Cluster 1 'Health':

- Healthy, safe and inclusive living and working environment:
- Towards symbiotic relations between cultural and natural environment
- Healthy, affordable, inclusive and beautiful built environment

Cluster 2 'Culture, Creative & Inclusive Society':

- Preservation and deep renovation of cultural heritage and sustainable development of the cultural and creative industries:
- NEB pathways between experiments and the proofs of concept evaluated and promoted through living labs
- Applied lessons from vernacular and regional architecture
- NEB initiatives connecting Academia, Industry, Craftsmen, Research, Design and Citizens
- Addressing knowledge gaps in climate change adaptation/mitigation, and better understanding of relations between nature and architecture through pilots and demonstrations, including transparent communication to general public
- Community approach, citizens' engagement, mutual learning processes
- Universities as innovation and education hubs
- International university clusters towards 'NEB Education4All'
- NEB international university portfolio, including guidelines for affordable, sustainable, healthy, and inclusive housing
- Addressing poverty and lack of understanding through NEB demonstrations well-adapted to local needs and budget
- Addressing policy constrains and barriers relevant to NEB

Cluster 3 'Civil Security for Society':

- Disaster resilience, nature-based solutions, resilient and secure smart cities
- Nature-based solutions towards holistic approach to the built environment
- Resilient and bioclimatic architecture
- Identify, record, and address the regional climate treats

Cluster 4 'Digital, Industry & Space':

- Circularity and waste management in cities and built environment with enhanced use of bio-based materials in construction and support of innovative digital tools
- Building and renovating by exploiting advanced materials for energy and resources efficient management
- Analysis, data, and fundamental research for NEB
- Affordable, climate-resilient, and climate-adaptive construction
- Circular economy, lifecycle assessment of bio-based materials, and cascading principles for materials in construction and textile sector
- Digitalisation of construction processes and design for 'disassembly' including the use of by-products and creation of new value chains for innovative construction materials utilising the by-products of agriculture and forestry

- Assessing the potential contribution of advanced digital tools to the sustainable operation of settlements and infrastructures in a changing world, which includes the deconstruction, reuse, and recycling practices

Cluster 5 'Climate, Energy & Mobility':

- Recycling and sustainable energy generation, energy efficiency and recovery, and wastewater treatments in buildings
- Energy storage for stationary applications in buildings
- Deep renovation of the building stock
- Carbon sequestration and built environment
- Sustainable, resilient, and inclusive cities
- Place-specific research and innovation initiatives for NEB
- Biodiversity conservation within buildings and settlements
- Bioclimatic building for Europe and Africa

Cluster 6 'Food, Bioeconomy, Natural Resources, Agriculture & Environment':

- Organic raw materials
- Urban, coastal, and rural development with circular economic, nature-based solutions for buildings and city resiliency.
- Forests and forest management in relation to wood and other bio-based products as building materials
- Bio-inspired design
- Sustainable food production in urban areas

Examples of specific calls addressing the listed topics

Cluster 1 'Health'	
Example 1	**Improving the 24-hour activity cycle (sleep, sedentary behaviour, physical activity) through restful indoor wood spaces**
Related expected impact of Strategic plan 2021-2024:	1. Staying healthy in a rapidly changing society; 2. Living and working in a health-promoting environments
Expected outcomes:	New evidence of benefits for health in the built environment
Project outputs:	Assessing effects of restorative indoor environment on the 24-hour human activity cycle of sleep, sedentary behaviour, light physical activity, and moderate to vigorous physical activity.
Related challenge:	Challenge 4
Example 2	**Ergonomic and restorative school environment to promote children's physical and mental health**
Related expected impact of Strategic plan 2021-2024:	1. Staying healthy in a rapidly changing society; 2. Living and working in a health-promoting environments
Expected outcomes:	Develop effective solutions for innovative school environment promoting health and well-being

Project outputs:	Creating effective and lasting solutions for a more sustainable school environment by developing flexible learning spaces that is ergonomic and restorative.
Related challenge:	Challenge 4
Example 3	**Renewable materials for restorative indoor spaces**
Related expected impact of Strategic plan 2021-2024:	1. Staying healthy in a rapidly changing society; 2. Living and working in a health-promoting environments
Expected outcomes:	Better understanding of health-promoting living and working environments created with renewable materials
Project outputs:	Developing evidence based guidelines for designing indoor restorative environments – which materials should be used, in what quantities, and in what applications to have the greatest impact on occupant well-being.
Related challenge:	Challenge 4
Example 4	**'Settling the unsettled' to create healthy, affordable, inclusive and beautiful built environment**
Related expected impact of Strategic plan 2021-2024:	1. Staying healthy in a rapidly changing society; 2. Living and working in a health-promoting environments
Expected outcomes:	Better understanding of health-promoting living and working environments created with renewable materials
Project outputs:	Develop solutions for transforming the economically challenged places into healthy, affordable, inclusive and beautiful built environment
Related challenge:	Challenge 4
Example 5	**Production without pollutants**
Related expected impact of Strategic plan 2021-2024:	1. Staying healthy in a rapidly changing society; 2. Living and working in a health-promoting environments
Expected outcomes:	Supporting the industry in the transition to a production of healthy and recyclable materials
Project outputs:	Replacement of substances hazardous to health and the environment in the mobility and construction industry (manufacturing and operation).
Related challenge:	Challenge 4

