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Public attitudes to energy-efficient-buildings and how to address them; community responses to the potential for NZEBs and how to support them

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Contents

Executive Summary

This report represents the outcome of IWG5 Project – Task 1.4that emphasizes the societal dimensions of achieving energy-efficient buildings across Europe. Through annual Study Tours held between 2023 and 2025 in Berlin, Brussels, and Valencia, this task explored how energy efficiency in buildings can be realized not only through technical innovation, but also through inclusive, people-centered approaches.

Each Study Tour focused on regional challenges and opportunities:

- **Berlin (2023)** highlighted systemic renovation strategies, integration of renewable technologies, and nature-based solutions in a high urban context.
- **Brussels (2024)** showcased people-centric retrofits in social housing, addressing the balance between affordability, heritage preservation, and energy performance.
- **Valencia (2025)** examined the role of architecture in promoting sustainable lifestyles through regenerative neighbourhood design and climate-focused educational environments.

Study Tours brought together a wide range of stakeholders, including architects, civil society actors, national policy representatives, and local residents. A unique perspective on stakeholder perceptions, user experience, and the cultural acceptance of sustainable architecture was offered by guided tours, interviews, and organized reflection sessions.

Key findings emphasize the following needs:

- Holistic building design that incorporates passive strategies, local materials, and lifecycle thinking.
- Stronger integration of user engagement, education, and social equity into renovation and construction processes.
- Policy instruments and financial frameworks that support innovation.
- Cross-sector collaboration, capacity-building, and communication strategies that bridge the gap between regulation, design, and practice.

The report concludes with actionable recommendations for national governments, municipalities, and market actors.

Introduction

In order to reduce the climate impact of the European building stock, existing buildings need to be transformed into Zero-Emission Buildings (ZEBs), which do not produce any on-site carbon emissions from fossil fuels by 2050. This transformation will be carried out in several stages: public buildings are required to achieve ZEB status by 2028, all new buildings by 2030, and the remaining existing buildings by 2050. The revised Energy Performance of Buildings Directive (EPBD) thus represents a shift from Nearly-Zero Energy Buildings (NZEBs), which aim to minimize energy consumption, toward fully zero-emission buildings[1].

This challenge requires not only technological innovation but also for meaningful stakeholder engagement with the people who build, inhabit, finance, and govern our built environment. Recognizing this, Task 1.4, led by WIP, set out with a clear objective: to realize energy-efficient buildings not only through technical plans and regulations, but through direct, human-centered experiences.

Through annual Study Tours, Task 1.4 provides a unique opportunity for IWG5 members, national government delegates, industry representatives, civil society actors and general public to engage directly with exemplary building projects across Europe. These are buildings that not only demonstrate cutting-edge energy efficiency and renewable energy technologies but also employ community participation, local initiative, and social innovation.

The primary aim of Task 1.4 is twofold:

1. **To educate and inspire**: by showcasing real-life buildings that exemplify how nearly zero-emission buildings (NZEBs) can be achieved through both innovation and people-centric design, Study Tour participants are encouraged to reflect on how these insights can inform policy, market action, and public communication.
2. **To generate actionable recommendations**: by engaging with local stakeholders: residents, developers, policymakers, utilities, and finance actors, each Study Tour aims to understand social perceptions, barriers to acceptance, and opportunities for community engagement. Through guided exchanges and roundtable discussions, the tours aim to uncover the attitudes that shape public opinion toward energy efficient buildings (and NZEBs) and how they vary across cultural and economic contexts.

From Berlin in 2023, with its emphasis on systemic renovation and efficiency, to Brussels in 2024, where community-driven retrofits and people-centered smart buildings took stage, and finally to Valencia in 2025, which showcased climate-adapted, circular, and inclusive

[1] https://www.iwg5-buildings.eu/wp-content/uploads/2025/06/IWG5_Deliverable-1.10_Recommendations-on-how-to-prepare-upcoming-National-Building-Renovation-Plans-with-a-focus-on-Zero-Energy-Buildings.pdf

architecture within a Mediterranean context, the tours have become a dynamic platform for learning and exchange.

Each Study Tour is complemented by structured documentation of findings, roundtable discussions, and reflection sessions, which inform this report. This report captures these conclusions drawn from the 2023–2025 Study Tours and provides recommendations for policy, local government, and industry, supporting the broader ambition of the European Green Deal and the recast Energy Performance of Buildings Directive (EPBD).

1. Berlin 2023 - Energy Efficiency and Innovation in Urban Transformation[2]

The first Study Tour of the IWG5 took place on 4 July 2023 at the Berlin Adlershof Technology Park, one of Germany's most advanced science and technology hubs. The tour was organized by WIP Renewable Energies in collaboration with Project Management Jülich, co-chair of IWG5.

It brought together participants from renewable energy associations, research institutions, and national governments to see how advanced building technologies and integrated design approaches are shaping the future of energy-efficient buildings in the EU.

The visited sites at Adlershof Technology Park showcased various approaches to achieving energy efficiency, integrating renewable energy systems, and introducing nature-based and user-centric design elements. Each site provided clear technical takeaways and practical recommendations for future replication and policy support.

Site Visits and Key Highlights: Practical Insights from Adlershof

1) Living Lab on BAIP – Integrated Solar Façades for Urban Energy Generation[3]

The first site is a living laboratory equipped with a 50-kW building-integrated photovoltaic (BIPV) façade, comprising 360 CIGS thin-film solar modules. The system is distributed across the south, west, and north façades of the building, illustrating how solar technologies can be effectively integrated into a building's envelope, even in urban settings with limited roof space.

Key Observations:

- Vertical and multi-orientation PV installation allows for extended daily generation and better use of available surfaces.
- Integration into the building façade offers both energy production and architectural value, in terms of aesthetics and functionality.

Recommendations:

- National building codes and incentive programs should support BIPV systems, particularly for dense urban areas.

[2] https://www.iwg5-buildings.eu/examples-of-innovative-and-energy-efficient-buildings-for-the-first-study-tour-in-berlin/
[3] https://www.adlershof.de/en/news/because-its-better

- Encourage the use of buildings as testbeds ("living labs") for energy performance monitoring to inform future design and policymaking.

2) Centre for Photonics and Optics – Passive Façade Systems and Natural Ventilation[4]

This multi-storey building utilizes a double-glass façade system that increases thermal insulation while enabling controlled natural ventilation. Transparency and daylight are maximized without compromising energy performance. Next to it, an experimental hall featuring a steel structure and extensive glazing was also showcased.

Key Observations:

- The double façade enhances indoor comfort and reduces heating and cooling demand.
- Passive design features can substantially improve efficiency when aligned with building orientation and usage patterns.

Recommendations:

- Update building performance assessments to include more passive design strategies, such as double façades and natural ventilation.
- Promote inclusion of adaptive façade technologies in renovation programs targeting office and institutional buildings.

3) Centre for Photovoltaics and Renewable Energies – Coupling Renewable Energy with Thermal Systems[5]

This building showcased a **comprehensive renewable energy strategy**. The foyer roof is equipped with large photovoltaic panels that generate electricity. Heat and cooling are provided by vertical ground loops installed in boreholes. In the offices, concrete core ceilings, and in the atrium, low-temperature underfloor heating, both use renewable energy sources to maintain comfort throughout the building.

Key Observations:

- Synergistic use of PV and geothermal systems maximizes energy autonomy.
- Low-temperature distribution systems are well suited to renewable energy sources and enhance efficiency.

Recommendations:

- Encourage deep renovation schemes that support the combined use of multiple renewable systems, particularly PV and geothermal.

[4] https://www.adlershof.de/en/properties/construction/architecture#c9708
[5] https://www.adlershof.de/en/science-technology/technology-centres/renewable-energy/info

- Expand technical support for planning and integrating thermal energy storage in office and mixed-use buildings.

4) Institute of Physics, Humboldt University – Nature-Based Water and Cooling Systems[6]

The Institute of Physics building demonstrated decentralized water management and nature-based cooling. Rainwater is collected in cisterns and used for watering the green façade and for evaporative cooling in air conditioning systems. Any excess water flows into a courtyard pond, where it can either evaporate naturally or seep into the ground.

Key Observations:

- Combining water reuse with building greening enhances both energy performance and climate resilience.
- Decentralized water systems can reduce operational costs and improve building autonomy.

Recommendations:

- Support the integration of water reuse and evaporative cooling in urban building regulations, particularly in regions facing increased heat stress.
- Incorporate nature-based solutions, such as green façades and rainwater systems, into energy performance rating schemes and NZEB definitions.

