BOOK OF PROCEEDINGS

2nd INTERNATIONAL CONFERENCE ON HOUSING, PLANNING, AND RESILIENT DEVELOPMENT OF THE TERRITORY

TOWARDS EURO-MEDITERRANEAN PERSPECTIVES

OCTOBER 16th-17th, 2025

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2nd International Conference on Housing, Planning, and Resilient Development of the Territory

Towards Euro-Mediterranean Perspectives

Conference Theme and Rationale

This conference returned for the second time within the Albanian and Mediterranean academic context, aiming to build a tradition of collaboration centered on scientific research and academia. Following the success of the first edition held on October 13th-14th, 2023, where proceedings were published in the Book of Proceedings, Albanica journal, and various international academic platforms, POLIS University and the Academy of Sciences of Albania relaunched this important event. The 2025 edition focused on housing, urban planning, and resilient territorial development, offering a platform for researchers, policymakers, and experts from the region and beyond.

Albania and the Western Balkans have faced major transformations in urbanization, spatial planning, and environmental management. Demographic changes, economic pressures, and environmental challenges created a need for new strategies in architecture, planning, and governance. This conference brought together diverse voices to explore these themes and promote resilient and sustainable development.

Key topics included architecture and the city, with emphasis on urban form, housing typologies, and the role of cultural heritage in modern urban design; urban mobility, addressing traffic challenges, public transport, and the use of technologies like GIS and AI in planning; and new housing models, focusing on affordability, energy efficiency, and innovative materials.

Discussions also covered demography and economy, exploring territorial governance, smart cities, social enterprises, and digital technologies such as AI, VR, and the Metaverse in urban management. Finally, the urban and natural environment was addressed through topics like pollution, adaptive planning, and nature-based solutions for climate resilience.

Through this conference, POLIS University and the Academy of Sciences of Albania aimed to foster a broad interdisciplinary debate on these pressing issues, combining academic and practical perspectives to offer concrete recommendations for future urban and territorial development policies and projects.

Organizers' Announcement

The International Scientific Conference on Housing, Urban Planning, and Resilient Territorial Development: Toward Euro-Mediterranean Approaches was held on October 16th-17th, 2025, in Tirana, Albania. Organized by POLIS University in collaboration with the Academy of Sciences of Albania and supported by national and international partners, including the University of Ferrara and Co-PLAN, Institute for Habitat Development, the event brought together researchers, academics, policymakers, and professionals to address key challenges in urban development, with a focus on resilience and sustainability in the Euro-Mediterranean region. The first day of the conference took place at the Academy of Sciences, while the second day was hosted at POLIS University.

The conference explored five main themes:

I. Architecture and the City, which investigated the typological and morphological dimensions of urban form, the evolution of collective and individual housing types, the relationship between architectural design and urban identity, and the role of historical and cultural heritage in shaping contemporary cities;
II. Urban Mobility and Resilient Cities, which addressed traffic congestion, infrastructure challenges, and public transportation, while also promoting the redesign of public spaces – such as streets, squares, and pedestrian zones – to improve accessibility and mobility; it also explored the integration of digital technologies like GIS, AI, and simulation tools to enhance planning, automation, and infrastructure management;
III. New Housing Models, which examined innovative approaches to affordable and social housing in response to demographic shifts and technological change, along with energy efficiency strategies, passive energy systems, and the application of new sustainable materials and construction technologies;
IV. Demography and Economy, which focused on macro-regional and national dynamics impacting territorial development, including urban governance, disaster risk reduction, and the rise of smart and inclusive cities; it also explored how emerging technologies – such as AI, VR, and the Metaverse – along with social enterprises and circular economy practices, could foster more equitable and adaptive urban systems; and
V. Urban and Natural Environment, which analyzed environmental degradation in urban settings, including air, water, and soil pollution, and promoted nature-based solutions, ecosystem-based planning, and adaptive strategies to enhance environmental sustainability and climate resilience.

The conference was conducted in English and Albanian (with self-translated texts where applicable) and was free of charge, with all registration fees fully covered by POLIS University in support of open academic exchange. Key deadlines included abstract submission by June 15th, acceptance notification by June 30th, first draft of papers by September 15th, and final submissions by October 31st.