Cluster 2 ‘Culture, Creative & Inclusive Society’	
Example 1	**Development of strategies and methodologies for renovation of existing buildings using renewable materials**
Related expected impact of Strategic plan 2021-2024:	8. The full potential of cultural heritage, arts and culture and creative sector as a driver of sustainable innovation and a European sense of belonging
Expected outcomes:	Improve the protection, enhancement, conservation and more efficient restoration of European cultural heritage and other existing buildings.
Project outputs:	Develop strategies and methodologies for renovation of existing buildings with renewable materials to create spaces that are fully functional, resilient, healthy, energy-efficient and accepted by the end-users.
Related challenge:	Challenge 5
Example 2:	**Support the inclusion, engagement, and participation of local communities in the long-term building renovation strategy execution**
Related expected impact of Strategic plan 2021-2024:	8. The full potential of cultural heritage, arts and culture and creative sector as a driver of sustainable innovation and a European sense of belonging
Expected outcomes:	Improve the protection, enhancement, conservation and more efficient restoration of European cultural heritage and other existing buildings.
Project outputs:	Develop methodologies to preserve traditional crafts that are crucial to historic preservation, to gather and store local knowledge related to past (memory) and future (needs) of the built environment.
Related challenge:	Challenge 5
Example 3:	**Educate society on NEB using university clusters and living labs**
Related expected impact of Strategic plan 2021-2024:	8. The full potential of cultural heritage, arts and culture and creative sector as a driver of sustainable innovation and a European sense of belonging
Expected outcomes:	Enable European integration and societal cohesion in the NEB principles.
Project outputs:	Develop education processes on NEB through university clusters and living labs where all groups of citizens can participate in the mutual-learning by artists, designers, architects, etc.
Related challenge:	Challenge 5
Example 4:	**Tackling policy barriers and fostering decarbonisation process**
Related expected impact of Strategic plan 2021-2024:	7. Democratic governance reinvigorated by improving the accountability, transparency, effectiveness and trustworthiness of rule-of-law based institutions and policies
Expected outcomes:	Develop policy recommendations and enhance transparency and effectiveness of policy-making for the future European built environment.

Project outputs:	Deliver guidelines for sustainable and circularity-forcing building permissions, fast enforcement of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive in the building sector of all member states, political framework for reuse building materials and components, 'top-runner-program' for permissions of constructions products (to lower CO2-footprint, raise recyclability, raise reuse, raise secondary feedstock).
Related challenge:	Challenge 10
Example 5:	**Devising and composing equity - NEB mass movement towards beauty**
Related expected impact of Strategic plan 2021-2024:	8. The full potential of cultural heritage, arts and culture and creative sector as a driver of sustainable innovation and a European sense of belonging
Expected outcomes:	Develop urban development guidelines according to the key principles of the NEB
Project outputs:	In-depth investigation and interpretation of post-WW2 urban development and its impacts on social cohesion/division (gentrification, etc.). Review of class segregation by architecture in history across the globe and exploring the transition of urban and landscape architecture into public art. Advancement of concepts for 'social mixing' by construction and planning (from building to landscape scale) by education and creating aesthetic attitudes.
Related challenge:	Challenge 5

Cluster 3 'Civil Security for Society'	
Example 1:	**Use the nature-based solutions to increase biodiversity and improve the ecosystem health in resilient, secure smart cities**
Related expected impact of Strategic plan 2021-2024:	11. Losses from natural, accidental and man-made disasters are reduced through enhanced disaster risk reduction based on preventive actions, better societal preparedness, and resilience and improved disaster risk management in a systematic way.
Expected outcomes:	Development of nature-based solutions that will increase biodiversity and improve the ecosystem resilience of contemporary cities and their human and non-human inhabitants.
Project outputs:	In line with the NEB principles, create inclusive and accessible green areas and water bodies, improving the air quality, encouraging outdoor activities and inviting small animals closer to our dwellings.
Related challenge:	Challenge 10
Example 2:	**Organic and recyclable buildings**
Related expected impact of Strategic plan 2021-2024:	11. Losses from natural, accidental and man-made disasters are reduced through enhanced disaster risk reduction based on preventive actions, better societal preparedness, and resilience and improved disaster risk management in a systematic way.

Expected outcomes:	Better understanding of safety of the built environment created with bio-based building materials.
Project outputs:	Demonstrate the efficient use of bio-based building material in closed-loops (fully recyclable in a technical cycle) by re-use of building materials and components. This includes development of warranty of used material, development of an EU-wide open-access electronic marketspace, setup of assessment and repairing service and infrastructure, secondary feedstock/ secondary raw material-use, rent- and leasing-opportunities of building components or materials, circularity and waste management in building trade (forcing and bringing together the recycling research and industry).
Related challenge:	Challenge 10
Example 3:	**Climate-smart and bioclimatic architecture, design and operation. Resilient and secure cities and buildings**
Related expected impact of Strategic plan 2021-2024:	11. Losses from natural, accidental and man-made disasters are reduced through enhanced disaster risk reduction based on preventive actions, better societal preparedness, and resilience and improved disaster risk management in a systematic way.
Expected outcomes:	Bioclimatic and low-tech strategies for buildings, vernacular, topography and climate-adapted planning.
Project outputs:	Perform interdisciplinary assessment of adapting buildings and settlements to climate change and shifting extreme-events regimes. This includes systemic stock-taking and appraisal of world-wide architectural diversity in response to different contextual challenges. Creating a European architect-in-residence programme, supporting especially young pioneers from the Global South. Honouring and Fostering Global ‘Archiversity’. Occam’s razor in architecture: how to achieve comfort and resilience in the simplest way.
Related challenge:	Challenge 4
Example 4:	**Safe, climate damage resilient settlement development**
Related expected impact of Strategic plan 2021-2024:	11. Losses from natural, accidental and man-made disasters are reduced through enhanced disaster risk reduction based on preventive actions, better societal preparedness, and resilience and improved disaster risk management in a systematic way.
Expected outcomes:	Locate and map regional climate threats. Proposals (geographic maps) for abandonment or protection of threatened settlement areas.
Project outputs:	Climate data-based, sustainable transport and settlement area development
Related challenge:	Challenge 4