Perspectives and Social Perceptions on Energy-Efficient Buildings and NZEB

This chapter synthesizes the insights gathered following the Study Tour of Adlershof's energy-efficient buildings, focusing on both the general perspectives on energy-efficient buildings and the social perceptions across different stakeholder groups and countries. The aim is to deepen understanding of the concept, identify barriers, explore public attitudes, and provide recommendations for promoting Nearly Zero Energy Buildings (NZEB).

A) General Perspectives on Energy-Efficient Buildings

Energy-efficient buildings are understood as structures that provide the same or improved levels of indoor comfort using less energy. This is achieved through optimized design, improved building stocks, and the integration of renewable energy sources. However, defining energy efficiency in buildings requires more than a conceptual explanation; it needs measurable benchmarks. The Energy Performance of Buildings Directive (EPBD) in the EU serves as a reference point, focusing on low primary energy demand as a core criterion. Complementary indicators such as reduced greenhouse gas emissions, energy costs, and enhanced indoor comfort contribute to evaluating a building's overall efficiency.

[6] http://www.gebaeudekuehlung.de/en/projekt.html

Energy efficiency benefits are assessed across multiple dimensions. It includes quantifiable indicators such as energy and cost savings, CO_2 reductions, and compliance with regulatory standards. Additionally, more qualitative aspects such as improved user well-being, increased property value, and enhanced energy security play a significant role. Lifecycle assessment (LCA) is highlighted as an essential tool to understand the broader impacts, encompassing not only operational energy use but also material production, disposal, and embodied emissions.

The implementation of energy-efficient measures, however, faces a range of challenges. One of the most significant of these are the high initial expenses associated with new technology and renovations, particularly when adapting existing buildings. Progress is also limited by technical constraints, complicated regulations, restricted access to reasonably priced funding, and a general lack of knowledge among the public and professionals. The lack of competent workers is still a significant barrier, especially when it comes to building and maintaining contemporary energy systems.

To overcome these obstacles, a well-thought-out, multifaceted approach is needed. Proposed solutions include the development of easy-to-access funding mechanisms, the establishment of one-stop advisory services, and the promotion of modular, prefabricated solutions to reduce disruption during retrofitting. All parties involved, from building owners to artisans, must get training and instruction in order to guarantee well-informed decision-making and appropriate project execution. In order to direct long-term investments and encourage energy-efficient practices, a supportive regulatory framework that is in line with contemporary sustainability goals is also required.

In integrating energy efficiency into sustainable building design, stakeholders are encouraged to adopt a holistic approach. This includes passive design strategies, optimized resource use, renewable energy integration, and user engagement. Energy efficiency, when combined with sustainability, creates synergies that benefit environmental, economic, and social dimensions. Nevertheless, potential trade-offs exist, such as increased material demands that may increase emissions. These should be managed through lifecycle planning and the selection of low-impact materials. Synergies with water conservation, waste management, and social equity further improve the overall sustainability of buildings.

Collaboration among stakeholders is a critical enabler of energy efficiency. Governments, energy providers, developers, and occupants must engage in transparent dialogue to align their goals. Policy support in the form of incentives, tax relief, and public procurement is vital. Business models such as district energy systems and tenant electricity arrangements can drive innovation and broader adoption. Strengthening professional networks and facilitating information exchange can also accelerate market transformation and scale successful practices.

B) Social Perceptions and Stakeholder-Specific Attitudes

Public attitudes toward energy-efficient buildings are diverse and often shaped by economic, cultural, and contextual factors. In many cases, there is a growing awareness of the environmental and financial benefits of energy-efficient buildings. However, concerns about high initial costs, lack of understanding, and resistance to new technologies still exists. For instance, while energy crises and rising energy prices have increased receptivity in some countries, skepticism remains, especially where regulatory frameworks are perceived as complex.

Social perception is influenced by several key factors, including public awareness, access to reliable information, perceived return on investment, and cultural acceptance. In some contexts, energy efficiency is narrowly associated with measures like insulation, while more comprehensive aspects such as energy performance certificates (EPCs) or renewable energy integration remain poorly understood. Generational differences also play a role, with younger demographics often more open to sustainable practices, particularly when supported by digital tools and applications.

Effective communication strategies are essential to address these gaps. Stakeholders are encouraged to use clear, relatable messaging that highlights the tangible benefits of energy efficiency, such as reduced energy bills, improved comfort, and environmental responsibility. Case studies, visual storytelling, and demonstration projects can help explain the technology and build trust. School-based education, community engagement, and partnerships with local media further amplify impact and foster a culture of sustainability.

Policymakers and government agencies have a central role in creating an enabling environment. By setting clear minimum energy performance standards, offering financial incentives, and supporting local-level information campaigns, authorities can guide public behavior and investment. Cross-sector collaboration with industry stakeholders ensures that regulations are practical and aligned with market capacities. Additionally, supporting research and innovation, particularly in building modernization, helps ensure that energy-efficient solutions remain accessible, cost-effective, and technologically advanced.

2. Brussels 2024 – People-Centric Energy Efficiency at the Heart[7]

The 2024 Study Tour focused on people-centric approaches to renovation, with a special emphasis on urban social housing in Brussels. Organized by WIP in cooperation with Bruxelles Environnement and Citydev.brussels, the tour presented practical, high-impact examples of how public authorities, developers, and residents are working together to achieve high energy performance in existing buildings, especially within vulnerable districts.

Three sites were selected for their relevance to Nearly Zero-Energy Buildings (NZEB) and their innovative use of technology, architecture, and community engagement in delivering energy-efficient outcomes. Each demonstrated how performance targets can be met while maintaining affordability, social cohesion, and urban identity.

Site Visits and Key Highlights: Social Housing and Sustainable Retrofits in Brussels

[7] https://www.iwg5-buildings.eu/study-tours/brussels-2-july-2024/

1) Rue de la Plume – Passive Social Housing in a Densely Built Historic District[8]

Located in the Marolles district, the Plume building is a flagship example of energy-efficient social housing. Recognized as an "Exemplary Building" by Bruxelles Environnement, it illustrates how high performance can be achieved even in constrained urban settings.

Key Observations:

- Each flat is equipped with individual mechanical ventilation with heat recovery, ensuring high indoor air quality.
- The rooftop photovoltaic system contributes to on-site renewable generation.

Recommendations:

- Promote fully electric retrofits in social housing, prioritizing indoor air quality and resident comfort.
- Support local authorities with technical and financial tools to adapt passive house principles to high-density areas.
- Use buildings like Plume as demonstration projects in national NZEB awareness campaigns.

2) Cité Hellemans – Balancing Heritage Conservation and Energy Goals[7]

Cité Hellemans is a historic early 20th-century housing estate also located in the Marolles area. Though architecturally significant, the building presents major challenges for energy renovation.

Key Observations:

- The building retains its original gas-powered heating system and gas cookers, with minimal energy upgrades.
- The building holds an indicative EPC G rating, demonstrating high energy consumption.
- Architectural heritage protection severely limits the scope of physical interventions.
- Residents benefit from cultural value and stability, but energy poverty risks persist due to inefficiency.

Recommendations:

- Develop heritage-sensitive renovation pathways under the EPBD that include realistic performance expectations and financial compensation for performance gaps.
- Encourage pilot programs for low-impact upgrades in heritage buildings, such as smart controls, window insulation layers, or hybrid heating systems.

[8] https://www.iwg5-buildings.eu/wp-content/uploads/2024/07/Presentation-du-patrimoine-visite-delegation-iwg5-EN.pdf

- Promote dialogue between preservation authorities and energy experts to co-design retrofit solutions that meet both conservation and performance needs.

3) Greenbizz.energy– Combining Circular Construction and Social Innovation[9]

Greenbizz.energy is Brussels' first renewable energy community in an economic activity zone. Twenty participants have come together around 943 solar panels producing 203 MWh a year to collectively maximise the self-consumption of locally-produced energy.

Key Observations:

- The building provides shared prototyping, office, and coworking spaces for cleantech and energy startups.
- Greenbizz supports local job creation, skill development, and early-stage innovation in sustainable construction.

Recommendations:

- Integrate **innovation hubs** like Greenbizz into regional renovation ecosystems to foster innovation-to-implementation pipelines.
- Use public procurement to create **market demand** for circular and low-carbon building materials.
- Facilitate **public-private partnerships** that connect incubators with housing authorities and retrofit contractors to pilot advanced solutions.

Rethinking Building Efficiency with Social Engagement

This chapter explores the social dimensions of energy-efficient buildings, drawing on insights from the IWG5 Study Tour in Brussels. By centering people in the conversation, the chapter highlights both the opportunities and challenges of making energy efficiency a socially accepted and inclusive standard.