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The Price of Progress: Unveiling the Environmental Cost of Urbanization in Tirana through Life Cycle Assessment

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Abstract

Urbanization in Tirana, like in many rapidly growing cities, poses significant environmental sustainability challenges – particularly within the construction sector. This study conducts a cradle-to-grave Life Cycle Assessment (LCA) of a representative residential building to quantify its energy use, material flows, environmental impacts, and external (eco-)costs throughout its life cycle. The analysis reveals that the production phase – dominated by materials like concrete, cement, and bricks – accounts for the majority of the impact, contributing €146.95 per m², or approximately 89% of total eco-costs. The operation phase, including energy and water consumption, adds €6.19 per m², while the end-of-life stage, particularly landfilling of inert waste, contributes €11.99 per m². In total, the life cycle eco-cost amounts to €165.12 per m² of gross floor area, representing approximately 13% of the direct purchase cost (€1275/m²). These findings highlight the critical environmental burden of current urbanization patterns, emphasizing the need for circular construction practices, energy-efficient building design, and adaptive reuse strategies in Tirana's housing sector. By quantifying environmental externalities in monetary terms, the study supports data-driven policy interventions aligned with Albania's sustainability goals and the broader transition to resilient, low-impact urban development in the Western Balkans.

Keywords

Life Cycle Assessment (LCA), eco-costs, urbanization, residential construction, Tirana

1. Introduction

The construction industry has a profound impact on the economy, society, and the environment (Sev, 2009). Worldwide, the built environment (buildings and infrastructure) is the fundamental component of economic and social development (Huang et al., 2018). The sector accounts for a substantial share of GDP and employment in both emerging and developed countries (Lopez, 2012). As a key contributor to economic prosperity and job creation, it is vital to achieving national social and economic goals (Serogina et al., 2022). Furthermore, it acts as an important economic multiplier, driving demand in adjacent areas such as manufacturing, transportation, and finance, broadening its impact across the economy (Ive and Gruneberg, 2000). However, the built environment (both residential and commercial structures) involves consuming enormous amounts of natural resources (Rao et al., 2025), thus contributing to environmental emissions and associated ecological burdens (Sandanayake, 2022). Material extraction, processing, and transportation for construction activities alone drive substantial levels of embodied energy and carbon emissions, with concrete and steel being among the most resource-intensive materials (Li et al., 2025). According to European Environment Agency data, the European Union the buildings sector accounted for 34% of all energy-related emissions in 2022.

The total life cycle energy consumed by a building is classified into operational energy and embodied energy (Abouhamad and Abu-Hamd, 2021). Even while emissions associated with building operations are declining due to improved energy efficiency and decarbonised energy sources, the production of building materials still has a significant environmental impact (Li et al., 2024). Therefore, it is suggested that life- cycle thinking be used as a crucial instrument in attempts to appropriately address the ecological impact of the construction industry (Buyle et al., 2013). Life-cycle assessment (LCA) is known to be one of the most comprehensive assessment tools for the analysis and prediction of multiple environmental impacts of the construction industry (Sala et al., 2021).

Beyond environmental issues, construction activities also impose notable social costs. These include the adverse impacts on nearby residents and communities during project implementation, which are often overlooked in conventional cost assessments (Çelik et al., 2019). The external environmental costs of the construction sector – those borne by society and ecosystems rather than by developers or end-users – are increasingly acknowledged. These costs represent a substantial component of the industry's total environmental burden (Allacker and De Nocker, 2012). Therefore, the use of monetized life cycle assessment (LCA) is becoming more popular as a way to promote more environmentally friendly decision- making in the building industry (Durão et al., 2019). Monetization refers to the process of expressing environmental impacts – such as emissions or resource use – in monetary terms, thereby allowing for direct comparison between environmental and economic trade-offs (Krieg et al., 2013).

Tirana, the capital of Albania, exemplifies the tension between rapid urban growth and sustainable development. However, rapid and often unregulated urbanization since the early 2000s has resulted in profound changes in land use, environmental conditions, and urban structure (Haxhiu and Aliaj, 2025). While the expansion of Tirana’s built environment has contributed to economic

growth and urban modernization, it has also raised critical concerns about the hidden environmental and social costs embedded in this rapid development.

So, what is the price of progress? To uncover these hidden burdens, this study conducts a cradle-to-grave Life Cycle Assessment (LCA) of a representative residential building in Tirana, intending to quantify the building's external environmental (eco-)costs per square meter (€/m²). By enabling a direct comparison between financial expenditures (i.e., direct purchase cost in €/m²) and ecological trade-offs, the analysis offers a more comprehensive and integrated perspective on the true cost of urban development.