Cluster 4 ‘Digital, Industry & Space’	
Example 1:	**Bio-based materials for construction and textiles**
Related expected impact of Strategic plan 2021-2024:	15. Global leadership in clean and climate-neutral industrial value chains, circular economy and climate-neutral digital systems and infrastructures through innovative production and manufacturing processes and their digitalisation, new business models, sustainable-by-design advanced materials and technologies enabling the switch to decarbonisation in all major emitting industrial sectors, including green digital technologies.
Expected outcomes:	Design of new materials for the construction and textile sector and its optimisation through materiomics approach.
Project outputs:	Development and implementation of organic sensing materials and engineering living materials in building sector. Collecting, cleaning, and reintroducing recovered wood to the market. Extending lifetime of wood-based construction materials by integrated sensing technologies. Recovery and application of bio-based compounds from seaweed, agricultural residues and industrial by-products according to zero-waste principle.
Related challenge:	Challenge 3
Example 2:	**Circular buildings and cities**
Related expected impact of Strategic plan 2021-2024:	15. Global leadership in clean and climate-neutral industrial value chains, circular economy and climate-neutral digital systems and infrastructures through innovative production and manufacturing processes and their digitalisation, new business models, sustainable-by-design advanced materials and technologies enabling the switch to decarbonisation in all major emitting industrial sectors, including green digital technologies.
Expected outcomes:	Develop solutions of diversifying supply chains.
Project outputs:	Develop demonstrations of smart networks for circularity from the household to the city scale, apply digital tools for waste management, propose appealing spatial and architectural solutions to deal with the waste collection in the living and work spaces, in line with NEB aesthetics, encourage the dialogue with citizens on the topic of waste, develop zero-waste solutions that would work in households, schools, offices, etc. Involve young generation and educational institutions, cooperate with artists and architects to make the strong connections of creativity, knowledge and industry. Designing and constructing in the least wasteful and most reusable way: a conceptual analysis. Assessing the existing building stock (local, regional, global): renovation, replacement or removal? Technology appraisal: What still needs to be invented/developed for full circularity? Second-best analysis: How to design very long cascades of usage (‘ultra-slow down-cycling’).
Related challenge:	Challenge 10
Example 3:	**Environmental impact assessment for citizens**
Related expected impact of Strategic plan 2021-2024:	15. Global leadership in clean and climate-neutral industrial value chains, circular economy and climate-neutral digital systems and infrastructures through innovative production and manufacturing processes and their digitalisation, new business models, sustainable-by-design advanced materials

	and technologies enabling the switch to decarbonisation in all major emitting industrial sectors, including green digital technologies.
Expected outcomes:	Adoption of industrial value-chains - steps towards unified life cycle assessment methodology and building certification system in EU in 10-years perspective, in which recycling potential of buildings is fully addressed.
Project outputs:	Develop a single tool for environmental impact assessment, including circularity, calculations, simple and efficient, based on software easy to use also for non-professionals (e.g. citizens interested in making their homes more sustainable) available for everyone, free of charge.
Related challenge:	Challenge 4
Example 4:	**NEB planning and building guidelines**
Related expected impact of Strategic plan 2021-2024:	15. Global leadership in clean and climate-neutral industrial value chains, circular economy and climate-neutral digital systems and infrastructures through innovative production and manufacturing processes and their digitalisation, new business models, sustainable-by-design advanced materials and technologies enabling the switch to decarbonisation in all major emitting industrial sectors, including green digital technologies.
Expected outcomes:	Creating new sustainable processes of the building sector
Project outputs:	Developing EU-wide, easy and open-access guidelines for sustainable planning and building; establishing EU-wide, easy and open-access measuring-methods of building-circularity and measuring methods of building-environmental-protection-preserving, developing and establishing a dismantling and recycling costs data bank.
Related challenge:	Challenge 4
Example 5:	**NEB planning and building guidelines**
Related expected impact of Strategic plan 2021-2024:	15. Global leadership in clean and climate-neutral industrial value chains, circular economy and climate-neutral digital systems and infrastructures through innovative production and manufacturing processes and their digitalisation, new business models, sustainable-by-design advanced materials and technologies enabling the switch to decarbonisation in all major emitting industrial sectors, including green digital technologies.
Expected outcomes:	Encourage the dialogue with citizens on the topic of waste and value in order to arrive at an abolition of the waste property and the concept of disposal. Ability to recognise obsolescence and its environmentally damaging effect to make it unattractive in a common sense.
Project outputs:	Exclusion of obsolescence from economic activity: from consumption to use.
Related challenge:	Challenge 2

Cluster 5 ‘Climate, Energy & Mobility’	
Example 1:	**Carbon cycle and carbon sinks as a part of sustainable, resilient and inclusive cities**
Related expected impact of Strategic plan 2021-2024:	21. Transition to a climate-neutral and resilient society and economy enabled through advanced climate science, pathways and responses to climate change (mitigation and adoption) and behavioural transformations.
Expected outcomes:	Development of tools that support decision makers in zero-carbon transition.
Project outputs:	Carbon cycle analysis for the built environment in a city scale and appropriately planned carbon sinks that will help to mitigate negative climate and environmental impacts. Accessible, inclusive and biodiverse green areas and water bodies, designed in line with NEB aesthetics and well-embedded in the urban tissue will strongly contribute to citizens’ comfort, health and well-being.
Related challenge:	Challenge 10
Example 2:	**Sinking Carbon by Construction**
Related expected impact of Strategic plan 2021-2024:	21. Transition to a climate-neutral and resilient society and economy enabled through advanced climate science, pathways and responses to climate change (mitigation and adoption) and behavioural transformations. 24. Efficient and sustainable use of energy, accessible for all is ensured through a clean energy system and a just transition.
Expected outcomes:	Support decision makers for mitigation and adaptation actions in zero-carbon transition of the built environment.
Project outputs:	Exploring and quantifying the maximal net carbon uptake potential of the global built environment in the next two centuries for plausible socioeconomic scenarios. This includes actions towards zero-impacts lamination techniques in timber architecture and portfolio of economic incentives (tax reductions, C-storage certificates, subsidies, etc.) for climate-positive construction.
Related challenge:	Challenge 10
Example 3:	**Innovative approach to the building stock deep renovation towards higher social acceptance, increased comfort and energy efficiency**
Related expected impact of Strategic plan 2021-2024:	21. Transition to a climate-neutral and resilient society and economy enabled through advanced climate science, pathways and responses to climate change (mitigation and adoption) and behavioural transformations. 24. Efficient and sustainable use of energy, accessible for all is ensured through a clean energy system and a just transition.
Expected outcomes:	Deliver basis for social acceptance of zero-carbon transition of the built environment.
Project outputs:	Deliver in-depth analysis with citizens’ engagement in participatory design and renovation processes. Deep renovation, recycling in buildings, increased comfort and energy efficiency in buildings, inclusive spaces, urban-gardening, resilience.
Related challenge:	Challenge 4