A) Focusing on the People-Centric Approach to Energy-Efficient Buildings

In terms of communicating and measuring the benefits of energy efficiency, several responses stressed the need to balance hard data (such as energy savings or emissions reductions) with soft metrics like comfort, user satisfaction, and improved indoor health. Smart meters and dashboards can help visualize data for end users, while community outreach and gamified comparisons—such as those embedded in the EPC certificate system in Brussels—can increase engagement. It was also noted that data should be localized and contextualized (e.g., climate-specific or building-type specific) and ideally include simulations or suggestions for cost-effective improvements tailored to each user group.

Energy efficiency must be in line with societal goals including affordability, health, climate action, and long-term well-being in order to be incorporated into larger sustainable living practices. This calls for

[9] https://ecobuild.brussels/en/projects/greenbizz-energy/

cultural significance in addition to technological design. This integration is simpler for new construction, which offers chances to apply bioclimatic, renewable energy, and circular design concepts. However, this becomes more complicated during renovations, particularly when working with historic structures or homes constructed in a way that deviates from social norms. Here, price, preservation, and energy efficiency must all be balanced, and performance standards should be taken into account real-world limitations.

Local community initiatives play an important role in driving these practices from the ground. Community-led energy actions not only raise awareness but also foster ownership, confidence, and behavioral change. Workshops, co-designed projects, and peer learning were cited as effective formats, while partnerships with municipalities or utilities can offer resources and amplify reach. When people feel empowered to act on energy efficiency within their own homes or neighbourhood s, it leads to stronger long-term commitment and helps normalize low-carbon lifestyles at the grassroots level. Community groups also serve as trusted intermediaries, bridging the gap between technical solutions and everyday lived experience.

B) Examining Social Perceptions and Engagement Strategies

Social and cultural perceptions around energy-efficient buildings are shaped by a combination of economic realities, historical context, and public trust. A strong contrast was drawn between countries like Denmark, where local foundations (e.g., Danfoss in Sønderborg) support ambitious decarbonization goals with clear political and technical backing, and other countries like Italy, where there has been public and political skepticism about energy performance regulation. In Italy's case, concerns around cost, loss of comfort, and the complexity of retrofitting older housing stock led to resistance during the recast of the EPBD. Cultural priorities, such as architectural preservation, can further complicate public attitudes.

Among the buildings visited in Brussels, the Plume project in Marolles was highlighted as nice, effective and practical example of energy-efficient design. The building combined aesthetic appeal with strong technical performance. Importantly, it was located in a historically underprivileged area, showing how high standards can be achieved even in socially complex contexts. By contrast, Cité Hellemans, while admired for its heritage and social value, illustrated the real limitations of energy retrofitting in protected historic housing, particularly with its outdated gas-based. This helped participants reflect on the range of challenges across building types and the need for realistic expectations and targeted strategies.

Cooperative models can promote real-time energy sharing, awareness, and mutual accountability between businesses and local actors, as shown by energy communities like Greenbizz.brussels. These models received recognition for their collaborative culture in addition to their technical design. Other suggestions included the establishment of innovation hubs where industry, government, and academia could collaborate to develop retrofit solutions, with community members being involved from the beginning.

3. Valencia 2025 - Sustainability in Education and Urban Living[10]

The last Study Tour held on 1 July 2025. Organized by WIP in cooperation with Imagine Montessori School, the tour highlighted how architectural design, green technology, and community participation intersect to support climate-resilient, user-centered environments.

Two key sites were selected for their relevance and emphasis on environmental quality, social value, and integrated urban planning. Each site demonstrated how performance goals can be met while advancing equity, education, and local identity.

Site Visits and Key Highlights: Education and Urban Regeneration in Valencia

1) Imagine Montessori School – Smart and Sustainable Learning Environment[11]

Located in Paterna, the Imagine Montessori School exemplifies how sustainability can be integrated into educational settings. Certified BREEAM Excellent and GBC Green 4 Leaves, the building reflects a high-performance standard across energy, water, and material use.

Key Observations:

- The building achieves approximately 45% energy savings, 21% less water consumption, and 47% reduction in CO_2 emissions compared to standard benchmarks.
- Mechanical ventilation systems equipped with CO_2 monitoring and natural cross-ventilation improve indoor air quality and comfort.
- Integrated daylight management, VRV climate control, and LED lighting systems reduce electricity demand while enhancing learning conditions.
- Rooftop photovoltaic panels and rainwater harvesting systems contribute to on-site renewable generation and sustainable water management.
- Low-impact, circular construction materials support long-term sustainability goals and align with educational values.

Recommendations:

[10] https://www.iwg5-buildings.eu/building-sustainability-iwg5-study-tour-highlights-green-innovation-in-education-and-urban-living/
[11] https://imaginemontessori.es/en/montessori-environments/

- Position sustainable schools as flagship projects, showcasing the co-benefits of energy efficiency, health, and learning performance.
- Replicate integrated systems for ventilation, daylight, and water reuse in public education infrastructure.
- Support early education on sustainability.

2) Barrio La Pinada – Regenerative Neighbourhood Development[12]

Barrio La Pinada represents one of Spain's most ambitious examples of regenerative urban design. This 30-hectare development integrates housing, nature, and community-driven planning to create a low-carbon, resilient neighbourhood model.

Key Observations:

- Planning is guided by circularity, energy efficiency, and resident co-creation which makes the process participatory and adaptive.
- The project combines environmental performance with strong emphasis on urban identity, affordability, and long-term liveability.

Recommendations:

- Use La Pinada as a model for neighbourhood -scale sustainability, especially in fast-growing peri-urban areas.
- Integrate participatory design and governance processes into regional planning frameworks.
- Support local innovation ecosystems to test and scale green mobility, shared services, and low-carbon construction methods.

Sustainable Architecture through Community and Culture

This chapter summarizes the reflections gathered through the discussions following the Valencia Study Tour. Drawing on participant inputs, it explores how sustainable architecture and living practices are understood.

A) Designing for Sustainable Architecture and Living

In Mediterranean contexts like Valencia, sustainable architecture must respond directly to climatic conditions, social diversity, and local identity. Across the responses, several design principles emerged to be considered: passive design strategies such as cross-ventilation, thermal mass, and solar shading are essential to minimize reliance on mechanical systems. Local and low-carbon materials like clay, timber,

[12] https://zubicities.com/promociones-sostenibles/barrio-la-pinada/

or traditional techniques reduce energy and foster regional identity. Water-sensitive urban design, such as rainwater harvesting and green roofs, supports both ecological balance and resilience to heatwaves.

Another key aspect is the integration of urban biodiversity and green infrastructure, including green facades, rooftop gardens, and shared courtyards. They are not only contributing to rainwater management and insulation but also promotes community wellbeing, stress relief, and reconnection with nature. In Valencia, green spaces were highlighted not just for their environmental function, but for their role in fostering inclusive, socially cohesive urban living.

It was generally accepted that architects, legislators, and community members shared responsibility for ensuring inclusivity and adaptability over time. Accessibility for individuals with different needs, flexibility in spatial design (e.g., modular layouts), and the incorporation of intelligent, responsive technologies were considered crucial instruments. These concepts can be expanded into mainstream initiatives with the aid of regulatory frameworks that integrate best practices, like those found in the Montessori School case.

The role that architecture can play in promoting sustainable practices was also highlighted by the participants. Residents may be encouraged to lead less impactful lives by features like shared living areas or laundry rooms, bike parking rather than car garages, and readily visible renewable energy systems. In order to encourage a sense of pride, identity, and environmental consciousness in its users, green living must be intuitive and appealing.

B) Strategies for Fostering Sustainable Living

Despite rising awareness, Mediterranean countries continue to face social, cultural, and economic obstacles to the shift to sustainable architecture. One of the biggest obstacles, according to the participants, is the perceived high cost of green buildings, especially for younger populations and in cities where housing affordability is already a problem. Furthermore, there is still a lot of opposition to altering conventional urban forms and false beliefs about green spaces being dirty or noisy. These problems show how important it is to use participatory design methods, in which local communities are actively involved in decision-making from the very beginning and on a regular basis.

Participants recommended certifications, financial incentives, and disassembly-friendly designs to facilitate material reuse in order to mainstream circular economy concepts in the construction industry. Additionally, public platforms that link customers with verified sustainable innovators and contractors were suggested. For mainstream actors to adopt sustainable building practices, innovation must coexist with funding support, education, and regulation.

Participants recommended pilot programs with mentoring, financial support for community-led projects, and the establishment of "One-Stop Shops"—local offices like Valencia’s Energy Office that provide technical advice, training, and support for retrofits and community energy initiatives.

Conclusion

One of the main pillars of the EU's energy and climate goals is the decarbonization of the European building stock. The shift to energy-efficient and sustainable buildings requires a comprehensive strategy that includes technological innovation with cultural, social, and institutional dimensions, as the Task 1.4 Study Tours carried out between 2023 and 2025 illustrate.