2. Materials and methods

2.1. Goal and scope

The goal of this study is to conduct a monetized life cycle assessment (LCA) to determine the environmental impacts and associated ecological costs of a typical residential building in Tirana. Eco-costs are "*hidden environmental costs for society that are not part of the market price"* (the so-called 'external costs'). The system boundaries for this analysis are defined as cradle-to-grave, encompassing all stages of the building's life cycle from the initial extraction of raw materials to its final disposal (Figure 1).

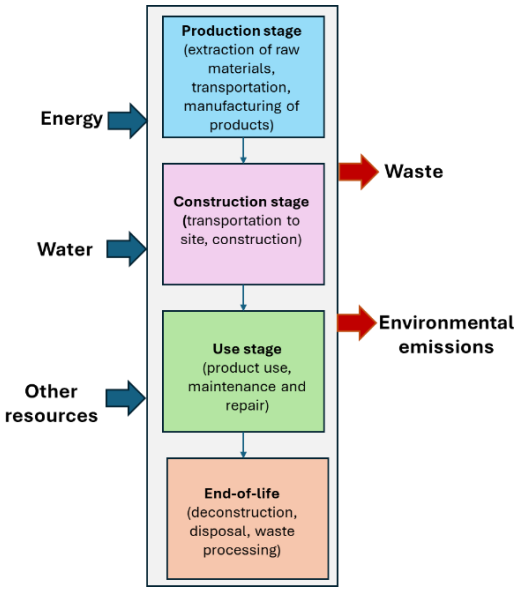

Figure 1. *System boundaries for the building life cycle assessment (LCA), structured according to EN 15978/ISO 21930.*

The functional unit is one square meter (1 m²) of gross floor area, assessed over a reference service life of 50 years. The analysis focuses on a multi-storey reinforced concrete building, representative of residential developments built in Albania after 2000, and incorporates the construction materials and technologies commonly used in the region.

2.2. Inventory analysis

The case study building is a multi-storey reinforced concrete structure, reflecting typical post-2000 residential developments in Tirana. The life cycle inventory (LCI) was compiled based on commonly applied construction materials and technologies in the urban housing sector (Gulcimen et al., 2021). Table 1 summarizes the recalculated values of construction materials, energy inputs, transport, and operational requirements per 1 m² of floor area, as well as typical annual consumption for one apartment during the use phase.

Category	Flow / Material	Ecocost
Concrete & Cement	Concrete	65.55
	Cement (Portland CEM I 52.5 N)	0.19
Metals	Steel (Europe mix, beams/sheet)	0.36
	Copper wire/plate/tube (68% prim, 32% sec)	3.58
Minerals	Sand	0.00
	Gravel	0.00
	Red clay brick (housing/roads)	0.05
	Gypsum	0.02
	Hydrated lime ($Ca(OH)_2$)	0.18
	Stoneware	0.09
Plastics & Wood	MDF	0.19
	Glass (float glass)	0.26
	PVC (upcycled)	0.62
	PS (EPS, white)	1.26
	Plywood (softwood)	0.21
	PE (LDPE)	1.22
Finishes	Roof tiles	0.06
	Paint (water-based white)	2.51
	Ceramic glass	0.53
Energy & Ops	Electricity (Albania)	0.02
	Diesel (low-sulphur)	0.93
	Drinking water	0.15
Waste & Transport	Landfill (inert waste)	0.14

	Truck transport (24t, B7)	65.55

Table 1. *Aggregated life cycle inventory of the case study building (per 1 m² gross floor area).*

2.3. Life cycle impact assessment and monetization

The life cycle impact assessment (LCIA) and subsequent monetization were carried out using the Eco-costs 2020 method (Vogtländer et al., 2001), which applies standardized damage cost factors to emissions (e.g., CO_2, SO_2, NO_x) and resource extractions. This approach converts environmental burdens into monetary values (€/kg emission). The final output is expressed as an external cost in euros per square meter (€/m²) of gross floor area, providing a common economic metric that enables direct comparison of environmental impacts with financial costs. The scope 3 Idemat dataset [Idemat 2024 Rev V1-2] was applied for ecocost calculation.

2.4. Market effects – true prices and price corrections

In the final step, environmental externalities are internalized into financial costs to calculate the corrected market price of the building. This approach bridges the gap between environmental assessment and economic decision-making by translating environmental burdens into monetary terms.

