

From green visions to viable projects: financing and business models for nature-based urban regeneration in Thessaloniki

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Extended abstract

Objective and contribution

Nature-Based Solutions (NBS) are increasingly promoted as effective responses to urban challenges such as climate change, environmental degradation, and declining quality of life. Despite their growing recognition, their large-scale implementation in European cities remains limited, primarily due to financial, institutional, and governance constraints. A core challenge lies in the fact that NBS generate multiple environmental, social, and economic benefits that function as public goods. These benefits are shared across many stakeholders and therefore cannot be easily captured through conventional revenue streams. As a result, many relevant projects remain dependent on short-term public funding, with limited pathways for long-term financial sustainability.

This paper presents findings from the ReGenWest project, focusing on the identification of financial opportunities, barriers, and business models for NBS interventions within the urban regeneration of the railway station district of Thessaloniki. The analysis is based on a systematic assessment of how NBS projects may create and deliver value, how costs are structured, and how financing and governance arrangements influence implementation. Particular attention is paid to the applicability of these projects within the Greek institutional and regulatory framework. In doing so, the work highlights the multifunctional value of NBS and addresses the persistent investment gap associated with their public-good nature.

The contribution is threefold. First, the paper shifts attention from the environmental performance of NBS towards the financial and organisational mechanisms that enable their implementation. Second, it develops a spatially grounded typology of NBS business models, showing how ownership structures, intervention scale, and stakeholder configuration shape financing and governance arrangements. Third, it offers planners and policymakers a route from climate-neutrality strategy to implementable projects, contributing to the broader debate on how cities can move beyond green visions towards financially viable pathways for sustainable urban transformation.

Data and methods

The study area is the Railway District of Thessaloniki, an area undergoing significant change in mobility patterns and land uses due to the arrival of the metro and the upgrading of the railway station. The district retains the character of a residential neighbourhood, with old social housing estates, apartment buildings of moderate height, and a lower-income resident population. Several open spaces around these buildings remain undesigned, underused, or poorly maintained, and much

informal parking has developed in response to the shortage of private parking. A survey conducted in 2024 identified eleven types of open space in the district as potential areas for renovation with NBS and renewable energy sources (RES), ranging from vacant plots and school grounds to street corridors, building rooftops, and higher education facilities.

The analysis follows a case-study research design combining structured literature review, spatial analysis, expert assessment, and business model framework development. A systematic spatial characterisation of the district, drawing on land-use data, municipal planning documents, satellite imagery, and field observations, informed the selection of thirteen intervention types tailored to the area's urban morphology and ownership regimes. These range from greening and tree planting to net-zero building retrofits, rain gardens, solar canopies, and rooftop photovoltaics. A structured review of the European NBS financing literature, focusing on established typologies such as the Naturvation business model catalogue, the Connecting Nature Business Model Canvas, and the NAIAD collection of financing instruments, provided the conceptual foundation for a business model template applied to each intervention. The template organises each intervention around six analytical dimensions: value proposition, value creation and delivery, value capture, financing model (CAPEX and OPEX structures), enablers, and barriers. CAPEX and OPEX ranges for each intervention were benchmarked against comparable European projects, and the resulting business model profiles were validated through iterative engagement with project partners, including the Municipality of Thessaloniki, the Thessaloniki Development Agency, and Aristotle University of Thessaloniki.

The thirteen interventions were then grouped into five business model categories, based on shared financing logic and spatial context: (1) public space interventions, (2) private space interventions, (3) public–private hybrid solutions, (4) multi-tenant building solutions, and (5) renewable energy solutions. To structure the comparison across categories, the analysis draws on the Pestoff Triangle, which positions initiatives across three institutional poles: public or state provision, private for-profit provision, and community-based provision. This framework allows the financing logic of each category to be read directly from its position relative to state, market, and community, instead of being inferred separately for each intervention type.