The visits to Berlin, Brussels, and Valencia have provided concrete examples of how energy efficiency in buildings can be achieved in various contexts. From high-performance retrofits in urban housing to climate-responsive educational facilities and regenerative neighbourhood planning, the selected case studies reflect an understanding that energy efficiency should utilize not only in building stock and systems, but also in governance models, user engagement, and local characteristics.

Following conclusions are derived from this work:

- Sustainable architecture should consider climatic conditions, resource efficiency, material circularity, and long-term adaptability, while ensuring that buildings are accessible, healthy, and responsive to user needs.
- Financial instruments, technical guidance, and regulatory flexibility are significant to support deep renovation, particularly in heritage buildings, social housing, and peri-urban developments where complexity and vulnerability is an issue.
- The success of energy-efficient buildings is closely linked to cultural relevance, public trust, and community involvement. Participatory processes, targeted communication, and local capacity-building play a decisive role in mainstreaming sustainable practices.

Annex – Compilation of Roundtable Discussions

Berlin - 2023

Following the Study Tour of Adlershof's energy efficient buildings, participants are asked to answer the following discussion questions. This working document aims to explore the concept of energy efficient buildings and gain a comprehensive understanding of social attitudes towards energy efficient buildings/Nearly Zero Energy Buildings (NZEB). The goal is to investigate the reasons behind these attitudes, identify strategies to address negative perceptions, and ultimately develop recommendations for future actions to promote energy efficient buildings.

A) <u>Focusing on the general perspective on energy efficient buildings</u>

1. How can we define energy efficient buildings and how can the benefits of energy efficiency in buildings be measured?

Answer 1

Energy efficiency in buildings is the focus of the Energy Performance of Buildings Directive (EPBD) and a long time research, demonstration and funding area of the EU. Within the EPBD the energy performance (which could be "translated" to energy efficiency) of buildings is measured by a low primary energy demand (in most countries low non-renewable primary energy demand). This requirement and indicator can be accompanied by other requirements such as renewable energy contribution, low heating (and cooling) demand, low thermal transmittance of the envelope, efficient heating, cooling ventilation and lighting systems, etc. All these strategies contribute to a high energy efficiency or energy performance of a building. The EU Members States use different combinations of requirements to guarantee energy efficiency in new buildings and major renovations. The website of Concerted Action EPBD gives an overview on the Member States approaches. Energy efficient buildings are expected to be also buildings with low greenhouse gas emissions. The energy efficiency of buildings can be indicated by building classes on energy performance certificates, otherwise by comparing the energy performance to the national requirements or average values of energy demand/energy consumption.

The measurable benefits of energy efficiency in buildings include:

- Low energy consumptions
- Low energy costs
- Low greenhouse gas emissions (calculated based on the final energy consumption)

- High indoor comfort (if correctly planned and realised). Some Member States include indoor comfort requirements in the energy performance regulations, e.g. summer performance
- Higher building value

Answer 2

The keyword is actually, I believe, “efficiency”, i.e., a building may be called “green” with utilizing renewables but may still not function efficiently. And the definition definitely needs a baseline for claims of “efficiency enhancement”. In this regard, energy efficient building might be defined as buildings providing “same comfort (same comfort might be important for fair comparison) with less energy” where efficiencies in heating, cooling, appliances & electronics are in question.

Again, for fair measurement of efficiency level of a building, where all aspects are taken into consideration, the following issues should be assessed: “Life cycle assessment” and bringing forward some sort of “levelized cost of energy”, where all environmental/social/economic effects are analysed. Energy savings, CO2 reduction, any social effect regarding the use of renewables/CO2 reduction etc. might be output of these assessments.

Answer 3

The benefits of energy efficiency in buildings can be measured through various metrics that showcase the positive impact on individuals, society, and the environment. Key measurements include energy savings, cost savings, environmental impact, economic growth and job creation, economic growth and job creation, resilience and reliability, public awareness and engagement, long-term sustainability, regulatory compliance, and standards. By utilizing these metrics and conducting comprehensive assessments, we can gain a holistic understanding of the benefits of energy-efficient buildings.

Answer 4

In my view there is no single definition of what energy efficient buildings are. I think it is more useful to see energy efficiency as a process that helps us to reduce bills, reduce problematic dependencies and meet our climate goals - ultimately to reach net zero by 2050 for the whole EU, or even earlier in certain regions/countries.

There are tools in EU legislation that can help, if not to define efficiency, at least to set categories of energy efficiency buildings. These include: “Energy performance certificates” (EPCs) that classify buildings between A and G; zero-emission buildings and nearly zero-energy building, with obligations to apply them to specific building types; “minimum energy performance standards”, setting minimum thresholds that triggering renovation of existing buildings. All of these tools need to be updated regularly, to reflect advancements in technology and people’s needs.

Benefits of increased efficiency can be measured in several ways, including:

- As savings for individuals and companies, by reducing bills
- As energy independence and an improved trade balance for countries and territories
- As a concrete solution at the individual level to mitigate climate change
- As a way to boost competitiveness in domestic clean technologies and jobs

2. What are some of the main challenges and barriers to implementing energy efficiency measures in buildings? How can these challenges be overcome?

Answer 1

Barriers include:

- Lack of finance for investing in energy related renovation measures
- Lack of finance for investing in better performing new buildings
- Inconveniences due to renovation works
- Lack of knowledge at the side of building owners
- Lack of knowledge at the side of planners
- Lack of craftsmen

How to overcome challenges:

- Easy to apply funding measures
- One stop-shops
- Educating an training of owners, planners and craftsmen
- Less expensive costs
- Modular, pre-fabricated components to decrease implementation times
- Regulatory framework (tenant laws, minimum energetic standards)
- Efficient allocation of resources with modernization roadmaps

Answer 2

Retrofits might be costly and technically impossible or limited for some current buildings. Public awareness might not be sufficient or it might be limited to only some aspects of energy-efficiency in buildings.

Country-specific problems should be assessed and specific financial models should be developed. Public awareness should be increased.

Answer 3

Building energy efficiency implementation faces many obstacles. The main obstacles include:

large initial costs, lack of awareness, split incentives (when landlords invest in energy efficiency measures, tenants pay less for utilities. This could discourage landlords from renovating), limited access to financing, technical complexity, resistance to change, regulatory and policy barriers (inconsistent or unclear energy codes, regulations, and policies can create confusion and uncertainty for building owners and developers) lack of incentives, perceived aesthetics (building owners may be deterred by energy efficiency measures like insulation or solar panels due to their appearance).

A multifaceted approach is needed to address these obstacles:

financial incentives (grants, subsidies, and tax benefits lower energy efficiency upgrade upfront costs and make them more appealing to building owners), education and awareness, establishing finance systems that make it easier for building owners to get energy efficiency loans with good terms, technical assistance, develop techniques to involve renters in energy conservation efforts so landlords and tenants benefit from energy efficiency gains, clear laws, demonstrate successful energy efficiency initiatives through demonstration buildings, case studies, and tours to inspire others and show their feasibility and benefits, collaboration (work with governments, industry groups, nonprofits, and private sector stakeholders to establish comprehensive energy efficiency solutions to overcome barriers. Through financial incentives, education, regulatory improvements, and collaboration, we can make energy efficiency solutions more accessible, appealing, and broadly implemented across the building sector.

Answer 4

- Some of the main challenges and barriers to apply efficiency measures:
- Lack of awareness/knowledge by building occupants/owners but often also architects, engineers and entrepreneurs renovating/constructing buildings of the technologies and measures available to increase efficiency.
- Lack of skilled labor to install newest and most efficient heating & cooling systems, insulation, ventilation and other materials.

- High upfront costs to integrate high efficiency into construction and renovation. This is often linked to problems to get funding.

- Policies that don't incentivize efficiency, such as subsidizing fossil fuels and mainly taxing labor rather than goods.

3. How can the concept of energy efficiency be integrated into the broader concept of sustainable building design and construction? Are there any synergies or trade-offs between energy efficiency and other sustainability goals?

Answer 1

- Energy efficiency is part of sustainability. It covers the life cycle phase "use" and has to be accompanied by the assessment of the other life cycle phases such as production, disposal etc. There are CEN standards for performing life cycle analysis. Sustainability includes more goals than life cycle analysis, but LCA is an important part of it.
- Holistic LCA approaches can consider the sustainability of building concepts. Existing approaches should be integrated in the planning of buildings and their modernization.

