Active Rooftops
South Europe

artes

BIANNUAL NEWSLETTER

MAY 2026

OUR PARTNERS



Cooperation Partners

NEWS FROM PARTNERS

Madrid, Spain







REBUILD construction expo for industrialized, sustainability, digitalisation and innovation for buildings

At the REBUILD Expo 2026, held in Madrid from 24–26 March, Ecómetro actively contributed to one of Europe's leading innovation events in the building sector. The exhibition serves as a key platform bringing together over 30,000 professionals across the construction value chain to explore advancements in industrialised construction, sustainability, and digitalisation.

During the event, Ecómetro showcased the progress of the aRTes project, engaging with a highly specialised audience of experts, engineers, and industry stakeholders. The stand facilitated valuable exchanges around sustainable building solutions, life-cycle assessment, and carbon footprint tools, helping to strengthen connections, raise awareness, and position aRTes within the broader transition toward a more efficient and decarbonised built environment.

Building on this engagement, Ecómetro also emphasised the role of digitalisation and data-driven approaches in supporting more sustainable and resilient construction practices. Discussions focused on emerging priorities such as circularity, energy efficiency, and low-carbon design, while highlighting innovative concepts related to rooftop utilisation developed within aRTes. The participation further enabled meaningful dialogue with key stakeholders, contributing to the dissemination of project results and reinforcing the project's relevance in addressing current challenges and opportunities within the built environment sector.

More information:
REBUILD Expo 2026: Website | Instagram | LinkedIn
Ecómetro: Website | Instagram | LinkedIn

Nicosia, Cyprus









aRTes at International Events & Conferences

Researchers from Society & Urban Form (SURF) Lab [Department of Architecture, University of Cyprus] actively participated in a series of international events, conferences, and workshops across Europe, strengthening aRTes' presence within the urban planning and architecture community.

Engaging with diverse audiences, from practitioners to policy stakeholders, contributed to discussions on innovative rooftop solutions, urban regeneration, and sustainable city development. Notable participations included events such as:

- Paris Rooftop Days - Paris, France | 26-28 September 2025
- NEB South+ Community Meeting – Seville, Spain | 8 October 2025
- 6th Week of Architecture – Santander, Spain | 11 October 2025
- "Otros Habitares – Other Ways of Dwelling" – Bilbao, Spain | 29 October 2025
- Screening & discussion "The Demolition Drama" – Madrid, Spain | 5 November 2025
- Institute of Architecture of Euskadi – San Sebastián, Spain | 4 December 2025
- College of Architects of Granada – Granada, Spain | 10 December 2025

Across these engagements, the aRTes project actively contributed to ongoing discussions on urban sustainability, rooftop innovation, and regenerative urban design. At the same time, they offered valuable opportunities not only to exchange knowledge with international experts, but also to present the project's objectives and emerging insights.

In parallel, they enabled meaningful engagement with a diverse range of stakeholders, including practitioners, policymakers, and local communities, thereby strengthening dialogue and fostering potential collaborations.

More information:
SURF Lab: Website | LinkedIn





05/11

Screening of the documentary "The Demolition Drama"





universidade de aveiro

Aveiro, Portugal

The University of Aveiro is advancing research on the environmental performance of green roofs, with a particular focus on rainwater retention capacity. Their recent work introduces predictive models that estimate how effectively green roof systems can manage rainfall under different urban conditions, supporting the development of solutions within Work Package 2.

This work is presented in the scientific article titled *"Water Retention Models for Green Roofs"*, recently published in the journal Sustainable Cities and Society. The findings demonstrate the strong potential of these systems, indicating that green roofs can retain up to 62% of rainfall in Aveiro and 59% in Faro. These results highlight the important role of green infrastructure in addressing urban water management challenges and enhancing climate resilience in cities.

Building on these results, the team is working towards extending the modelling approach to additional cities, enabling a broader application across the aRTes consortium. This will further support the development of data-driven solutions tailored to different climatic and urban contexts.

In parallel, the University of Aveiro continues to actively disseminate its work, with further results on regulatory aspects scheduled to be presented at a national conference in September 2026.

More information:
University of Aveiro: Website | Instagram | X

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journal homepage: www.elsevier.com/locate/scs



Check for updates

Worldwide assessment of green roofs retention using general linear models and multivariate adaptive regression splines

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Keywords:
Green roof
Hydrology
Stormwater
Drainage
Runoff retention
General linear models (GLM)
Multivariate adaptive regression splines (MARS)

This study presents a comprehensive global assessment of the runoff retention performance of green roofs. These infrastructures, also identified as vegetated roofs, eco roofs or ecological roofs, are widely acknowledge for their capacity to retain rainwater. However, the effect of their drivers remains insufficiently understood. Moreover, reliable and easy-to-use tools for estimating retention performance under limited data availability and across diverse climatic contexts are still lacking. Using a worldwide dataset comprising 2692 samples, this systematic review assesses the runoff retention performance of green roofs through two complementary modelling approaches: statistical analysis using General Linear Models (GLM), and machine-learning methods using Multivariate Adaptive Regression Splines (MARS). Results indicate that rainfall, climate, location, vegetation, substrate and drainage layer influence runoff retention. The developed models predict runoff with correlation factors varying between 0.92 and 0.98. Compared with GLM, MARS models select a reduced set of predictors and enable the identification of nonlinear and interaction effects. In particular, interactions are identified between rainfall depth and climate, substrate depth and drainage layer type, and between climate and location, while the effect of rainfall depth on retention is shown to be nonlinear. Overall, the proposed modelling framework provides insights into the drivers of green roof hydrological performance and offers a practical screening tool to inform preliminary stormwater design and planning decisions, particularly where detailed physical data are unavailable.

1. Introduction

To mitigate the impacts of climate change and the growing extent of impervious surfaces in urban areas, adaptation measures are urgently needed for effective stormwater management. The adoption of nature-based solutions (NbS) is recognized as an effective approach to address this challenge. NbS integrate virtually all sustainability-oriented concepts of urban drainage that have been introduced since the second half of the XX century in different locations across the globe, including: Sustainable Urban Drainage Systems, Low-Impact Development, Green

"Worlwide assessment of green roofs retention using general linear models and multivariate adaptive regression splines" published in Sustainable Cities and Society

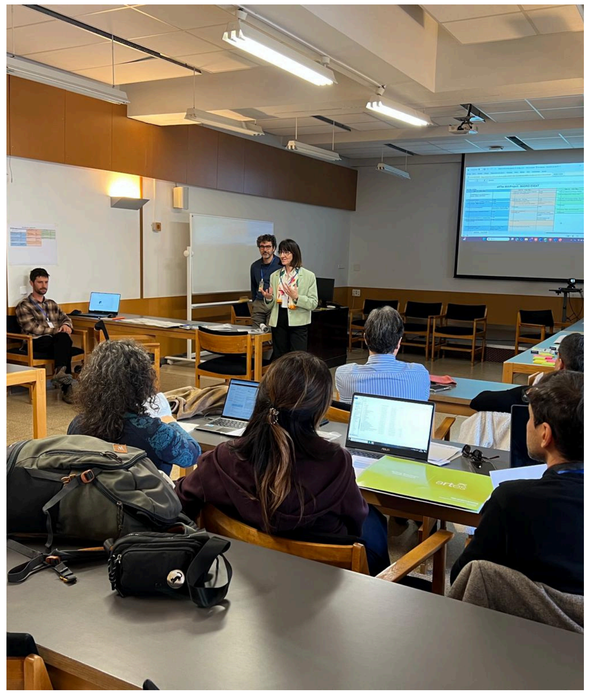
PARTNERS' MEETING IN SPAIN

May 12-14, 2026 | Madrid











The aRTes consortium recently gathered in Madrid for the Mid-Project Meeting, bringing together project partners to reflect on progress achieved so far and discuss the next phases of implementation.