Example 4:	**Advanced materials and holistic approach to transition to renewable energy, including energy storage for stationary applications in buildings**
Related expected impact of Strategic plan 2021-2024:	21. Transition to a climate-neutral and resilient society and economy enabled through advanced climate science, pathways and responses to climate change (mitigation and adoption) and behavioural transformations. 24. Efficient and sustainable use of energy, accessible for all is ensured through a clean energy system and a just transition.
Expected outcomes:	Guidelines for design and application of advanced materials in buildings, combined with holistic approach to transition to renewable energy.
Project outputs:	Development of the proofs of concepts for energy storage for stationary applications in buildings. This includes addressing the end-users needs by inviting the citizens to the co-creation process and providing the support of professional architects to help understanding the challenges and find the functional and beautiful solutions.
Related challenge:	Challenge 4
Example 5:	**Geometry of Urbanity and Rurality**
Related expected impact of Strategic plan 2021-2024:	21. Transition to a climate-neutral and resilient society and economy enabled through advanced climate science, pathways and responses to climate change (mitigation and adoption) and behavioural transformations.
Expected outcomes:	Design and evaluate solutions and pathways for mitigation and adaptation of cities to climate change.
Project outputs:	Comparative evaluation of different city structures (concentric, checkerboard, heterogeneous, etc.) in view of the NEB criteria. Critical appraisal of polycentric and fractal settlement geometries with an emphasis on the human dimensions. How to design 15-minute cities or even 15-minute entanglements (where a genuine patch of nature is in walking distance from every home).
Related challenge:	Challenge 4
Example 6:	**Preparing for the 'Cyborganic Age'**
Related expected impact of Strategic plan 2021-2024:	21. Transition to a climate-neutral and resilient society and economy enabled through advanced climate science, pathways and responses to climate change (mitigation and adoption) and behavioural transformations. 24. Efficient and sustainable use of energy, accessible for all is ensured through a clean energy system and a just transition.
Expected outcomes:	Design transformation path of the built environment.
Project outputs:	Assessing how the combination of evolutionary construction solutions ('No-Tech') and advanced cybernetic methods ('Hi-Tech') could/will transform the built environment. Exploring the possibility of 'living architecture', e.g. hybrid buildings that partly consist of growing components such as trees.
Related challenge:	Challenge 4

Cluster 6 ‘Food, Bioeconomy, Natural Resources, Agriculture & Environment’	
Example 1:	**Biomimetic, bioclimatic and bioinspired design for buildings**
Related expected impact of Strategic plan 2021-2024:	27. Climate neutrality is achieved by reducing GHG emissions, maintaining natural carbon sinks, and enhancing the sequestration and storage of carbon in ecosystem, including by unfolding the potential of natural based solutions, production systems on land and at sea as well as rural and coastal areas, where adaptations to climate change are also being fostered for enhancing resilience.
Expected outcomes:	Improving the efficient and sustainable use of resources through innovative production reducing the GHG emissions.
Project outputs:	Implementation of biomimetic / bioclimatic / bioinspired solutions for the building sector, including the materials with novel properties and building elements with innovative functionalities. Combination of passive and active heating, cooling and ventilation strategies oriented towards aesthetic, efficient, reparable and affordable built environment, making the most of the natural resources.
Related challenge:	Challenge 4
Example 2:	**High-performance and environmentally safe bio-based materials for construction and textile sectors**
Related expected impact of Strategic plan 2021-2024:	27. Climate neutrality is achieved by reducing GHG emissions, maintaining natural carbon sinks, and enhancing the sequestration and storage of carbon in ecosystem, including by unfolding the potential of natural based solutions, production systems on land and at sea as well as rural and coastal areas, where adaptations to climate change are also being fostered for enhancing resilience.
Expected outcomes:	Improving the efficient and sustainable use of resources through innovative production reducing the GHG emissions.
Project outputs:	Identification and development of sustainable sources of bio-based materials for construction and textile sectors. Creating the policy network to avoid deforestation and encourage correct forest management and forestation practices. Development of multifunctional treatments based on green and environmentally friendly processes for improvement of performance of bio-based materials also in demanding environments.
Related challenge:	Challenge 3
Example 3:	**Sustainable food production in the urban areas**
Related expected impact of Strategic plan 2021-2024:	27. Climate neutrality is achieved by reducing GHG emissions, maintaining natural carbon sinks, and enhancing the sequestration and storage of carbon in ecosystem, including by unfolding the potential of natural based solutions, production systems on land and at sea as well as rural and coastal areas, where adaptations to climate change are also being fostered for enhancing resilience. 29. Sustainable and circular management and use of natural resources as well as prevention and removal of pollution and mainstreamed, unlocking the potential of the bioeconomy, ensuring competitiveness, and guaranteeing healthy soil, air, fresh and marine water for all, through better understanding of