Answer 2

LCA is a great tool to be able to determine this. For ex: one might have developed a perfect insulation material, which might look promising to be used in buildings. However, when considered the whole value chain of that material, the production/mining etc. stage, for example, might not be sustainable (high energy-intensive, CO2-emitting production pathway or limited/diminishing raw materials are used in production etc.). Whether this is the case or not is assessed by LCA.

A link might be connected between water sustainability, with a building concept where concepts like reduced water use, local (in-building) wastewater treatment, grey water utilization, compost formation and utilization etc.

Answer 3

Integrating the concept of energy efficiency into the broader framework of sustainable building design involves adopting a holistic approach from the beginning to the end of the project. This approach includes the implementation of passive design strategies, the optimization of the building envelope to minimize heat transfer and air leakage, the utilization of efficient HVAC systems, the integration of renewable energy sources, the selection of sustainable materials, and the consideration of water efficiency. Furthermore, the incorporation of energy efficiency extends beyond mere technical elements, emphasizing the active involvement of occupants, continuous monitoring, and careful consideration of the surrounding local environment. By integrating energy efficiency into the core principles of sustainable design, it becomes possible to create buildings that not only mitigate their

environmental footprint but also offer occupants places that are comfortable, healthy, and efficient. The implementation of a comprehensive approach guarantees that energy efficiency is in coherence with other sustainability goals, leading to the development of environmentally friendly and socially advantageous structures.

Energy efficiency in sustainable building design has synergies and trade-offs with other sustainability goals. Energy-efficient buildings frequently combine resource efficiency, interior environmental quality, renewable energy integration, climate adaption, and operational savings. Trade-offs might arise in initial costs, aesthetics, technological complexity, location constraints, and tenant behavior. Interdisciplinary collaboration and strategic decision-making are needed to optimize synergies and minimize trade-offs to ensure that energy efficiency improves sustainability without compromising building design and performance.

Answer 4

There is tension between the projected increase in the demand of materials and resources needed to make buildings efficient, and what this could do to the environment. It is necessary to prioritize the reduction of embodied carbon emissions (expected to be around 30% of total buildings emissions, with the remaining 70% being operational emissions), by taking measures like reducing concrete and metal use where possible, renovating rather than reconstructing buildings, favoring low impact natural materials like certified timber and straw, avoiding over dimensioned built spaces and supporting co-sharing.

4. **How can collaboration and partnerships between various stakeholders, such as building owners, government agencies, and energy providers, be fostered to accelerate the adoption of energy-efficient practices in buildings?**

Answer 1

- Legal requirements
- Funding
- Information
- Business models (tenant electricity, heat as a service, district energy systems and markets, usage of buildings flexibility)

Answer 2

Incentives are required by authorities, in order to provide support in terms of affordable loans for retrofitting. Moreover, decrease or exempt of taxes for activities towards refrofitting might be considered and presented to related government agencies.

Answer 3

This can be achieved by fostering shared goals, promoting transparent communication, offering incentives and support, building capacities through training, facilitating data sharing, aligning policies, showcasing successes, organizing collaborative projects, and networking events, engaging financial institutions, and recognizing achievements. By creating a collaborative ecosystem, stakeholders can collectively drive innovation, knowledge exchange, and the widespread implementation of energy-efficient measures, resulting in a more sustainable and energy-efficient built environment.

Answer 4

Governments should give industry and building owners certainty that efficiency measures are supported via loans and grants, while carbon alternatives are disincentivized (e.g. stop subsidies, start early to prepare integration of buildings to ETS system). Strengthen upskilling and reskilling in the construction sector, particularly at the level of installers, by increase spaces available, making trainings more attractive and also more flexible.

B) Examining stakeholder and/or country-specific social perceptions of energy efficient buildings

1. What are the current attitudes and perceptions of the general public towards energy-efficient buildings, and the key factors influencing such attitudes and perceptions?

Answer 1

- Lack of understanding of EE (definition, metrics), EPCs, etc.
- Economic concerns, e.g. affordability (short-term) vs benefits (medium/long-term).
- EE measuring needs data à fears related to lack of data privacy.
- Lock-in effects à evolution / adaptability of requirements vs existing solutions.
- Lack of co-design / co-creation (user-centred)?
- Energy crisis?

- Mixture between understanding the impact on the climate and rejection because of costs. With the war in the Ukraine more understanding because of higher energy tariffs and less gas availability.

- In general low willingness to pay for new technologies and building modernization. Different trends in the market:

    - Some people investing in modernization measures to save costs in times of increasing energy costs.

    - Some people reject new technologies and regulations

Answer 2

Cultural factors are important, in that regard, attitudes & perceptions might be country-specific.

High energy prices and so, inevitable necessity of saving approach, might strengthen positive perception towards energy-efficient buildings. This positive approach will surely be reinforced with incentives / affordable loans

As for Tükiye case; some aspects of EEB is welcomed by public, namely “enhanced insulation/jacketing for insulation to reduce heating costs in winter”.

Below are some notes from a Turkish survey on energy efficiency, a bit old (2013), yet still might give a clue of public approach:

- 90% believe that thermal insulation is very important in residences.
- “Energy efficiency is jacketing” is what is perceived by the public. 25% of people considers energy efficiency during buying a residence. Awareness is low.
- 82% people considers jacketing to be the best way of insulation. Most assume a 2 year payback duration and recommends this application to friends and colleagues.
- People think, white goods & appliances are to blame for the soaring energy prices
- 40% have insufficient information on EPC.

Answer 3

The general public's current attitudes and perceptions of energy-efficient buildings vary, with some recognizing the importance of energy efficiency for cost savings, environmental benefits, and comfort, while others may still prioritize initial costs or lack awareness of the long-term benefits. The level of public awareness and education about the benefits of energy efficiency, the perceived complexity of implementing energy-efficient measures, concerns about aesthetics or disruptions during renovations, the availability of incentives and financial support, as well as societal norms and cultural factors shaping attitudes toward sustainable practices, are all important influencing factors. Public attitudes can be impacted positively through targeted awareness campaigns, easily accessible information, clear demonstrations of benefits financial incentives, and community involvement in sustainable building initiatives.

Answer 4

Below is a list of a few general perceptions (P) on energy efficiency and factors/arguments that may influence (I) them towards better outcomes:

- (P): Renovating buildings is a personal choice and governments should keep off; (I): personal choices not only impact a person's energy bill and long term environment impacts. It can also have more immediate effect on energy security and grid reliability, prompting authorities act. The gas crisis in Europe is not over and a cold winter can force governments to make hard choices.
- (P): Building renovations are expensive; (I): EE upfront costs are often high, but returns of investment are largely positive over their operational life (20-25 years for heating systems and often longer for insulation material); (I) energy prices have increased sharply over the past 2 years (well above inflation) and are unlikely to fall anytime soon for gas, so the payback of EE measures should be shorter in many cases.

(P) New heating systems are less reliable/more complex than traditional ones (e.g. heat pumps don't heat as well as gas); (I) Many of these technologies have been used successfully for years in several countries; (I) EE solutions need to be tailor-made for a specific building.

2. How can stakeholders effectively communicate the benefits of energy-efficient buildings to the general public? What communication strategies and channels can be employed to raise awareness and change public attitudes?

Answer 1

- (Need for) Increasing knowledge of building user behaviours, in particular in terms of energy consumption.
- Find examples / good practices (energy communities?) and/or leverage on groups of people with most/shared interest:
    - Ageing ('before' Gen X)
    - Millennials (Gen Y)
    - Generation Alpha (Gen Z)
- Leverage on IT apps / Mobile apps? AI-based Apps?
- Demonstration of good examples. Guidance towards lower costs.
- The communication has not been successful in the past. People often only think of investment costs. Measures: Demonstration of examples (public buildings first), transparency, information events with guidelines for building owners.

Answer 2

Creating awareness at early ages (beginning from primary schools) is of significance.

Illustration of EEB effects though animations might be useful. In these animations, several scenarios/cases of EEB might be considered.

Emphasis on the fact that this is more public-oriented compared to renewables

Best practices, pilot demonstrations should be carried out and promoted.

Some legal enforcements might do good, too.

Answer 3

Stakeholders may effectively communicate the benefits of energy-efficient buildings to the general public by using simple and relatable messaging that emphasizes tangible benefits such as reduced energy bills, increased comfort, and less environmental impact. Benefits can be made more applicable by engaging real-life case studies, and realistic examples. To express difficult concepts, strategies for communication must focus on simplicity, using jargon-free language and visual aids. A multi-channel approach is required to promote awareness, including the use of social media, websites, educational materials, public events, and partnerships with local community organizations. Collaboration between governments, industry associations, non-profits, and media sources can strengthen messaging, and create a consistent narrative, ultimately reshaping public attitudes and promoting the widespread adoption of energy-efficient practices in buildings.