During the meeting, partners presented key developments across the project and exchanged insights on ongoing activities, while important advancements were highlighted in areas such as innovative rooftop solutions, digital tools, pilot preparation and research activities. Therefore, it represented an important milestone for the consortium, reinforcing collaboration and supporting the project's shared vision of transforming rooftops into more sustainable, multifunctional and people-centred urban spaces.

Read the full aRTicle: https://t.ly/TKReu
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WP DELIVERABLES AND ACTIVITIES

WORK PACKAGE 1:

Setting the scene, co-design and consultancy package

Understanding the Conditions for Rooftop Transformation



Work Package 1 is laying the foundation for rooftop transformation by examining the regulatory, technical and governance landscape across six Southern European countries.

Key findings highlighted that the main barriers to rooftop retrofitting are not necessarily linked to a lack of perceived value. Rather, they stem from the combined impact of regulatory complexity, financial constraints and technical challenges. In particular, structural limitations, waterproofing concerns and long-term maintenance requirements were identified as some of the most critical factors affecting implementation.

The analysis demonstrated that rooftops are increasingly being recognised as valuable urban assets with the potential to support biodiversity, climate adaptation, energy generation and broader social benefits. In this context, the findings also emphasised the importance of clearer regulatory frameworks, stronger governance mechanisms and more integrated approaches to facilitate rooftop transformation.

Country Insights Across Southern Europe

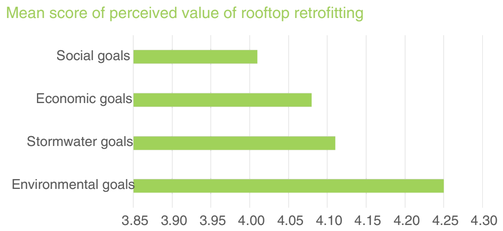
Cyprus demonstrates a strong focus on energy-related rooftop interventions, particularly photovoltaics and insulation. However, despite robust technical regulations, implementation often faces challenges related to permitting procedures and co-ownership structures.

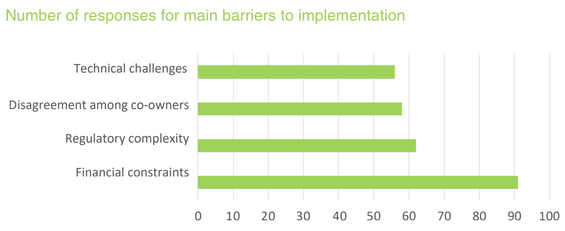
France benefits from strong alignment between European and national frameworks, supported by advanced governance structures. Nevertheless, complex regulations and heritage-related constraints continue to affect the wider implementation of multifunctional rooftop solutions.

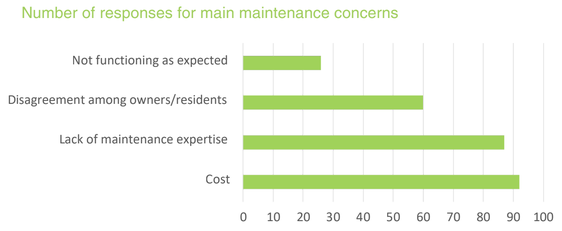
Italy shows significant potential for rooftop transformation, supported by financial incentives and technical standards. At the same time, administrative complexity and regulatory constraints remain important barriers to broader uptake.

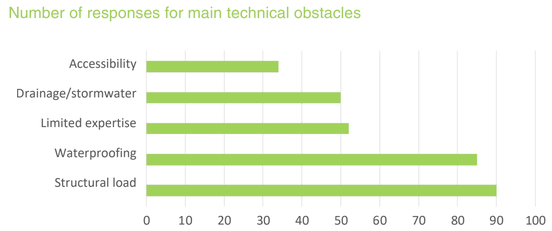
Portugal increasingly recognises rooftops as valuable urban spaces; however, limited standardisation and local implementation challenges still influence large-scale deployment.

Spain, similarly, demonstrates strong technical foundations, although rooftop retrofitting often depends on fragmented implementation approaches and local governance structures.







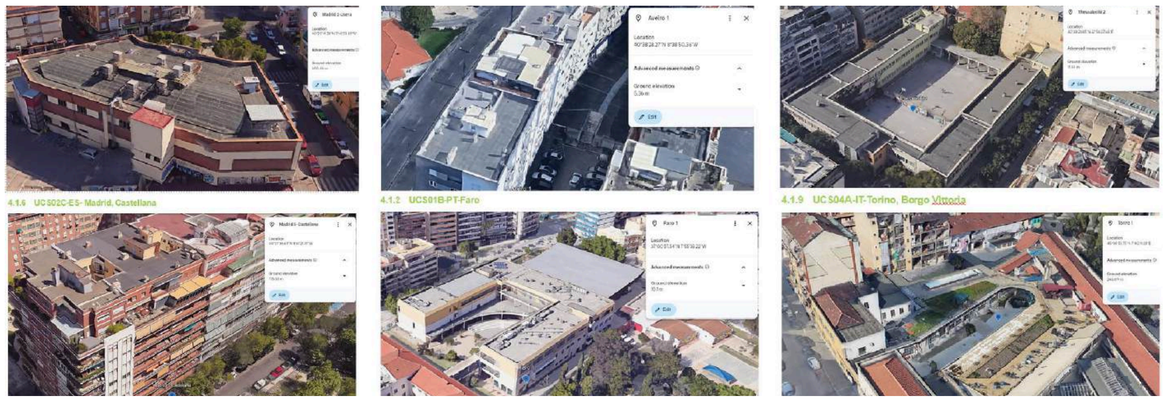


From Data to Action: Mapping Rooftop Potential Across Europe



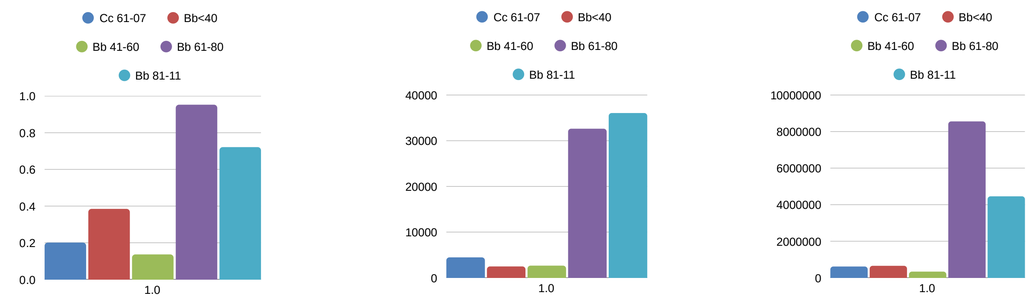
In parallel with the broader policy and regulatory analysis, **Work Package 1** is also developing a mapping and spatial analysis tool capable of identifying key spatial, structural and regulatory conditions that influence rooftop transformation opportunities.