	planetary boundaries and deployment of innovative technologies and other solutions, notably in primary production, forestry and biobased systems.
Expected outcomes:	Technology breakthrough and sustainable business models with bio-based solutions in urban environments.
Project outputs:	Encourage sustainable food production in the urban areas by developing and demonstrating solutions for building elements that enable individual and collective food farming, e.g. green and kinetic green facades, urban balconies, green roofs, etc. Enable co-creation, citizens' engagement and interdisciplinary education through cooperation with university clusters, and in particular with architects, botanists, ecologists, artists and social science representatives.
Related challenge:	Challenge 1
Example 4:	**Sustainable Supply of Bio-Materials**
Related expected impact of Strategic plan 2021-2024:	29. Sustainable and circular management and use of natural resources as well as prevention and removal of pollution and mainstreamed, unlocking the potential of the bioeconomy, ensuring competitiveness, and guaranteeing healthy soil, air, fresh and marine water for all, through better understanding of planetary boundaries and deployment of innovative technologies and other solutions, notably in primary production, forestry and biobased systems.
Expected outcomes:	New knowledge in management of natural resources.
Project outputs:	Geographical-explicit high-resolution analysis of global reforestation/afforestation potential ('Earth's tree carrying capacity'), considering different climate-change scenarios (including those compatible with the Paris Agreement). This includes: - Empirical and theoretical investigation of carbon-sequestration performance of natural vs. managed forests over the respective lifetimes. - Dynamical simulation modelling of forests explicitly designed (species mix, age-class distribution, ecological fertilisation & pest control) for maximal sustained biomass yield. Resilience analysis of forests of different composition (including non-domestic and possibly genetically-modified species).
Related challenge:	Challenge 3
Example 5:	**Conservation of biodiversity within buildings and settlements**
Related expected impact of Strategic plan 2021-2024:	29. Sustainable and circular management and use of natural resources as well as prevention and removal of pollution and mainstreamed, unlocking the potential of the bioeconomy, ensuring competitiveness, and guaranteeing healthy soil, air, fresh and marine water for all, through better understanding of planetary boundaries and deployment of innovative technologies and other solutions, notably in primary production, forestry and biobased systems.
Expected outcomes:	To a large extent, compensate for the disturbance of nature of building by building. Generating environmental and social added-value through building.
Project outputs:	An easy-to assessment and evaluation tool through the application of which one learns to offer and implement compensatory measures for construction-related environmental degradation in building design. Guidance on developing and implementing sufficiency and consistency measures in the building process. The tool can also be used by permitting authorities to assess the

	environmental balance (climate and biodiversity, water and soil life cycles) and to make permitting conditional on the achievement of benchmarks
Related challenge:	Challenge 2
Example 6:	**Small forests as biodiversity protected areas**
Related expected impact of Strategic plan 2021-2024:	28. Biodiversity is back on a path to recovery, and ecosystems and their services are preserved and sustainably restored on land, inland water and at sea through improved knowledge and innovation. 29. Sustainable and circular management and use of natural resources as well as prevention and removal of pollution and mainstreamed, unlocking the potential of the bioeconomy, ensuring competitiveness, and guaranteeing healthy soil, air, fresh and marine water for all, through better understanding of planetary boundaries and deployment of innovative technologies and other solutions, notably in primary production, forestry and biobased systems.
Expected outcomes:	Improving biodiversity knowledge and protection, and silviculture practices.
Project outputs:	Identify how ecosystem services can encourage landowners with small, disconnected forest areas that cannot be used economically to protect and conserve them. This would reduce economic burden of such forest areas on small landowners, and in turn reduce the biodiversity demands of very large, economically-managed forest areas (e.g. state forests) and agricultural land. Consider the potential of such small, disconnected forest areas to serve as living labs, helping to ascertain to what extent fragmented pockets of biodiverse forest can promote overall forest biodiversity conservation.
Related challenge:	Challenge 3

Annex 3: Collection of ‘Precedent Actions’ that reflect the NEB spirit

The following selection of precedents take the form of specific actions – in these examples both buildings and educational programmes – that reflect a number of the NEB principles outlined in this report. By no means comprehensive in their solutions nor fully representative of the host of criteria entailed in a regenerative design approach to the transformation of the built environment, these examples variably engage the modes of inquiry that characterise the NEB mission: fundamental research and its application, demonstration, and education. Abiding by the spirit that, where honestly exposed, experimental failure is as instrumental to transformative innovation as obvious success, this sampling of experiments in circular- and bio-materiality, energy and material efficiency, bioclimatic design, the reinterpretation of traditional skills and techniques, and new formats of engagement and education, should be embraced for their specific objectives, their earnest efforts, and the many lessons they may offer upon close inspection.

Building Experiments

Prinz-Eugen-Park, Urban site development (2014-2020), Munich, Germany

Architects: Annette Hafner, Ruhr-University Bochum with Planning Department City of Munich