Answer 4

Suggestions to communicate EE benefits:

- Apply high EE standards in public buildings (schools, hospitals, local administration, etc) and communicate on it where possible
- When covering costs of living, the press could focus more on available solutions, including concrete examples to save with EE. Public administration can better communicate on local/regional/national EE support programs.
- Incentivize voluntary labels and local competitions for EE in businesses, industry, etc.

Education is schools on energy saving measures.

3. **Are there any successful examples of public engagement and education campaigns that have effectively shifted public attitudes towards energy-efficient buildings? What lessons can be learned from these initiatives?**

Answer 1

- (Leverage on) existing energy communities & how to cluster users having interest on EE.
- New European Bauhaus? (Beautiful/aesthetics, Sustainable, Together/inclusive)
- Lessons:
    - Standardise sets of data? Standardise user interfaces? For users with specific needs?

Answer 2

Integrating pupils in energy renovation of schools. Demonstration of energy efficiency in public buildings. Energy performance certificates.

Answer 3

The campaign to substitute old incandescent lightbulbs by led equipment has been successful. Other parallels can be made with campaigns to separate domestic waste. It is important to communicate simple key messages to as many people as possible, using local channels where possible. Promote one stop shop EE advice services and audits at local/regional level.

4. **What role can policymakers and government agencies play towards energy efficiency in buildings? How can they collaborate with industry stakeholders to create a supportive environment for energy-saving practices?**

Answer 1

- EU taxonomy for sustainable investments (including EE).
- Setting and explaining minimum energy performance requirements to citizens in an understandable way, supported by easy to apply funding mechanisms and tax reductions. Funding of further demonstration and research in energy efficient buildings. Cross evaluation of current demonstration and research projects.
- Set the regulatory framework for new business models. Support energy efficient technologies with funding. Organize events for information dissemination of building modernization in local neighbourhoods.

Answer 2

Incentives & affordable credits are a must.

Semi-autonomous building companies might be more practical in the implementation of projects on energy-savings in buildings.

Answer 3

By shaping regulatory frameworks, incentives, and guidelines, policymakers and government agencies play a vital role in advancing energy efficiency in buildings. They can establish and enforce energy codes and standards, provide incentives for energy-efficient retrofits, and encourage the integration of renewable energy. They can adopt a supportive environment by engaging in open dialogues to align policies with industry needs, providing financial incentives and tax benefits for energy-efficient initiatives, supporting research and development of innovative technologies, and facilitating

collaboration between the public and private sectors. Through these partnerships, policymakers and government agencies can promote market transformation, encourage investment in energy-efficient practices, and pave the way for a sustainable built environment.

Answer 4

Government should actively support businesses that either work or wish to work in the EE sector. For manufacturers of EE products, this can include giving grants and loans, as well as using public procurement to renovate their buildings. Flexibilities in EU state aid policy and new EU funding channels should also be explored by local and regional authorities.

Brussels - 2024

Following the Study Tour at energy efficient buildings in Brussels, participants are asked to answer the following discussion questions. This working document aims to gain a comprehensive understanding of social attitudes towards energy efficient buildings/Nearly Zero Energy Buildings (NZEB). The goal is to investigate the reasons behind these attitudes, identify strategies to address negative perceptions, and ultimately develop recommendations for future actions to promote energy efficient buildings.

A) Focusing on the People-Centric Approach to Energy-Efficient Buildings

1. How do you define an energy-efficient building, and what specific features contribute to this definition from a user perspective?

Answer 1

Energy-efficient buildings are designed to minimize energy consumption while maintaining comfort and functionality. There are a multitude of features which contribute to an energy-efficient building, including high-performance insulation, energy-efficient windows, and advanced heating, ventilation, and air conditioning (HVAC) systems.

Ultimate optimization requires sensors, controls, software, and interfaces to optimize lighting, Heating, Ventilation, and Air Conditioning (HVAC), shading, security, and other essential building systems. Building Automation and Control Systems (BACS), as the brain of the building play a crucial role. BACS significantly increases overall building efficiency while optimizing the functioning of the technical building systems and services.

Answer 2

From an end user, an energy efficient building is a very cheap one to live in / operate. The features that make it efficient also make it more livable e.g., insulation to protect the user from excessive temperatures, clean heating and cooling that also removes humidity from the air, correctly sized radiators etc.

Answer 3

An energy-efficient building is one that optimizes energy use while ensuring a comfortable and healthy environment for its occupants. From a user perspective, such a building typically incorporates high-performance insulation and energy-efficient windows and doors, which work together to maintain stable indoor temperatures and reduce the need for heating and cooling. Additionally, efficient HVAC systems

are essential, as they not only lower energy consumption but also ensure good indoor air quality and reliable temperature control. These features collectively contribute to lower energy bills, enhanced comfort, and a reduced environmental footprint, all of which are critical for users seeking both economic and environmental benefits.

2. **How should we effectively measure and communicate the benefits of energy-efficient buildings to building inhabitants and the broader community?**

Answer 1

To effectively measure and communicate the benefits of energy-efficient buildings to inhabitants and the broader community, it is essential to focus on both quantitative metrics and qualitative impacts. Quantitative Metrics like Energy Consumption Data can be acquired using Building Automation and Control Systems (BACS) to track and analyze real-time energy usage, showcasing reductions in energy consumption and cost savings. Environmental Impact can be Measure and reported through reductions in carbon emissions and resource use.

Qualitative Impacts like Comfort and Health Benefits can be highlighted by Communicating how energy-efficient buildings enhance indoor air quality, temperature regulation, and overall comfort. Share occupant satisfaction surveys and testimonials. Cost Savings can be Illustrated through long-term financial benefits, including reduced utility bills and maintenance costs. Provide case studies or examples of buildings with proven savings.

By combining detailed data with clear, accessible communication, the benefits of energy-efficient buildings can be effectively conveyed to all stakeholders.

Answer 2

The best if to gamify the process, comparing the expenses along with other economical indicators (e.g., resale/rent value). This needs to be coupled with suggestions and simulations of improvements and their benefits (e.g., the PEB certificate in Brussels).

Answer 3

Effectively measuring and communicating the benefits of energy-efficient buildings to inhabitants and the broader community requires a multifaceted approach. Quantitative metrics such as energy savings, reduced utility costs, and lower carbon emissions should be clearly presented through regular reports, dashboards, or smart home interfaces that are easily accessible to users. Additionally, qualitative benefits, including improved indoor air quality, enhanced comfort, and increased property value, should be highlighted through case studies, testimonials, and community outreach programs. Engaging educational campaigns and transparent data sharing can further empower occupants and the community to understand and appreciate the long-term economic and environmental advantages of energy-efficient buildings. By combining clear communication with tangible data, the broader impact of energy efficiency can be effectively conveyed, fostering greater adoption and support.

3. **How can energy efficiency be integrated into the overall concept of sustainable living and building design in a way that matches the values of society?**

Answer 1

Integrating Energy efficiency into the overall concept of sustainable living and building design involves energy-saving strategies with broader environmental, economic, and social goals.

For example, the prioritisation of health and wellbeing in building design should reflect the change that we want to see in society and its values. Indoor Environmental Quality measures requiring buildings to optimise thermal comfort, air quality, acoustics and lighting, is a prime example of improving standards, for the benefit of the occupant and the planet.

Align with Environmental Values through emphasizing the reduction of the Carbon footprint and promoting resource conservation. Support economic Values through a focus on cost savings and economic growth through clean jobs.

Answer 2

In the design of new buildings this is quite easy to achieve, it is in the renovation of older dwellings where a balance needs to be attained.

Answer 3

Integrating energy efficiency into the broader concept of sustainable living and building design requires aligning it with societal values such as environmental stewardship, economic responsibility, and community well-being. This can be achieved by designing buildings that not only minimize energy consumption but also utilize renewable resources, reduce waste, and support healthier lifestyles. Energy-efficient practices should be part of a holistic approach to sustainability that includes water conservation, sustainable materials, and green spaces, thereby enhancing the overall quality of life.

Education and engagement are crucial in ensuring that these practices resonate with societal values, emphasizing the role of energy efficiency in mitigating climate change, reducing costs, and promoting social equity. By framing energy efficiency as a key component of a sustainable, responsible lifestyle, it can be seamlessly integrated into the values and aspirations of society.

4. **What role can local community initiatives and partnerships play in accelerating the adoption of energy-efficient building practices?**

Answer 1

Local community initiatives play a significant role in accelerating the adoption of energy-efficient building practices. Citizen-driven energy actions that contribute to the clean energy transition, advancing energy efficiency within local communities, given us the power to better our own communities, from the bottom

up. Educational Programs through Local initiatives can offer workshops, seminars, and training sessions to educate residents, builders, and policymakers about the benefits and techniques of energy-efficient building practices. Information Campaigns through Community groups can run awareness campaigns that highlight success stories, share practical tips, and demystify energy efficiency concepts.