By leveraging GIS technologies and digital analysis methods, the tool enables researchers to move beyond static rooftop assessments and instead explore how rooftops can actively contribute to more sustainable and multifunctional urban environments. In this context, rooftop characteristics such as accessibility, structural capacity, solar potential and existing use patterns are being analysed as opportunities for future intervention rather than limitations.



At the same time, the consortium is conducting **12 urban case studies** across six European countries, allowing the partners to test and compare rooftop adaptation scenarios in different urban contexts. These studies are expected to provide measurable insights through a set of **Key Performance Indicators (KPIs)** covering environmental, social and energy dimensions, including biodiversity enhancement, renewable energy production, rainwater retention, urban heat mitigation and public wellbeing.

In addition, initial analysis conducted in Madrid revealed particularly promising results, showing that more than half of existing buildings may be suitable candidates for rooftop interventions. Such findings further demonstrate the significant untapped potential of rooftops and reinforce the project's vision of transforming underused urban surfaces into active and multifunctional spaces.





Key Figures of predominant candidate building type

Year of construction: 1970s
Mean rooftop area: 234 m²
Floors: 6–8
Housing units: 24–32
Roof share per unit: 6–8 m²

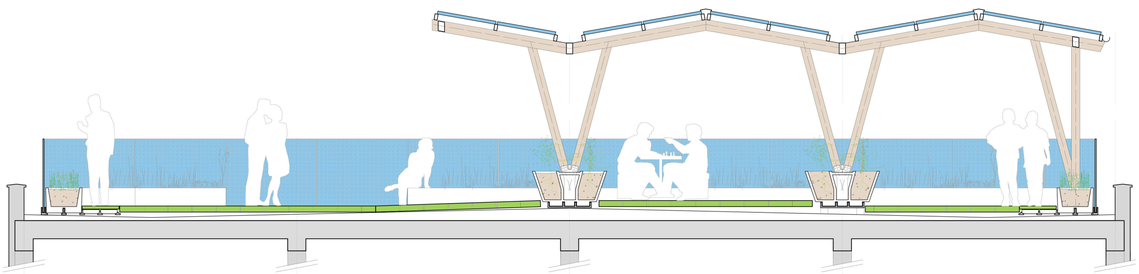
WORK PACKAGE 2:

Physical solutions towards new ways of using rooftops

Reimagining Rooftops Through Physical Innovation

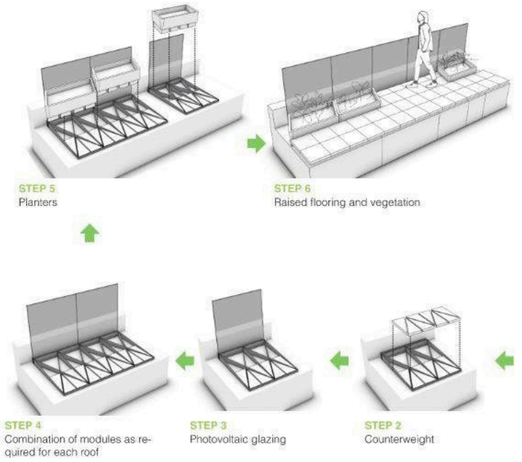


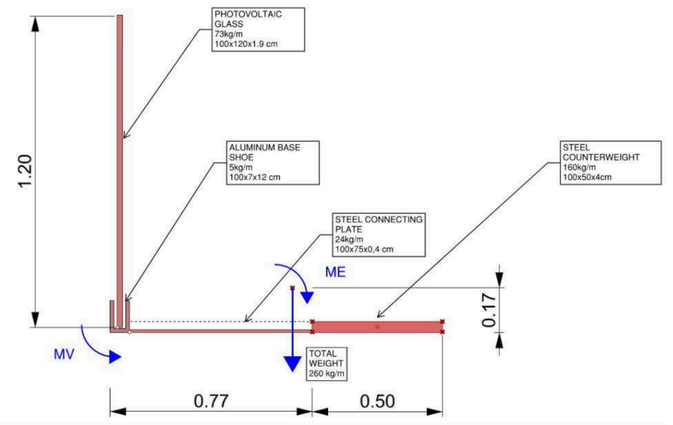
Led through collaborative efforts across the consortium, **Work Package 2** explores new ways of transforming underused rooftops into safe, accessible and multifunctional spaces that support both people and the environment, by developing practical and innovative solutions that can bring these ideas into reality.



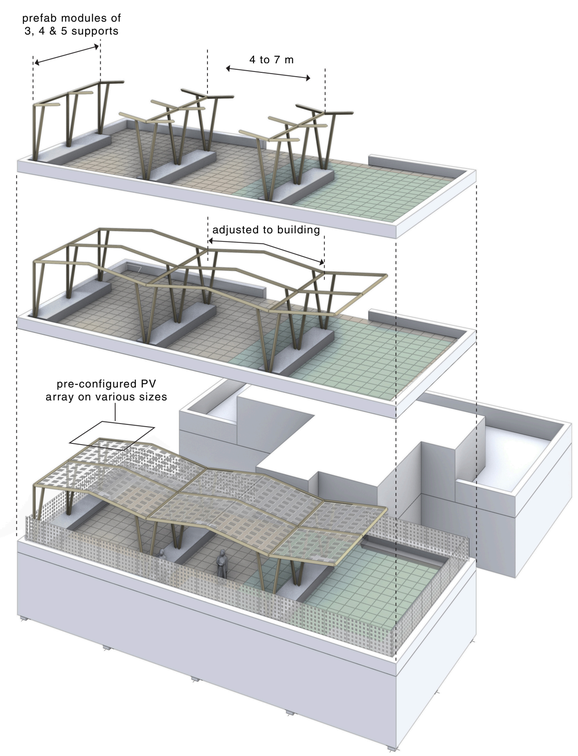
During the Mid-Project Briefing in Madrid, partners presented important progress regarding the development of **physical rooftop innovations** designed to adapt to different urban contexts and building typologies, proposing solutions with the combination of social use, biodiversity and renewable energy generation while addressing existing structural and technical limitations.

One of the key innovations currently under development is the **Perimeter Wall solution**, an adaptable rooftop safety system designed to improve accessibility while integrating additional functions beyond traditional protection elements. In addition to enhancing safety, the system incorporates semi-transparent photovoltaic glass, integrated greenery and modular design elements, allowing rooftops to generate energy while creating more welcoming and usable spaces.