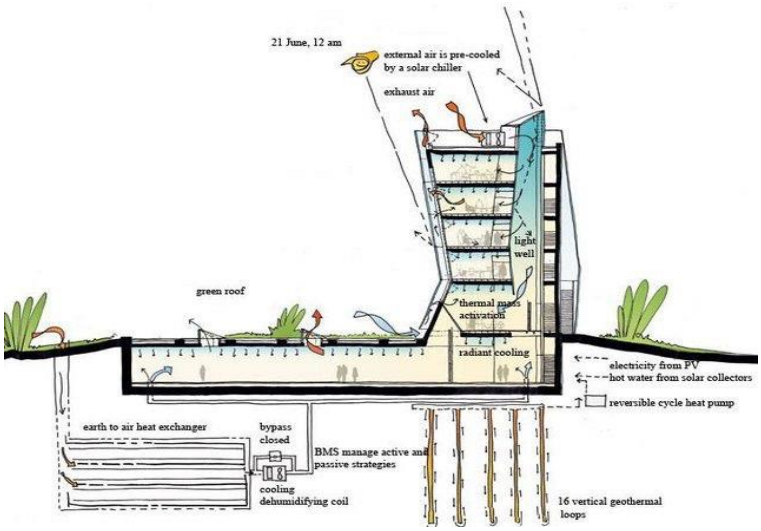
An urban site development in Munich with nearly 600 flats (2/3 of them as social housing) as temporal carbon storage. It is the largest urban timber neighbourhood in Germany by now. All development activities are summarised under the concept of building an eco-city with low carbon emissions and a high standard for living for all groups of inhabitants, common activities like urban gardening, etc. (Eight buildings with different material selections ranging from wood-constructions to wood-concrete hybrid constructions were environmentally assessed. Results show that about 12.5 million kg of CO2 are stored in the wooden structures.) (Hafner et. al. 2020).

© Ruhr-University Bochum, 2020. Source: https://www.mdpi.com/2071-1050/12/14/5827

Centre for Sustainable Energy Technologies (CSET) (2006-2008), Ningbo, China

Architects: Mario Cucinella Architects (MCA), School of the Built Environment of the University of Nottingham

The research activity of CSET is focused on renewable energy systems and new components for sustainable building, while the mission of CSET is to diffuse sustainable technologies and provide solutions to environmental problems. The form of the building is directly linked to the local bioclimatic context, and the biomimetic approach allowed to follow the model of natural flows. Water heated in solar tubes powers a solar chiller that pre-cools ventilation air and the building is self-sufficient in terms of renewable energy from PVs, geothermal heat pumps and wind turbine. The hybrid system combines passive and active strategies to deal with the issue of maximum energy efficiency and best building performance with minimal ecological impact. (Widera, 2016).



© MCA, 2008. Source: http://dx.doi.org/10.13140/RG.2.1.2162.5768

The Modern Seaweed House on Læsø (2012-2013), Denmark

Architects: Vandkunsten and Realdania Byg

This dwelling represents contemporary aesthetics and the use of natural, sustainable materials. The sea plant from the family Zostera marina, gained on the shore was used as an insulation for ceilings, roofs and walls while the light structure was designed without steel nor concrete. The life cycle assessment analysis proved that with the proper insulation and the usage of wind energy the building has negative carbon footprint and minimal potential environmental impact throughout the assumed lifetime of 50 years (Widera 2014).

© Helene Hoeyer Mikkelsen, Realdania Byg, 2013. Source: https://www.realdaniabyogbyg.org/projects/seaweed-houses-on-laeso-the-modern-seaweed-house ; http://dx.doi.org/10.13140/RG.2.1.1638.2881

Willa Wrocław (2014), Wrocław, Poland

Architect: Pawel Spychała

This contemporary estate of 95 apartments represents the vision of NEB aesthetics designed in human scale, appealing through the simplicity of forms and a harmony of natural and built environment. Sustainable strategies involve solar energy for heating and electricity production as well as an appropriate positioning of shading elements, so that interiors do not overheat in summer whilst passive solar gains are possible in winter. The concept applies rainwater retention and a high ratio of permeable and biologically active surfaces with the limited car-traffic and inclusive public and semi-public spaces. The residents financed a greenery project linking the estate's ecosystem with the neighbouring park and aquifer areas. A participatory, living-lab approach encourages urban-gardening and increased biodiversity including melliferous plants and sustainable food production. The community is engaged in environmental studies with special focus on air quality research. The activities involve emissions and air- pollution monitoring and awareness campaigns addressed to local neighbourhood.


© Barbara Widera, 2021

InnoRenew CoE's building Livade (2021), Izola, Slovenia

Architects: Eva Prelovšek Niemelä, Arne Niemelä

The InnoRenew CoE's building, the biggest wooden building in Slovenia, is an exemplary case of applying sustainability and building research to architecture and enables continued high-level research. The design was based on research outputs from the InnoRenew CoE. It was designed according to state-of- the-art principles of contemporary sustainable construction following the principles of REED (Restorative Environmental and Ergonomic Design) that were developed by the InnoRenew CoE's researchers. The building's dual purpose – serving the usual function of a building while also being an active research object is a notable innovation. This advance will result in new knowledge related to building performance, construction, maintenance, and occupant wellbeing and will contribute to advances in building monitoring methods from an interdisciplinary perspective.

© InnoRenew CoE, 2021. Source: https://innorenew.eu/2021/11/innorenew-coe-completes-construction-slovenias-largest-wooden-building/

Recycling House (2021), Hanover, Germany

Architects: Cityförster architects

The recycling house is an experimental residential building, a prototype that tests the possibilities and potential of various types of recycling, circular reuse, and resource efficiency. The project uses both recyclable building products such as a primary structure comprised of adhesive-free massive timber elements and recycled materials, including a recycled concrete foundation and wall insulation made of used jute bags. A focus of the design was a strategy that facilitated the future disassembly and reuse of building components without a reduction in quality and the requirement that the materials be separated at the end of the building's life.

© Olaf Mahlstedt, Cityförster, 2019. Source: https://www.cityfoerster.net/projekte/recyclinghaus-218-1.html

Single Family Home (2010), Deitingen, Switzerland

Architects: Spaceshop

The architect employed local building materials and artisanal techniques.to create contemporary architectural form. The walls are constructed from loam gathered from a nearby excavation and shaped without formwork in a traditional manufacturing method called ‘Wellerbauweise’. Wood and straw comprise the roof.