Results

The five business model categories differ less in their environmental function than in the ownership structure and stakeholder configuration behind them, and this is what ultimately determines their financing logic. Public space interventions (greening, tree planting, rain gardens, botanic gardens, native meadows) generate benefits that accrue broadly across the urban population, without a direct revenue stream for a single investor. CAPEX for these interventions is comparatively accessible through municipal budgets, EU structural and cohesion funds, the LIFE programme, and national schemes such as ‘Antonis Tritsis’, but OPEX (commonly €10–30 per tree or €20–50 per square metre a year) remains structurally underfunded once project grants are exhausted. Private space interventions, such as green fences and vertical greening on private facades, follow a different logic: value is captured indirectly, through reduced cooling energy costs and property value uplift, and depends on private owner initiative, with public policy playing a catalytic rather than a primary role.

Hybrid interventions, such as permeable pavements and high-reflective materials, exploit a ‘piggyback’ financing logic: their incremental cost is modest when bundled into resurfacing or roofing work that would occur regardless of any NBS objective, which substantially lowers the effective cost

burden on both public and private actors. Multi-tenant building solutions, principally net-zero building retrofits, combine high upfront CAPEX (€500–1,150 per square metre) with the need for collective decision-making among homeowners' associations; state-led subsidy programmes are the pivotal enabling mechanism, showing that targeted state support can unlock substantial private co-investment even where collective action is difficult to organise. Renewable energy solutions (solar canopies, rooftop photovoltaics, smart grid integration) follow the most conventional investment logic of the five, with significant CAPEX but low OPEX and long asset lifetimes, increasingly supported in Greece by net-billing arrangements and energy community models.

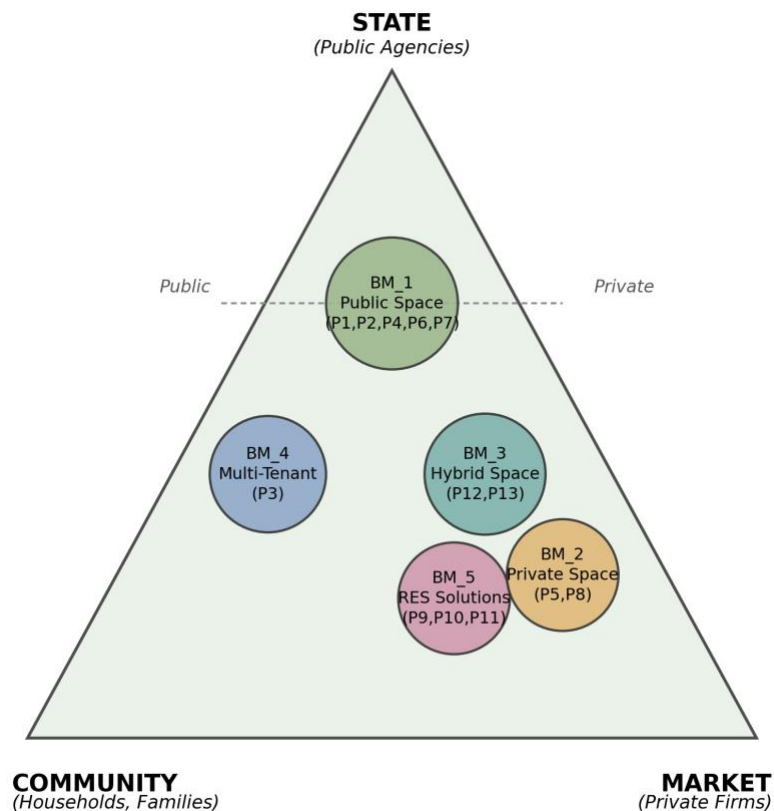


Figure 1. Positioning of the five business model categories within the Pestoff Triangle (adapted from Pestoff, 1998).

Figure 1 summarises this pattern. Public space interventions (BM_1) sit closest to the state apex, with a slight lean towards community that reflects the contribution of voluntary stewardship. Private space (BM_2) and renewable energy (BM_5) both gravitate towards the market, though BM_5 sits notably closer to community, reflecting the collective self-consumption structures of energy communities. Hybrid interventions (BM_3) occupy a central position between state and market, consistent with their combination of direct public investment and policy-induced private expenditure. Multi-tenant building solutions (BM_4) lean markedly towards community, reflecting the central role of homeowners' associations as the primary collective decision-making unit in Greek multi-family buildings. This positioning carries a practical implication: deep building retrofits depend less on market mechanisms than on the capacity for collective action at the building level.