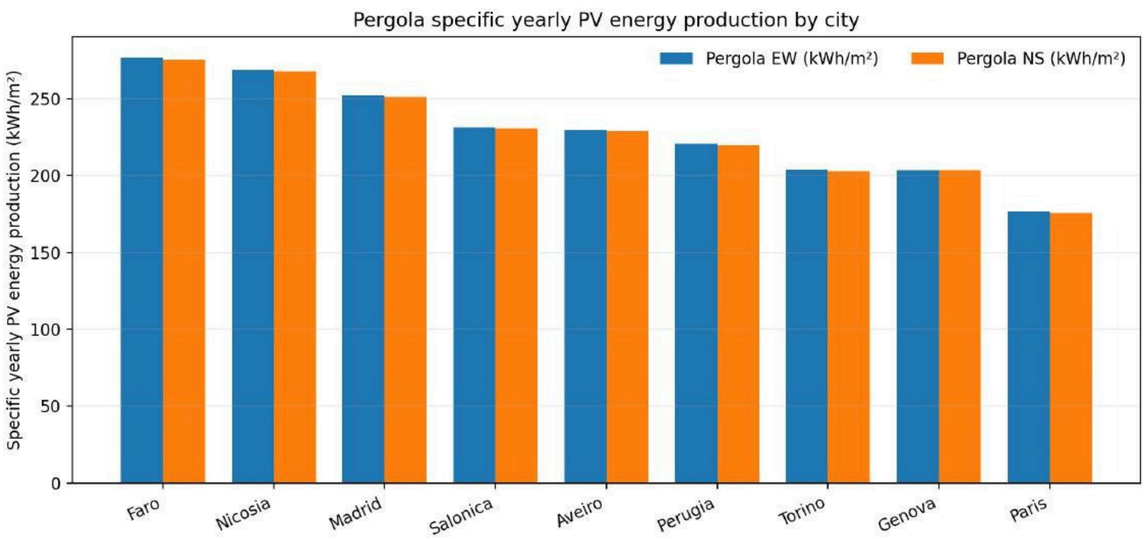




Furthermore, partners introduced the **Photovoltaic Pergola prototype**, a multifunctional structure designed to support the coexistence of local energy production and everyday rooftop activities. By combining shaded social spaces, integrated photovoltaic technologies and greenery solutions, the innovation seeks to create environments that can simultaneously contribute to energy efficiency, climate adaptation and urban wellbeing.



Unlocking Rooftops as Local Energy Sources



230 kWh/m²

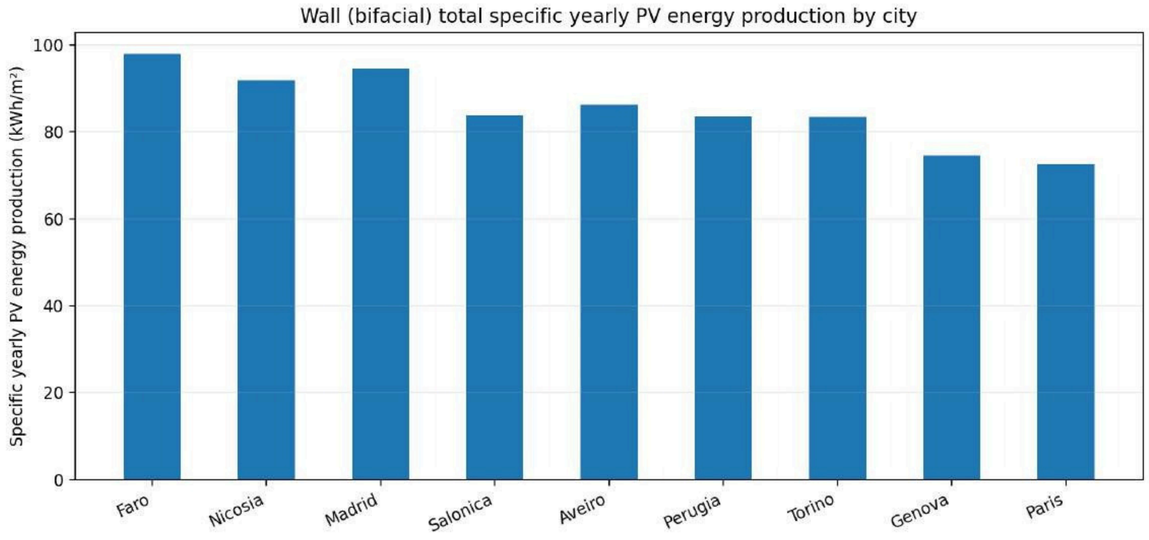
*** Average production across all project locations**

In addition to improving accessibility and social use, **Work Package 2** is also exploring how rooftop innovations can actively contribute to renewable energy production. To better understand their potential impact, the consortium assessed the expected photovoltaic performance of the proposed solutions across multiple urban case studies and project locations.

More specifically, results presented during the Mid-Project Briefing demonstrated promising outcomes for both the Photovoltaic Pergola and the Perimeter Wall innovations. The analysis showed that the **Photovoltaic Pergola system** could generate an average annual production of **approximately 230 kWh/m²**, while the **Photovoltaic Perimeter Wall** reached an estimated **85 kWh/m** across project locations.

Simulations indicated that these innovations could provide meaningful energy contributions at building scale. For example, a rooftop equipped with photovoltaic pergolas could generate renewable electricity equivalent to the annual energy consumption of approximately five households, while also covering around 15% of the electricity needs of a residential building with 24 housing units.

Similarly, the photovoltaic perimeter wall demonstrated additional energy generation potential, reinforcing the broader aRTes vision of transforming rooftops into multifunctional urban infrastructures that combine energy production, environmental benefits and social value.



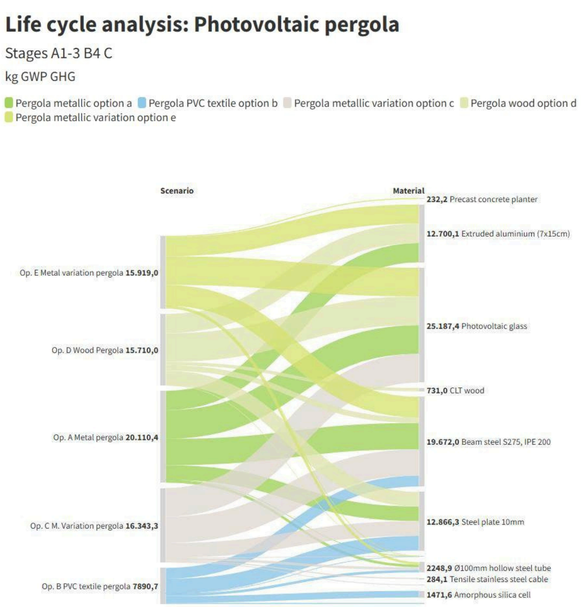
85 kWh/m

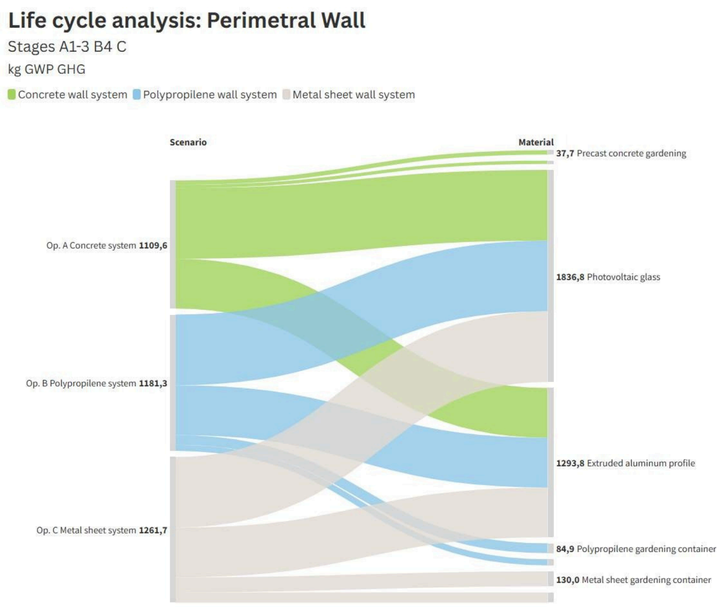
*** Average production across all project locations**