© Stefan Weber, Spaceshop Architekten, 2010. Source: https://www.baunetzwissen.de/gesund-bauen/objekte/wohnen/wohnhaus-flury-in-deitingen-1556003

Training Centre (2010), Gordola, Switzerland

Architects: Durisch and Nolli

Designed as a modular, flexible steel structure, the building was conceived as a future ‘urban mine’, a material and component resource at the end of the building’s life. The elevation of the building leaves the topography of the site nearly untouched, with parking spaces and storage facilities placed beneath it.

© Walter Mair, Durisch + Nolli Architetti, 2010. Source https://www.baunetzwissen.de/geneigtes-dach/objekte/bildung/ausbildunsgzentrum-fuer-den-baumeisterverband-in-gordola-1582669

Dwelling extensions Cité du Grand Parc (1996), Bordeaux, France

Architects: Lacaton and Vassal.

Renovation of 530 social housing apartments at Bordeaux, France. The renovation involved the addition of 3.8-metre-deep winter gardens and open-air balconies to each apartment. Small windows were replaced by large glass sliding doors opening on to the winter gardens and outdoor areas. So as to cause minimum disruption to residents, who remained in their homes during the work, these extensions were made using prefabricated modules. The project provides beautiful and reproducible response to the urgency of urban re-densification. 'Transformation is the opportunity of doing more and better with what is already existing. The demolishing is a decision of easiness and short term. It is a waste of many things – a waste of energy, a waste of material, and a waste of history. Moreover, it has a very negative social impact. For us, it is an act of violence.' Anne Lacaton.

© Philippe Ruault, 2017. Source: https://www.lacatonvassal.com/index.php?idp=80

Common Ground High School (2016), New Haven, Connecticut, USA

Architects: Gray Organschi Architecture

This environmental charter school combines urban agriculture and sustainable land-management practice in an innovative curriculum that serves New Haven area teenagers during the day and younger children and adults through extensive after-school programs in the afternoons and evenings. The project brief challenged the architecture / engineering / prefabrication team design team to weave the new building and its exterior spaces into the fabric of farm buildings, agricultural fields, upland forests, and wetland habitat that lie at the city's edge and serve as the school's working landscape and outdoor classroom. A primary objective was a pedagogical one: that the building itself would be an environmental exemplar that integrated new ecological concepts and building technologies in a clearly legible and potentially instructive way. The high-performance building is constructed using primarily bio- based materials, including regionally-sourced mass timber structural components in assemblies prefabricated in a manufacturing facility 100 miles away. Students worked with the design team to calculate carbon storages and produce a life cycle assessment of the building.

© David Sundberg, ESTO, 2016. Source: https://grayorganschi.com/projects/selected/common_ground_high_school; https://www.thinkwood.com/projects/common-ground-high-school

The kindergarten for the University of Göttingen (2010), Germany

Architects: Despang Architekten

The passive kindergarten of the University of Göttingen was created to be very natural-looking, but also sophisticated and contemporary composition of the building and the landscape to emphasise the educational mission of 'post-fossil' attitudes towards the environment. The holistic concept, including materials and adopted solutions was aimed at creation of the learning environment for the youngest children, and at providing maximum protection to flora and fauna in the green campus area. The thermally conditioning triple pane passive house glazing has been used to maximally open the southern façade. Biodynamic screen shades help stack effect cooling and do not disturb the view into the outdoor garden space. The north-western part of the building has been discretely hidden and protected against the heat loss with the green roof, which makes a natural continuation of the landscape, providing the continuous habitat for the species living in the area (Widera 2012).


© Olaf Baumann, 2010. Source: https://www.researchgate.net/publication/236244767; http://www.despangarchitekten.com/html/first_click_options/playing_goettingen_university_kindergarten.html

Educational (programmes)

S|UM Sustainability and Urban Mining

University of Wuppertal, Germany

The continuing education program is based on a paradigm shift in construction: Recognition of world capacity and acting in environmental consistency. The first two semesters introduce and deepen sustainable and resource-efficient designing (strategies of sustainability, sustainable site and neighbourhood development, urban ecosystems/ urban greening, cycles in construction, urban-mining- design/ cradle to cradle, assessment and optimisation of environmental consistency/ urban-loop- design). This is continued with tools of a digital transformation of planning (building information modelling, madaster, building product traceability) and sustainable project development (including sustainable mobility, the future of building culture, social aspects of sustainable building, life cycle assessment) an add on building and environmental law (environmental policy and law, environmental concerns in urban land use planning, public building and administrative law, architectural and public procurement law, environmental social governance).

Sustainability and bioclimatic architecture portfolio.

Faculty of Architecture, Wrocław University of Science and Technology, Poland

The new contents of sustainable and bioclimatic design were introduced to the course of History and Theory of Contemporary Architecture at the Faculty of Architecture WUST (starting from 2020) aimed at extension of the issues of energy efficiency in buildings, climate resilient design and circular economy in building and city scale. The course participants were encouraged to embrace the idea of European Green Deal (EGD) and

the NEB and to use the innovative, pro-environmental approach in their design. The portfolio was completed by an experimental elective course (master-level programme), with the aim to demonstrate the possibility of implementing the EGD and NEB principles using the methods of sustainable design, the impact of their application on design skills, taking into account the challenges of the climate crisis, the impact on the increase in environmental awareness, and the assessment of the results and usefulness of such an approach in the educational process. The results on the experimental portfolio were evaluated by a survey among participants and presented in journal articles (Sadowski 2021, Widera 2021).

Source: http://www.wiete.com.au/journals/WTE&TE/Pages/Vol.19,%20No.1%20(2021)/12-Widera-B.pdf

Circular Construction and Carbon Neutrality in Building Design and Construction: a plan for master-level study module on circular economy for students of architecture and engineering.