A collective sense of environmental responsibility and pride will be crucial in achieving Europe's goals on carbon neutrality. Grassroots initiatives install confidence in communities, affording locals the capacity to reduce and regulate their energy consumption.

Answer 2

Small suggestions and assistance into make them available to the whole community would ensure that the initiative can start a process of deeper renovation.

Answer 3

Local community initiatives and partnerships play a crucial role in accelerating the adoption of energy-efficient building practices by fostering collaboration, raising awareness, and providing resources that make energy efficiency more accessible. Community-based programs can educate residents and businesses about the benefits of energy-efficient technologies, offer incentives for upgrades, and support the implementation of best practices through workshops, demonstrations, and local case studies. Partnerships between local governments, businesses, non-profits, and educational institutions can further amplify these efforts by pooling resources, offering financial incentives, and advocating for supportive policies. By leveraging the collective influence and resources of the community, these initiatives can create a groundswell of support for energy efficiency, making it a standard practice in building design and renovation, while also contributing to broader sustainability goals.

B) <u>Examining Social Perceptions and Engagement Strategies</u>

1. **How do various socio-economic and cultural factors influence perceptions and attitudes towards energy-efficient buildings across different demographics? You can provide examples from countries you know.**

Answer 1

Socio-economic and cultural factors can significantly influence perceptions and attitudes towards energy-efficient buildings across different demographics.

During a recent trip to Sonderborg, Denmark, I witnessed firsthand the ongoing commitment to energy efficiency initiatives at both local and national levels. Neighbouring the Danfoss's headquarters in Nordborg is the city of Sønderborg. With the continued support of the Danfoss Foundation, Sønderborg is striving for carbon neutrality by 2029. A local initiative labelled ProjectZero focuses on sustainable growth in the city while creating green jobs and improving the inhabitant's lives. The example above

illustrates Denmark's continued commitment to energy efficient practices at local and national level. Conversely, misconceptions surrounding energy efficient buildings have surfaced in recent years. For example, the pushback from Italian politicians during the negotiation stages of the recast EPBD, reflected their scepticism, and the effectiveness of the Directive. High upfront costs, limited impact and a sacrifice of comfort were among the main worries communicated by Italy.

Comparing the Denmark and Italy, cultural and socio-economic factors determine the emphasis each Member State puts on energy efficient buildings. In wealthier regions, such as Scandinavian countries (e.g., Sweden, Denmark), there is often a higher adoption of energy-efficient technologies due to greater financial resources and government incentives. In contrast, in lower-income areas, the high initial costs of energy-efficient upgrades can be a barrier. For the energy-efficient buildings to be introduced, we must showcase the benefits through smart tools, guidelines and smart technologies.

Answer 2

I am not sure there are many differences between countries except the economical one. Based on purchasing power parity, it is more difficult to attain the tools necessary for making the building energy efficient.

Answer 3

Various socio-economic and cultural factors significantly influence perceptions and attitudes towards energy-efficient buildings across different demographics. In affluent communities, where financial resources are more readily available, there is often a stronger emphasis on the long-term cost savings and environmental benefits associated with energy-efficient buildings. These groups may prioritize advanced technologies and sustainable practices as part of their lifestyle choices. Conversely, in lower-income demographics, the initial cost of energy-efficient upgrades may be a barrier, even though these investments can lead to substantial savings over time.

Cultural factors also play a critical role. For instance, in Italy, historical and aesthetic values are deeply ingrained in the building practices of many communities. The preservation of architectural heritage is a priority, which can sometimes slow the adoption of modern energy-efficient technologies that are perceived to conflict with traditional designs.

However, in regions like Trentino-Alto Adige, there has been a successful integration of energy efficiency into traditional Alpine architecture. Here, the combination of local government incentives and community-led initiatives has encouraged the adoption of energy-efficient practices without compromising cultural identity. This example highlights how cultural respect, coupled with targeted socio-economic support, can positively influence the acceptance and implementation of energy-efficient building practices across diverse demographics.

2. **Which of the buildings we visited in Brussels did you find the most effective and practical example? Or, what was your highlight?**

Answer 1

In my opinion, the Plume in the Marolles district of Brussels was the most impressive and effective example of energy-efficiency. Named an exemplary building by Bruxelles-Environnment, the complex contained a double-flow ventilation unit with individual heat recovery in each flat, coupled with 12 photovoltaic panels of 330 Wp.

A district that was once a victim of urban decay in the 20th century, Marolles is now at the forefront of the Brussels' energy transition. For this reason, visiting the lodgements on Rue de la Plume was one of the highlights of the IWG5 study tour.

Answer 2

All buildings seem to achieve their targeted results.

Answer 3

I participated in the Tour of Energy Efficient Buildings with a People-Centric Approach in the Marolles District and found the Cité Hellemans particularly interesting for its historical significance and its status as a visually appealing, historic social housing project. However, despite its charm, it is not the most effective or practical example of an energy-efficient building. The heating system is collective gas, the cookers are also gas-powered, and it's indicative Energy Performance Certificate (EPC) rating is G, which is far from ideal.

In contrast, I found the Plume building to be an excellent example of energy efficiency. It is a passive building, designed to achieve thermal comfort with minimal heating and cooling through features such as insulation, airtightness, well-designed windows and doors, ventilation systems with heat recovery, and the elimination of thermal bridges. Additionally, it has an electric cooker, an indicative EPC rating of A, a double-flow ventilation system, and photovoltaic panels. The complex is also visually appealing and spacious.

3. **What innovative collaboration models can be developed between government entities, industry stakeholders, and community groups to foster a supportive ecosystem for energy-efficient practices?**

Answer 1

Joint industry research initiatives, where government bodies and academia collaborate to produce to develop energy-efficient technologies and practices, will certainly aide the advancement of a carbon-neutral society. This initiative, coinciding with energy-orientated consulting firms who provide advice and recommendations to stakeholders and house owners, will surely foster a supportive ecosystem for

energy-efficient practices.

Energy communities, which generate, consume and distribute renewable energy, are another example of an innovative collaboration model.

Furthermore, when visiting Greenbizz.brussels, it further resonated with me the importance of these communities. The synergy on display among the 44 businesses in this building is a prime example of the cooperation that the energy industry requires moving towards the implementation process.
Community groups can work with local governments and businesses to create programs that address specific local needs. For instance, a neighborhood association might partner with a local utility company to implement a home energy audit program and offer discounts on energy-efficient upgrades.

Answer 2
More free support.

Answer 3
Innovative collaboration models between government entities, industry stakeholders, and community groups are essential for creating a supportive ecosystem for energy-efficient practices. One effective model is the establishment of public-private partnerships (PPPs), where government agencies collaborate with private companies to fund and implement energy-efficient projects. Governments can provide regulatory frameworks, financial incentives, and grants, while industry stakeholders offer technical expertise, innovative solutions, and scalable technologies. Community groups, in turn, can play a key role in outreach, education, and ensuring that local needs and values are addressed.
Another model is the creation of energy efficiency hubs or innovation clusters, where government, industry, and community representatives co-locate to work on shared goals. These hubs can facilitate knowledge exchange, joint research and development, and the piloting of new technologies in real-world settings.

For example, in some cities, local governments have partnered with energy companies and neighborhood organizations to develop "energy transition zones" where new technologies are tested and refined before broader implementation.

Collaborative platforms that bring together these diverse stakeholders can also be instrumental. These platforms can host forums, workshops, and joint planning sessions, fostering transparency and mutual understanding. Through such collaboration models, all parties can contribute to a more cohesive and effective approach to promoting energy efficiency, ensuring that the benefits are widely distributed and aligned with broader sustainability goals.

4. **Do you think there are advanced data analytics and segmentation techniques that can be used to customize communication approaches for different community groups and stakeholders?**

Answer 1

Advanced data analytics and segmentation techniques can be invaluable in customizing communication approaches for different community groups and stakeholders.
By analyzing past data, predictive models can identify trends and patterns that can be used to forecast future behavior or outcomes. This can help tailor communication strategies to anticipate needs and preferences. For example, residential users with high energy consumption might receive targeted messages about cost-saving measures, while businesses might get information on energy-efficient upgrades and their financial benefits.

Furthermore, the segmentation of various demographics will prove crucial in understanding various stakeholders. The division of the population based on age, geographic location, income, gender etc. will highlight the demographics that need more attention. For instance, younger audiences might engage more with digital campaigns and social media, while older demographics might prefer traditional media or community events.