Designing Rooftop Solutions with Sustainability in Mind

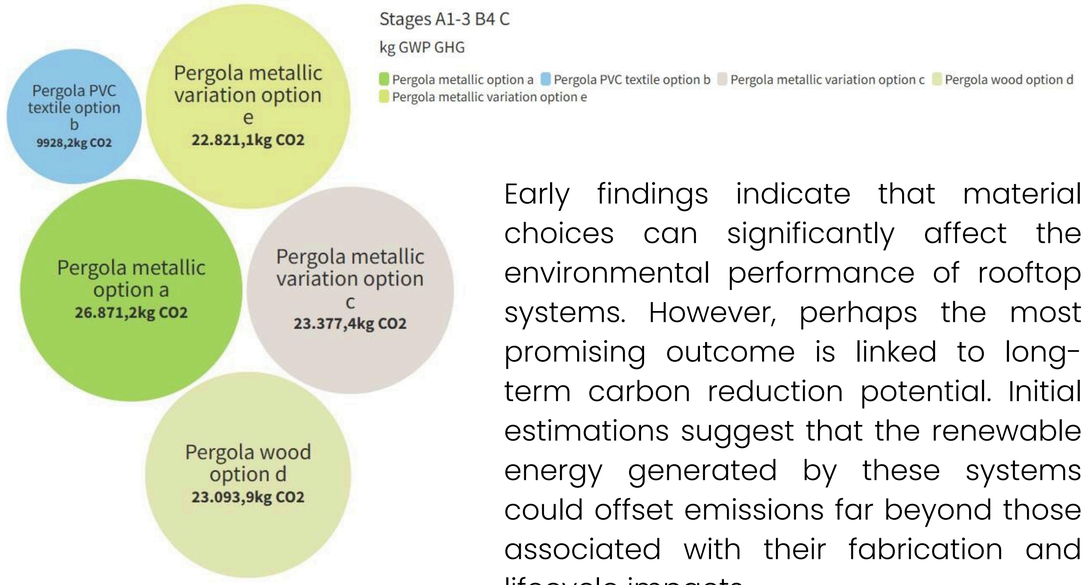
Etapa	Producto			Proceso construc tivo		Uso							Fin de vida				Beneficios y cargas del s.
	Suministro de materias primas	Transporte	Fabricación	Transporte	Construcción-instalación	Uso	Mantenimiento	Reparación	Sustitución	Rehabilitación	Uso de energía en servicio	Uso de agua en servicio	Deconstrucción y demolición	Transporte	Tratamiento de residuos	Eliminación de residuos	Potencial de reutilización, recuperación y reciclaje
Módulo	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Módulo declarado	X			ND	ND	ND	ND	ND	X	ND	ND	ND	X	X	X	X	X

Beyond performance and energy production, **Work Package 2** is also assessing the environmental footprint of the proposed rooftop innovations through preliminary **Life Cycle Analysis (LCA) studies**. This approach helps the consortium understand how design choices and material selections influence environmental impacts throughout the entire lifecycle of each solution — from production and construction to use and end-of-life stages.

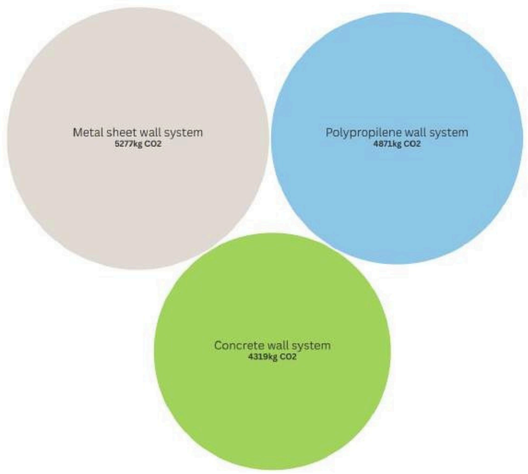




More specifically, different material scenarios were compared for both the **Photovoltaic Pergola** and the **Perimeter Wall** systems. For the pergola, several configurations involving steel and laminated wood structures, as well as different photovoltaic technologies, were evaluated. Similarly, for the perimeter wall, multiple structural alternatives were assessed in order to identify efficient and adaptable design options.

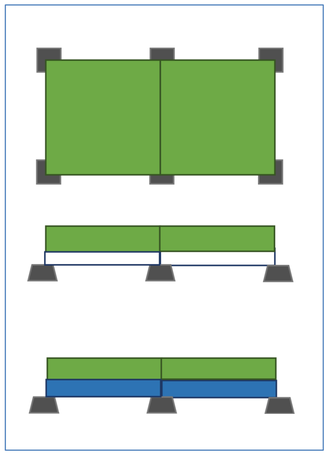


Early findings indicate that material choices can significantly affect the environmental performance of rooftop systems. However, perhaps the most promising outcome is linked to long-term carbon reduction potential. Initial estimations suggest that the renewable energy generated by these systems could offset emissions far beyond those associated with their fabrication and lifecycle impacts.

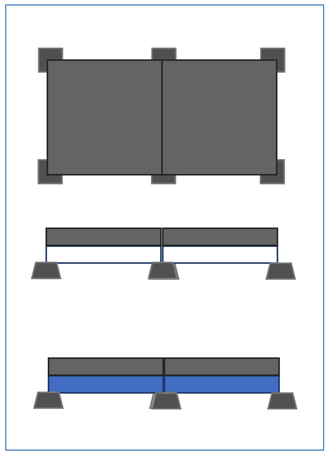


In particular, avoided emissions were estimated to reach up to 3.2 times the emissions generated during fabrication and end-of-life stages, demonstrating the strong environmental potential of multifunctional rooftop solutions.

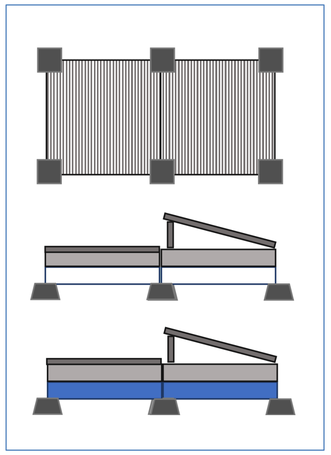
Building Flexible Rooftops for Multiple Urban Needs



- Substrate;
- Filter layer;
- Drainage layer;
- Tray/box.