The true price per square meter is calculated as (Eq. 1):

True Price per m² = Direct purchase cost (€/m²) + Eco-cost (€/m²) (Eq. 1)

For the Tirana case study, the direct purchase cost of the building was estimated at €1,275 per m². By incorporating the monetized environmental externalities (eco-costs) derived from the LCA, the true cost of housing per square meter is determined. This corrected price reflects both the market cost of construction and the hidden environmental costs, providing a more comprehensive basis for policy, design, and investment decisions.

3. Results

Figure 2 shows the calculated eco-costs per life cycle stage of the residential building. The production stage clearly dominates the total impact, contributing 145.52 €/m², or about 88% of the overall external costs. The operation stage follows with 6.19 €/m² (≈ 4%), while the disposal stage accounts for 11.99 €/m² (≈ 7%). This distribution aligns closely with broader research findings, where embodied impacts from materials have been shown to account for over 85% of a building's environmental footprint in monetized LCA assessments – particularly in public construction procurement – consistently highlighting material production as the dominant contributor to environmental costs (Arendt et al., 2020; Fregonara et al., 2022).

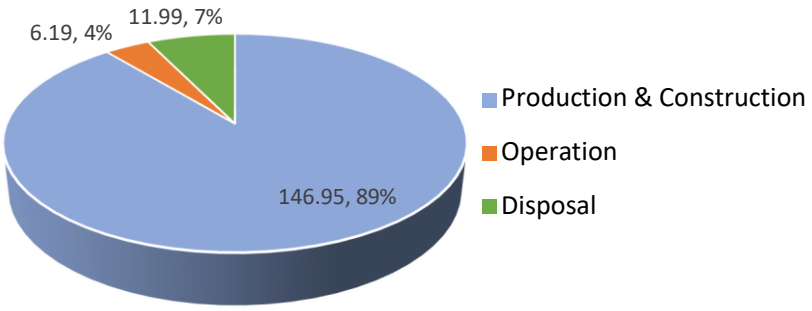

Figure 2. *Share of Eco-costs by building life cycle stage.*

The breakdown of production-stage eco-costs (Figure 3) shows that structural materials are the dominant contributor, with 82.18 €/m² (≈ 56% of production costs). This reflects the heavy reliance on concrete, cement, and reinforcing steel in Albania's post-2000 residential construction, which are known for its energy- and emission-intensive production processes. This pattern is consistent with international findings, where embodied emissions from structural materials often represent the bulk of environmental impacts in residential buildings (Zhang, 2017; Fregonara et al., 2022). The second largest share is attributed to envelopes and finishes (56.90 €/m², ≈ 39%), including windows, insulation, doors, flooring, and coatings. While individually less impactful than structural materials, their cumulative contribution underscores the importance of material choices for architectural finishes and building envelopes. Though less impactful individually, finishes collectively play a crucial role in eco-costs – a point emphasized by Pujadas-Gispert et al. (2021), who showed that sourcing and durability can significantly shift a building's overall profile. By contrast, MEP installations (mechanical, electrical, plumbing) contribute only 6.45 €/m² (≈ 4%), reflecting their relatively low mass intensity compared to bulk construction materials. This is in line with studies that consistently show MEP systems play a smaller role in total environmental burdens when compared to bulk construction materials (Collu and Boninu, 2018). Construction-stage inputs (1.09 €/m², ≈ 1%) and transport activities (0.33 €/m², <1%) are negligible in comparison. Overall, the results confirm that the eco-cost profile of residential buildings in Tirana is strongly determined by material production, with a particular emphasis on cement, steel, and other structural components.

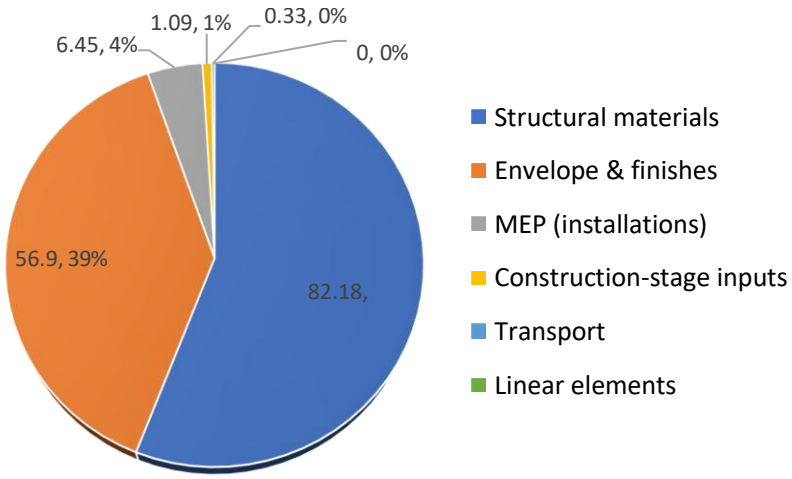

Figure 3. *Production-stage eco-cost breakdown of residential buildings in Tirana.*