Localized Messaging: Leverage GIS tools to analyze geographic data and create localized communication strategies. For example, areas with higher energy usage could be targeted with information about energy-efficient solutions that address local climate conditions and building types.

Answer 2

I think sometimes we use to many resources on communication rather than concreate action. Improve the lives of the people living in a building and they will become the ambassadors of the campaign.

Answer 3

Yes, advanced data analytics and segmentation techniques are highly effective in customizing communication approaches for different community groups and stakeholders. By leveraging big data and machine learning, organizations can analyze demographic, behavioral, and psychographic data to identify specific preferences, concerns, and motivations within different segments of the population. This allows for the creation of targeted messaging that resonates with each group's unique values and priorities.

For instance, data analytics can reveal that younger, environmentally conscious individuals are more likely to respond to messaging that emphasizes the environmental impact and sustainability of energy-efficient practices. On the other hand, older homeowners or lower-income groups might be more concerned with immediate cost savings and the long-term financial benefits. By segmenting these groups and tailoring communication strategies accordingly—whether through social media campaigns, community workshops, or direct mail—organizations can more effectively engage diverse audiences.

Moreover, predictive analytics can be used to anticipate the needs and concerns of different stakeholders, allowing for proactive communication strategies. For example, if data indicates that a particular community is concerned about the aesthetic impact of energy-efficient retrofits on historical buildings, communication efforts can focus on showcasing examples where energy efficiency has been successfully integrated with preservation efforts.

Overall, these advanced techniques enable more personalized and relevant communication, increasing the likelihood of adoption and support for energy-efficient practices across various community groups and stakeholders.

Valencia - 2025

Following the Study Tour at Imagine Montessori School and information gathering about Barrio La Pinada in Valencia.

This working document aims to gain a deeper understanding of the design, cultural, and societal aspects that shape the implementation and acceptance of sustainable buildings and lifestyles. The goal is to identify opportunities, challenges, and best practices related to sustainable architecture - particularly in Mediterranean and urban contexts- while also exploring how sustainable living can be mainstreamed in future developments.

C) <u>Designing for Sustainable Architecture and Living</u>

5. What key design principles define truly sustainable architecture in your opinion, especially in the context of the Mediterranean climate?
(Consider elements like passive design, local materials, urban integration, and biodiversity.)

Answer 1
Cross ventilation, solar protection, water management (catchment, reuse…), green roofs or walls (biodiversity, rain, isolation), creating public spaces as climate refuges, promoting bike lanes and parking instead of car's facilities.

Answer 2
I think that low tech, passive and life cycle analysis are key principles to define sustainable architecture as we have seen in Montessori school with the use of "boveda catalana" to minimize the use of concrete and steel.

Answer 3
- Passive design strategies such as cross-ventilation, thermal mass, shading devices reduce reliance on mechanical cooling; provide free cooling/night ventilation
- Local and natural materials such as limestone, clay, and timber reduce embodied energy and

blend with the landscape

- Compact urban design reduces car dependency and fosters walkability and social interaction
- Incorporate native vegetation and wildlife corridors helps to maintain ecological balance, biodiversity and microclimates. It is also healthy for the residents.

6. **How can architects and urban planners ensure that sustainable buildings are also inclusive, accessible, and adaptable to diverse user needs over time?**

Answer 1

Considering the range of circumstances we are aware of nowadays (mobility, acoustic or visual accessibility, for example), just as designing some key elements flexible enough so that they could be modified in the future if needed.

Answer 2

I should not depend only on them but on the regulation learing form best practices like the school visited to improve legal requirements and support their implementation.

Answer 3

- Early involvement of diverse user groups in the planning process
- Universal design, step-free access, wide doorways, and modular and flexible spaces ensure usability for all ages and abilities and changing needs (e.g. remote work)
- Use of smart technologies and adjustable systems that offer personal comfort while conserving resources.

7. **What role does the integration of green spaces (e.g. rooftop gardens, green facades, community gardens) play in promoting sustainable living in dense urban environments?**

Answer 1

I find them key elements that boost biodiversity, water catchment, air purification, isolation… as well as some social benefits like community life, and connection and sensitivity to nature in the middle of artificial spaces like urban areas.

Answer 2

Greenspaces are fundamental in promoting sustainable living in urban environment like Valencia city area, as they are needed to reduce the Heat Island effect and adapt to heat wave and connect the citizen directly with nature and its benefits.

Answer 3

- Reduces urban heat islands and improves air quality
- Common gardens and green roofs promote a sense of community and reduce stress
- Green roofs and permeable gardens are important for rainwater management

- Enables community farming.

8. In your view, how can architecture promote behavioural change towards more sustainable lifestyles within residential communities?

Answer 1

Being intentional towards a low energy use, green spaces, bike use, community life, natural and local materials, renewable energy, re-connection with nature… are values and priorities that could be the core of modern residencies at an architectural level, thus influencing and inspiring inhabitants to align themselves with their homes.

Answer 2

By designing space within and around buildings that allow and facilitate these changes, else people won't change (For instance sharing a living room, or a washing room to use less resources and found social benefits).

Answer 3

- Visibility of green technology fosters identification among residents
- Community gardens, bike parking spaces or car-free courtyards promote sustainable habits
- Smart meters and dashboards help residents adjust energy and water consumption
- Green living shown as aesthetically pleasing makes sustainability desirable, not only functional.

D) <u>Strategies for Fostering Sustainable Living</u>

1. What are the most common social or cultural barriers to the adoption of sustainable architecture, and how can we address them through design and communication?
(You may include examples from your region or country.)

Answer 1

I would say that the high cost of sustainable buildings is the main barrier for Mediterranean citizens to shift from "cheap", fast-construction and low-quality houses, to sustainable ones. The Mediterranean region is experiencing a serious problem of access to housing, especially marked in young people and urban areas.

Besides, the mainstream building sector is still not aligned to sustainable values, and it requires a huge effort to go against the flow.

We need to decrease costs and mainstream sustainability between the citizens and the building sector.

Answer 2

Rejection of green areas for being more dirty and not solving other problems (parking and mobility issues,

noise from use of green area), design in this case should include properly define participatory process with neighbors to understand their needs and avoid rejections.

Answer 3

- Perception of higher costs --> Inform building owners of the lifetime savings and long-term value, use cost-effective passive design
- Reliance on traditional aesthetics and resistance to change --> pilot projects or demonstration homes to build trust and awareness and subtly integrate sustainable features into familiar forms
- Examples from Germany: International Building Exhibition (IBA) Hamburg showcases sustainable living models in practice; Vauban District in Freiburg balances conservation with innovation.

2. **Which feature during the Valencia Study Tour best demonstrated a holistic approach to sustainability? Why did it stand out to you?**

Answer 1

I just participated in Montessori School's visit. It was a great example of how sustainability and rational costs could be integrated.

Answer 2

The Catalan vault was a good example of traditional, low tech and low cost low emission solution, recovering a local know how from the area.

Answer 3

- Imagine Montessori School stands out for its bioclimatic design and integration of nature into the learning environment. It demonstrates a holistic approach by combining energy/water efficiency with education and indoor/outdoor well-being.
- Barrio La Pineda plans its focus on community regeneration and resilience. By integrating social housing, public space, and ecological restoration, it wants to show how sustainability can address both environmental and social needs in a cohesive way.

3. **How can circular economy principles (e.g. reusing building materials, minimizing construction waste) be more effectively integrated into mainstream construction practices?**

Answer 1

Through certification, economic incentives or penalties, market innovation, sensibilizing about real and interesting alternatives instead of mainstream and polluting ones…

Creating a public platform where clients interested in sustainable companies related to architecture and construction can find a detailed list of candidates certified through their past projects and practices that align with these kinds of values.

Answer 2

By making proper regulation enforceable, training and funding mainstream construction actors for that purpose.

Answer 3

- Material passports can track material origin and future reuse potential
- Use of connections that allow easy separation and repurposing (design for disassembly)
- Encourage on-site recycling (e.g. concrete crushing, timber reuse)
- Build partnerships with suppliers to encourage take-back programs or leasing of building components.

4. **What types of policy support or incentive structures are most effective in encouraging sustainable architecture and community-based living models?**

Answer 1

Public housing with affordable costs for young people that increases accessibility to housing as well as lead by example using sustainable architecture principles.

Answer 2

First subvention pilot projects not only hardware but as well community building, training and mentoring process along the project (this is not cost effective and won't be) and then scaling up through for instance the development of One Stop Shops for energy transition and sustainable living like the energy office of Valencia and program to support community based transition projects n real environment not only new eco neighborhood.

Answer 3

- Tax benefits or subsidies for retrofitting, green roofs, solar panels, low-carbon materials, etc.
- Building performance standards
- Support of cooperative housing and local energy initiatives (grants).