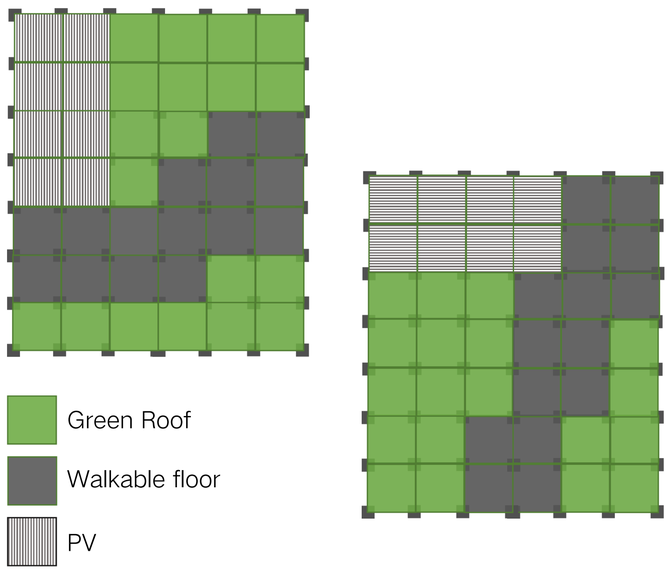


- Tray/box;
- Support system;
- Floor finish.



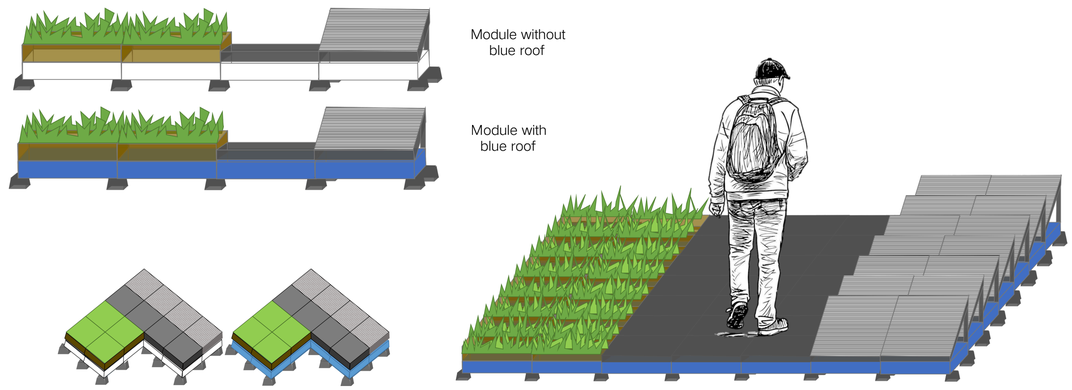
- Tray/box;
- Support system and accessories.

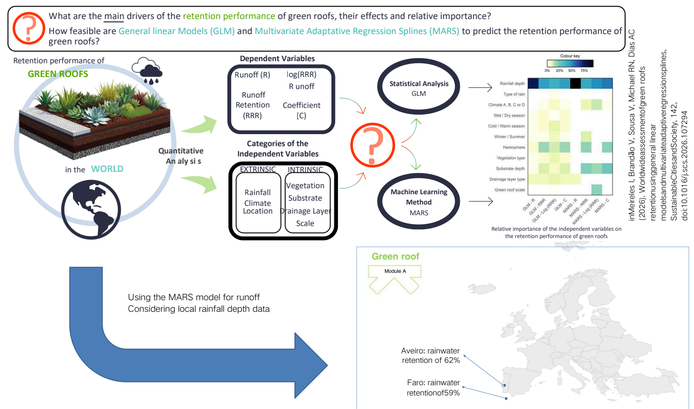
Work Package 2 continues to advance the development of the **Raised Floor system**, an innovative modular solution designed to transform rooftops into adaptable multifunctional spaces. Rather than offering a fixed rooftop configuration, the system is being developed as a flexible platform capable of supporting different combinations of green infrastructure, photovoltaic systems and accessible spaces according to local needs



The modular concept allows different rooftop elements to work together seamlessly. Green roof areas, walkable surfaces and photovoltaic components can be interconnected and rearranged, enabling dynamic rooftop environments that can evolve according to seasonal demands and user requirements.

A dedicated support structure is being developed to position and elevate rooftop modules. This **system** is designed to improve ventilation beneath rooftop installations, protect waterproofing membranes and facilitate technical infrastructure such as drainage systems and photovoltaic cabling. Depending on structural requirements, modules may also incorporate blue roof functionalities, supporting rainwater retention and more efficient water management.





inMeireles I., Brandão V., Sousa V., Michael RN., Dias AC. (2025). Modelling green roofs retention:a regional test of modelsandmultivariateadaptiveregressionsplines. SustainableCitiesandSociety, 142. doi:10.1016/j.scs.2026.107294

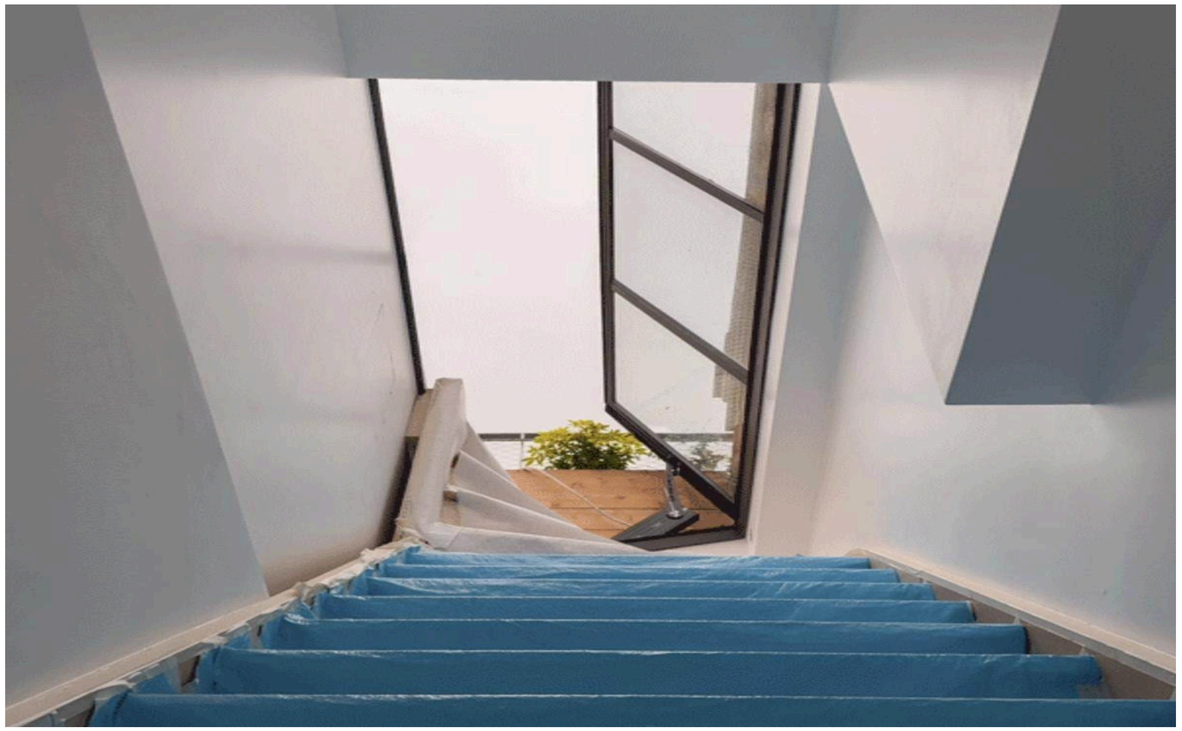
At the same time, researchers are evaluating the environmental performance of green roof systems by investigating the factors influencing rainwater retention. Through statistical analysis and machine-learning methods, including predictive modelling approaches, the study aims to better understand how climatic and structural variables affect rooftop performance.