Authors: Matti Kuittinen, Pekka Heikkinen (Aalto University), Alan Organschi, Andrew Ruff (Yale University)

An innovative study program, sponsored by the SITRA Finnish Innovation Fund. The curriculum integrates principles from the circular economy into the building design, assessment, and construction process. By offering protocols and strategies for addressing operational and embodied emissions in the building and construction industry, the study module will empower students and emerging professionals in architecture and engineering to dramatically reduce the environmental impact of new buildings. The study module, comprised of a methodology course, studio course, and design-build practicum, was developed in an international collaboration between Aalto University's School of Arts, Design, and Architecture (Finland) and Yale University's School of Architecture (USA) in an effort to integrate circular economy principles and practices into innovative design pedagogies and practice. The courses of the module are supported by on-line lectures, reference texts, publicly accessible learning materials, sample syllabi, and pedagogical guides developed by Aalto and Yale Universities.

Source: https://www.decarbonizedesign.com/lectures

Annex 4: List of generic topics for consideration in Horizon Europe

The following compilation represents a set of sample topics that reflect strategic research and experimentation priorities.

1.	**Sinking Carbon by Construction:**
1.1.	Exploring and quantifying the maximal net carbon uptake potential of the global built environment in the next two centuries for plausible socioeconomic scenarios
1.2.	Towards zero-impacts lamination techniques in timber architecture
1.3.	Portfolio of economic incentives (tax reductions, C-storage certificates, subsidies, etc.) for climate-positive construction
2.	**Sustainable Supply of Bio-Materials:**
2.1.	Geographical-explicit high-resolution analysis of global reforestation/afforestation potential ('Earth's tree carrying capacity'), considering different climate-change scenarios and climate adaption scenarios in forests (including those compatible with the Paris Agreement)
2.2.	Empirical and theoretical investigation of carbon-sequestration performance of natural vs. managed forests over the respective lifetimes
2.3.	Dynamical simulation modelling of forests explicitly designed (species mix, age-class distribution, ecological fertilisation & pest control) for maximal sustained biomass yield
2.4.	Resilience analysis of forests of different composition (including non-domestic and possibly genetically-modified species)
3.	**Climate-Smart Architecture, Design and Operation:**
3.1.	Adapting buildings and settlements to climate change and shifting extreme-events regimes: interdisciplinary assessment
3.2.	Occam's razor in architecture: How to achieve comfort and resilience in the simplest way
3.3.	Assembling and employing lessons from building cultures worldwide, including indigenous approaches
3.4.	Assessing the potential contribution of advanced digital tools to the sustainable operation of settlements and infrastructures in a changing world
4.	**Circularity in the Built Environment:**
4.1.	Designing and constructing in the least wasteful and most reusable way: A conceptual analysis
4.2.	Assessing the existing building stock (local, regional, global): renovation, replacement or removal?
4.3.	Technology appraisal: What still needs to be invented/developed for full circularity?
4.4.	Second-best analysis: How to design very long cascades of usage ('ultra-slow downcycling')
5.	**Geometry of Urbanity and Rurality:**
5.1.	Comparative evaluation of different city structures (concentric, checker-board, heterogeneous, etc.) in view of the NEB criteria

5.2. Critical appraisal of polycentric and fractal settlement geometries with an emphasis on the human dimensions

5.3. How to design 15-minute cities or even 15-minute entanglements (where a genuine patch of nature is in walking distance from every home)

6. Devising and Composing Equity:

6.1. In-depth investigation and interpretation of post-WW2 urban development and its impacts on social cohesion/division (gentrification, etc.)

6.2. Review of class segregation by architecture in history across the globe

6.3. Advancement of concepts for 'social mixing' by construction and planning (from building to landscape scale)

7. Settling the Unsettled:

7.1. Developing the 'science of informality' in the built environment: phenomenology, typology, criteria, quantification, monitoring. modelling

7.2. Appraisal of existing ways and identification of new ways to 'upgrade' slums through planners-dwellers collaboration

7.3. Scenario analysis for housing the next two billion people on Earth: bottom or top?

8. Mass Movement towards Beauty?:

8.1. How make urban and landscape architecture a public art (again): lessons from the past and visons for the future

8.2. Exploring the role of education in creating aesthetic attitudes

8.3. Questioning the contemporary socio-political model of architectural beauty contests

9. Honouring and Fostering Global 'Archiversity':

9.1. Systemic stock-taking and appraisal of world-wide architectural diversity in response to different contextual challenges

9.2. Interdisciplinary analysis of why and how the 'western' construction paradigm came to dominate the world

9.3. Creating a European architect-in-residence programme, supporting especially young pioneers from the Global South

10. Preparing for the 'Cyberorganic Age':

10.1. Assessing how the combination of evolutionary construction solutions ('No-Tech') and advanced cybernetic methods ('Hi-Tech') could/will transform the built environment

10.2. Exploring the possibility of 'living architecture', e.g. hybrid buildings that partly consist of growing components such as trees.

Cover page image (from left to right)**:** Mill River Park Carousel Pavilion, © David Sundberg, ESTO Photographers, 2017. Source: https://grayorganschi.com/projects/selected/mill_river_park_carousel_pavilion; ERDEN Pure Walls, © European Union, 2021; RoSana guesthouse, © European Union, 2021; RoSana guesthouse, © European Union, 2021.

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The ‘Horizon Europe-New European Bauhaus Nexus Report’ (2022) is an independent expert report. The report offers a set of guiding principles that can shape the goals and ambitions of the New European Bauhaus initiative. The recommendations aim to support the New European Bauhaus core values – sustainability, inclusion, and aesthetics.

The recommendations are based on the current and future organisational structures and timeframes of the Horizon Europe research and innovation framework programme. They consider opportunities for the funding period 2021-2022, mid-term goals for the period 2023-2024, and long-term actions beyond 2024 that reflect the transdisciplinary and trans-sectoral vision of the New European Bauhaus.

The report also provides a roadmap with strategic priorities and associated benchmarks that describe a possible path forward for European society and its response to the climate crisis, together with the EU’s global partners.

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