In terms of impact categories, Figure 4 shows that the carbon footprint is by far the most dominant driver of external costs, with a total of 101.46 €/m², accounting for nearly two-thirds of the overall impact. This outcome is consistent with findings from other authors (Arendt et al., 2020; Fregonara et al., 2022), which confirm that emissions from the production of cement, concrete, and reinforcing steel represent the largest share of embodied carbon in residential buildings – especially in regions with limited material substitution and low-carbon infrastructure. The second most relevant category is protecting nature, with 31.07 €/m² (≈ 20%). This category includes impacts related to land use change, ecosystem degradation, and emissions to soil and water, all of which are common consequences of raw material extraction and open-pit mining for construction minerals. Such effects were similarly emphasized by Zhang (2017), who noted that environmental degradation during upstream material sourcing is often underestimated in conventional LCA unless linked to monetized indicators. Resource scarcity follows with 21.76 €/m² (≈ 14%), reflecting the depletion of non-renewable raw materials during material extraction and end-of-life losses at the disposal stage. These impacts are especially prominent in linear construction economies, where material recovery and circularity remain underdeveloped (de Melo et al., 2024). By contrast, the human health category contributes only 10.84 €/m² (≈ 7%), primarily due to emissions of air pollutants during the production of bulk construction materials. Collectively, these findings confirm that the environmental cost structure of residential buildings is largely shaped by carbon emissions and material extraction impacts, reinforcing the need for upstream interventions in material efficiency, carbon reduction, and ecosystem preservation.

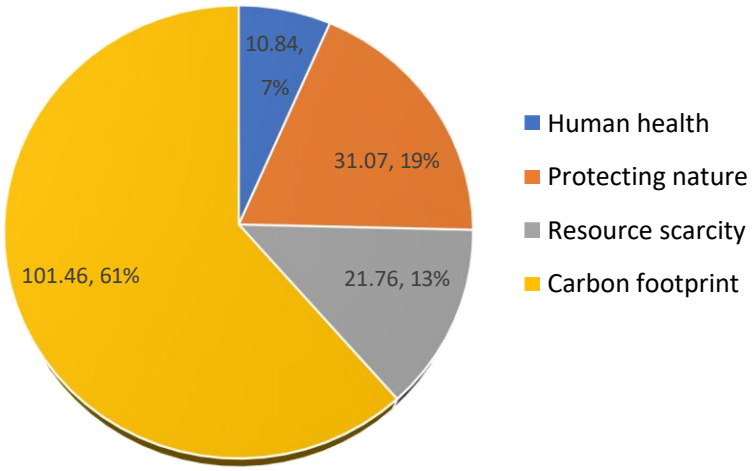

Figure 4. *Distribution of eco-costs by impact category for residential buildings in Tirana.*

The assessment shows that the production and construction phase is the dominant contributor across all categories (Figure 5), particularly for the carbon footprint (98.04) and ecosystem protection impacts (29.69). Human health (9.99) and resource scarcity (9.23) burdens are also concentrated in this stage, reflecting the significant role of material extraction and manufacturing processes. The operation stage contributes only marginally, with low values across all indicators (≤3.43), suggesting that the use phase is relatively efficient compared to the embodied impacts of construction. At the disposal stage, the main issue is resource scarcity (11.99), linked to waste management challenges and material losses at end-of-life, while other impacts remain negligible.

These findings are consistent with broader literature, which confirms that early life cycle stages – particularly material production – dominate environmental burdens in residential buildings, while operational and end-of-life phases contribute comparatively little (Arendt et al., 2020; Fregonara et al., 2022; de Melo et al., 2024).