Initial findings already demonstrate promising results.

Using rainfall-based modelling approaches, preliminary estimations indicate rainwater retention rates of approximately 62% in Aveiro and 59% in Faro, highlighting the potential contribution of green rooftop systems to climate adaptation and urban resilience.

Making Rooftops More Accessible: From Concept to Real-Life Prototype

Another important development within **Work Package 2** focuses on **Rooftop Accessibility**. While many urban rooftops remain disconnected from everyday building use, this task aims to create solutions that enable safe and practical access between indoor spaces and underused rooftop areas.



To address this challenge, the team has been working on innovative access systems specifically designed for pitched roofs and climate adaptation interventions.

Throughout the development process, key priorities included accessibility, waterproofing, affordability, replicability, preservation and design quality, ensuring that solutions are not only technically feasible but also adaptable to different urban contexts.



A major milestone has already been achieved with the implementation of the project's first rooftop access prototype in Paris. The system includes a staircase crossing attic spaces, waterproofing details and a movable skylight, creating a direct connection between the building interior and rooftop environment.

Preliminary results have already demonstrated the short-term technical feasibility of the concept, particularly regarding construction methods, assembly processes and structural performance. At the same time, monitoring activities will continue to assess long-term performance and durability.

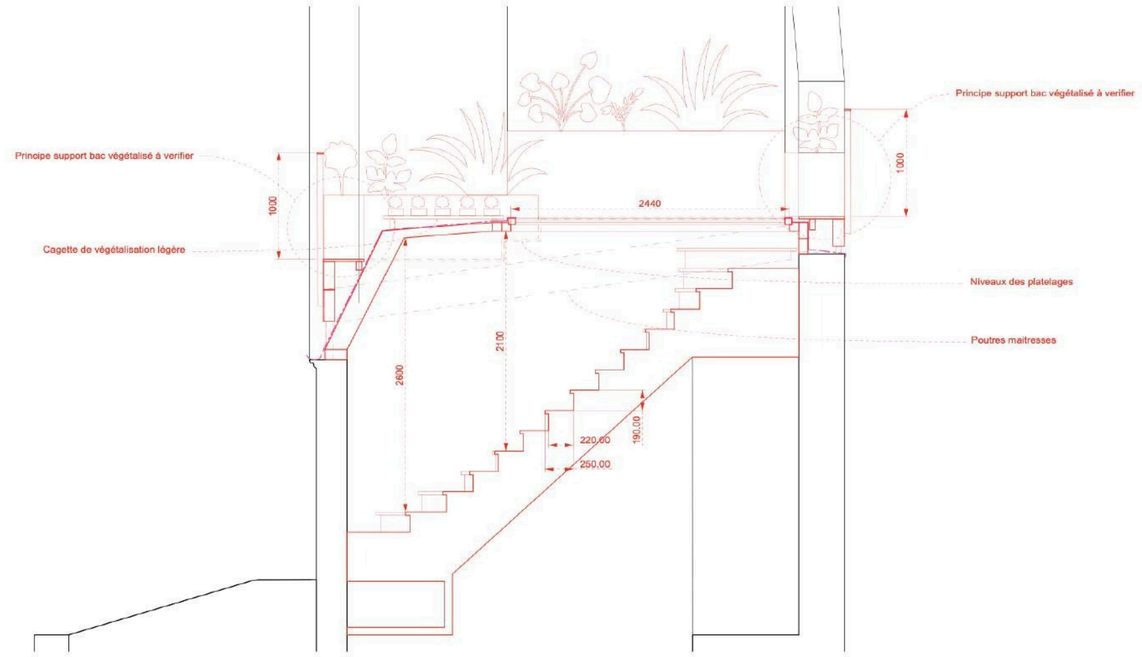


Figure (top): image of the access from the bottom of the newly created opening

Figure (left): drawing set for the rooftop access prototype

Figure (right): construction of the first rooftop access prototype

Way forward

Additional prototype opportunities for rooftop access over pitched roofs in Paris have been identified, each with specific access challenges. Several building permits have already been received by Roofscapes Studio for those deployments. In 2026, we will work on documenting and monitoring the first prototype while building the next ones.

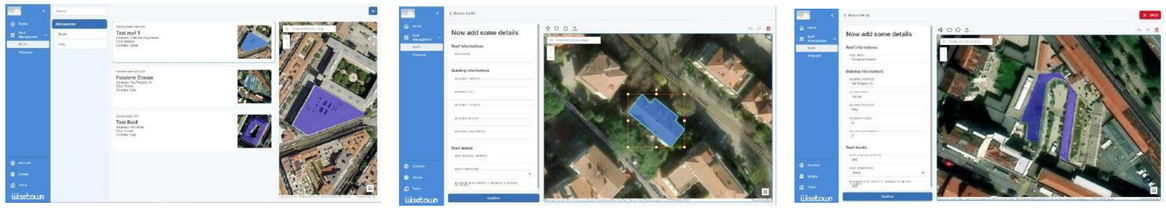
Looking ahead, additional rooftop access opportunities have already been identified across Paris. Several building permits have been secured, and future work will focus on monitoring the first implementation while further prototypes continue to be developed.

WORK PACKAGE 3:

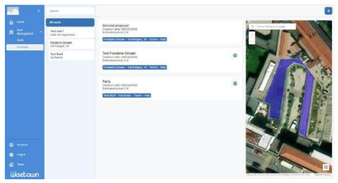
Digitalization of the Innovations

Bringing Rooftop Innovation into the Digital World

While innovative physical solutions are transforming rooftops, Work Package 3 focuses on their digital dimension, creating the tools and digital infrastructure needed to support smarter planning, management and decision-making. Led through collaboration between project partners, this work aims to make rooftop transformation more connected, data-driven and accessible.

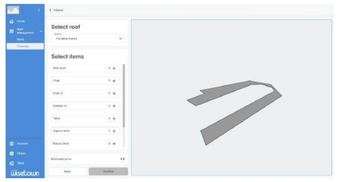


To achieve this, the aRTes project is developing a digital ecosystem that combines rooftop data, spatial information and interactive tools into one integrated environment. As a result, planners, stakeholders and communities will be able to explore rooftop opportunities more efficiently and collaboratively.

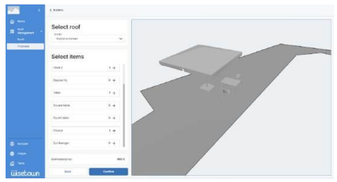


The Proposal Home acts as the central hub for managing proposals. Users can:
- View all proposals
- Navigate through proposal records
- Access filtering options

Similar to the Roofs module, proposals can be filtered:
Flexible query capabilities
Support for different filtering criteria



The system allows linking a proposal to a specific roof:
Selection of a roof during creation
Contextual association between spatial and proposal data
This highlights integration between the two modules.