Because the five categories differ in ownership structure and actor base, the optimal blend of public, private, and community financing instruments is not the same for each. Table 1 maps the applicability of specific financing instruments across the five categories in the Thessaloniki

institutional context. Public grants and EU programmes remain the primary source for public space interventions, private self-financing and bank loans dominate private space and renewable energy solutions, and multi-tenant retrofits rely on a distinctive combination of state-backed preferential loans and energy-efficiency subsidies. Blended and innovative instruments, such as corporate sponsorship, participatory budgeting, and urban offsetting funds, play a complementary role chiefly in the public and hybrid categories, where conventional market mechanisms are weakest.

Table 1. Applicability of financing instruments across the five business model categories.

Financing Instrument / Source	BM_1 Public	BM_2 Private	BM_3 Hybrid	BM_4 Multi-Tenant	BM_5 RES
A. PUBLIC GRANTS & PROGRAMMES					
Municipal capital budget	●	–	◐	–	◐
EU Structural / Cohesion Funds	●	–	◐	◐	◐
EU LIFE Programme	●	–	◐	–	–
National ‘Antonis Tritsis’ programme	●	–	◐	–	–
National Recovery & Resilience Plan (NextGenEU)	◐	–	◐	◐	◐
‘Exoikonomo’ energy renovation (state-led) subsidy program	–	–	–	●	–
B. PRIVATE INVESTMENT & MARKET INSTRUMENTS					
Private owner self-financing	–	●	◐	◐	●
Commercial bank loans (standard)	–	◐	◐	◐	●
Preferential loans (state-backed)	–	◐	–	●	◐
Net-billing (or net-metering) / self-consumption savings	–	–	–	–	●
Energy community models	–	–	–	–	●
C. BLENDED & INNOVATIVE INSTRUMENTS					
Corporate sponsorship/CSR/adopt-a-tree	◐	–	–	–	–
Participatory budgeting	◐	–	–	–	–
Development impact fees/planning gain	–	–	◐	–	–
Urban offsetting/biodiversity net gain funds	◐	–	◐	–	–
Green/sustainability-linked bonds	–	–	◐	–	◐
Community crowdfunding/stewardship (in-kind)	◐	–	–	–	–

Note: ● = primary/dominant financing source; ◐ = complementary or supplementary source; – = not applicable. Source: Authors, based on UNEP-CCC (2024).

Across all five categories, a consistent structural pattern emerges: the public sector remains the necessary backbone of NBS financing in the Thessaloniki context, yet public funding alone is insufficient to ensure either the scale of implementation required for meaningful ecological impact or the long-term operational sustainability of individual interventions. The central constraint is a

temporal mismatch, not a lack of resources: capital grant cycles fund installation comparatively well, while the continuity of ecological functioning depends on operational funding that is far harder to secure. Addressing this gap requires embedding NBS stewardship within routine municipal operations, regulatory frameworks applicable to private development, and community governance structures capable of sustaining engagement over time, instead of relying on renewed project grants at the end of every funding cycle.

Conclusions

The Thessaloniki Railway District case shows that NBS viability depends on aligning value creation, value capture, financing, and governance, and that this alignment is intervention-specific and not uniform across a project portfolio. Ownership structure and stakeholder configuration, together with the technical characteristics of each intervention, determine which of the five business model categories applies, and this reframes business models as governance frameworks that distribute costs, risks, and responsibilities across specific actors, instead of simply financing instruments to be selected only based on cost. The main barriers identified across categories, such as institutional fragmentation, split incentives in multi-tenant buildings, regulatory gaps around planning-gain instruments, and administrative constraints on collective solar, are predominantly governance barriers, which indicates that the implementation gap motivating this paper is institutional as much as it is financial.

By linking intervention type, ownership, and financing logic into one framework, the study gives planners a practical route from climate-neutrality strategy to implementable projects, and a transferable approach for other compact Mediterranean cities working to integrate NBS into urban regeneration. Future work will test these business model configurations against real implementation outcomes as the interventions move from design to construction and will examine how the financing and governance arrangements identified here can be scaled beyond the Railway District.

Keywords: Nature-based solutions; urban regeneration; business models; financing; Pestoff Triangle; Thessaloniki