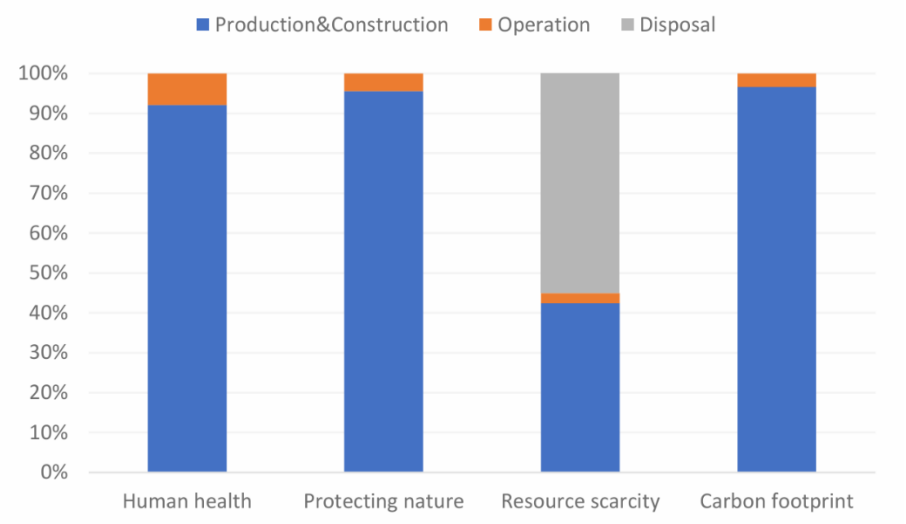

Figure 5. *Distribution of eco-costs by impact category and life cycle stage.*

The True Price of Housing per m² is the adjusted cost of a structure, including direct purchase costs and monetized environmental externalities (eco-costs). Figure 4 illustrates this calculation: Adding the total eco-costs of € 165.12/m² to the direct purchase cost of € 1,275/m² yields a total price of € 1,440.12/m². This adjustment represents a 13% increase over the financial cost alone, highlighting the hidden environmental burden of residential construction and demonstrating the significance of life cycle cost accounting.

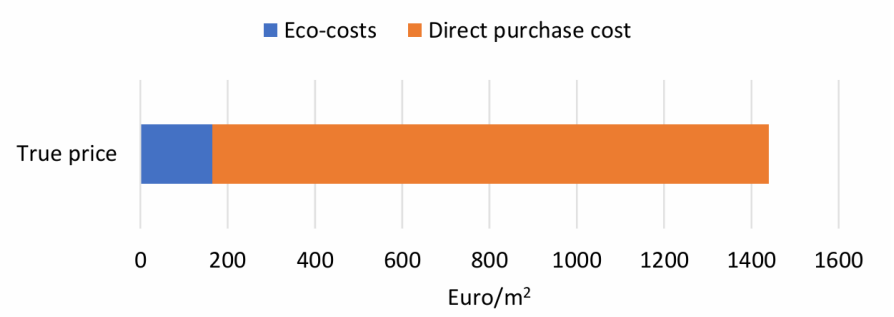

Figure 6. *The True Price of Housing per m², combining direct purchase costs with monetized eco-costs.*

4. Conclusions

Modernization in Tirana is transforming the urban landscape; yet, structures continue to have substantial negative environmental implications, such as emissions, resource use, and ecological damage. In the building industry, environmental impacts result in costs borne by society and

ecosystems rather than developers or end users. Such external costs are rarely captured by traditional economic assessments, which normally only include commodities and services with a direct market price. The *true price* concept captures both the market price of a product and the external costs associated with its production – costs that are typically hidden from conventional financial analyses.

In this work, we used monetized Life Cycle Assessment (LCA) coupled with current market prices to uncover the hidden environmental costs of residential development and determine a more comprehensive true price of housing. The results show that the total eco-costs of one square meter in Tirana amount to 165.12 €/m², which are heavily concentrated in the production stage (≈88%), with structural materials such as cement, concrete, and steel representing the largest share. When these monetized eco-costs (165.12 €/m²) are added to the direct purchase cost (1,275 €/m²), the true price of housing rises to 1,440.12 €/m² – an increase of about 13% over financial costs alone.

The research does not attempt to establish the exact value of eco-costs, but rather to illustrate the usefulness of monetization as an assessment tool. Different monetization methods exist, each applying varying damage cost factors and assumptions, which can lead to differences in results. Nonetheless, the comparative insights remain valuable for demonstrating the hidden environmental burdens of construction and guiding more sustainable decision-making.

As Tirana's urbanization proceeds in the next years, with increased modernization and the emergence of multi-level structures, incorporating such ideas will become critical. Companies, investors, banks, and governments may all use monetized LCA to increase transparency, incorporate sustainability into financial planning, and influence investment decisions. By incorporating hidden environmental costs into the true cost of building, these players can discover cost-effective ways to decrease environmental burdens, encourage material substitution and energy efficiency, and support policies that promote circular and low-impact urban development.

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