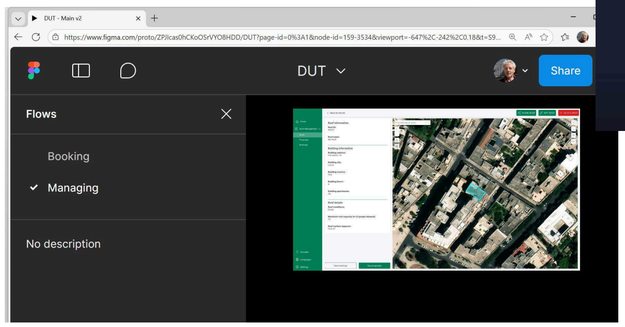
Users can initiate a new proposal without selecting a roof and enrich proposals by adding items:
A modular structure for proposals
Support for multiple components within a single proposal

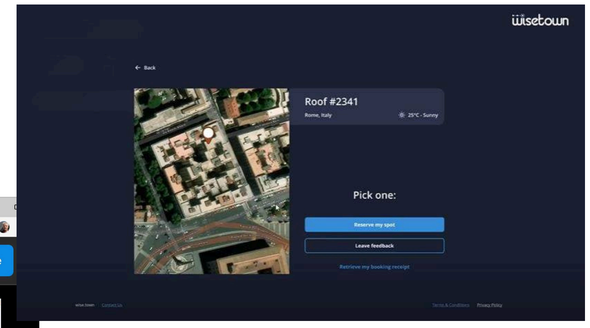


The *Proposal Detail* view provides a full overview of the proposal

One of the key developments is the **Rooftop Renovation Collaborative Design Tool**, which supports a transparent and participatory co-design process. Rather than relying on isolated decisions, the platform allows users to create, manage and evaluate rooftop proposals while incorporating multiple factors such as spatial data, sustainability indicators, lifecycle information and technical assessments. In addition, users can create rooftop geometries, review detailed attributes and connect proposals with specific rooftop sites, improving both usability and decision-making processes.

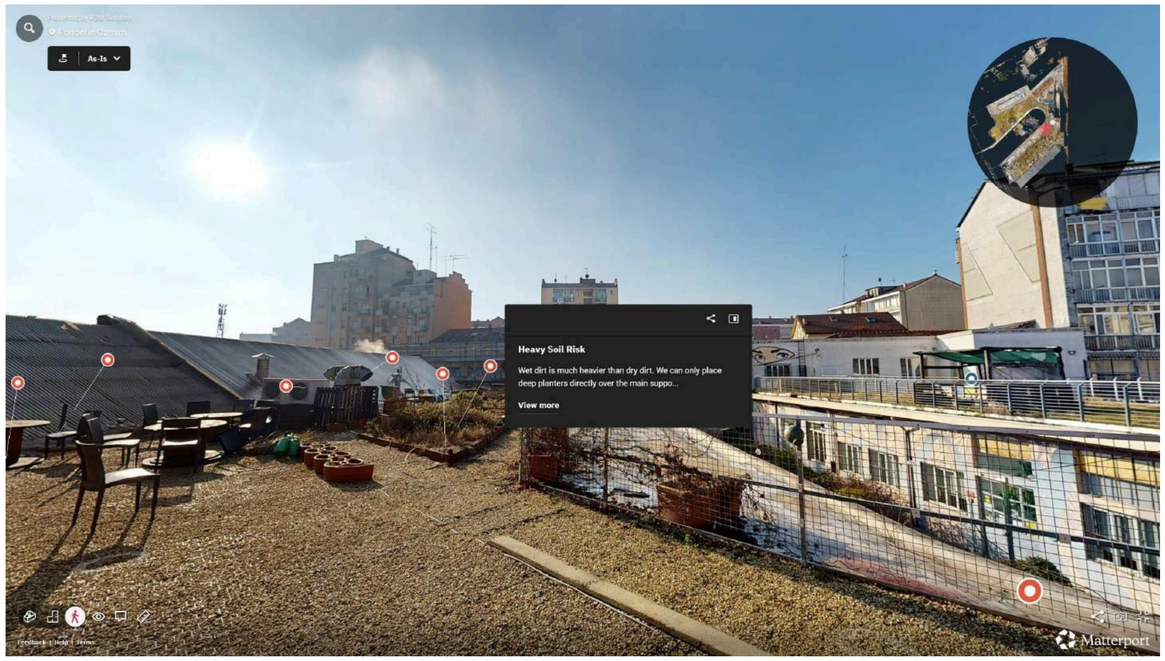
At the same time, development continues on tools supporting safe rooftop planning and socio-technical monitoring. Although the interface is still under development, important backend foundations are already in place. The system architecture and middleware have already been configured to support future rooftop management functionalities, including booking, monitoring and interaction services.





Another major achievement is the development of the **Holistic Rooftop Dataspace Integration Middleware**, which acts as the digital backbone of the entire ecosystem. This infrastructure enables communication and synchronization between rooftop data acquisition, processing and visualization systems while ensuring interoperability among different platform components.

From Digital Tools to Smarter Rooftop Experiences



Work Package 3 continues expanding the project's digital ecosystem through advanced tools designed to make rooftop transformation more interactive, accessible and easier to understand.

One of the latest developments is the creation of an **interactive 3D Digital Twin environment**, transforming rooftop pilot sites into navigable digital experiences. Rather than functioning as static reports, these digital twins combine physical conditions, contextual information, sensor data and proposed aRTes interventions into a single virtual environment. Users can explore rooftop spaces in both their **current ("As-Is")** and **future ("To-Be") conditions**, allowing opportunities and challenges to become easier to visualize and assess.

To support this effort, the first virtual pilot has been developed around the Fonderie Ozanam rooftop in Turin, Italy. Progress has already included completion of a **3D Matterport scan** and the integration of contextual rooftop information. Moreover, future development will enrich the platform through **IoT sensor data**, live information layers and interactive web functionalities. As a result, rooftop planning becomes a more immersive and data-driven process that supports communication among partners, municipalities and future users.

At the same time, another important innovation focuses on simplifying one of the most challenging aspects of rooftop transformation: understanding complex regulations and legal requirements.

For this reason, the project is developing a **GenAI-powered Smart Expert Assistant**, designed to make rooftop knowledge more accessible for both citizens and professionals. Through a conversational interface, users can ask questions in natural language about topics such as permits, structural limitations, fire safety requirements, incentives and rooftop regulations.

Unlike general-purpose AI systems, this tool is built on a curated knowledge base of official documents, manuals and research sources. Therefore, responses remain grounded in verified information, prioritizing reliability and trust over speculation.







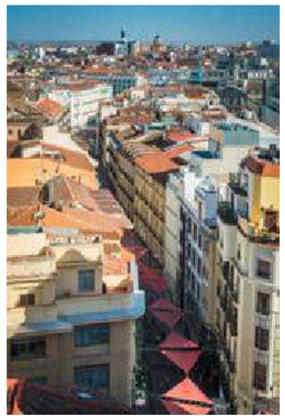
The Turin prototype is already operational internally and is gradually expanding to support additional countries, languages and regulatory contexts. Ultimately, this innovation aims to democratize rooftop knowledge by transforming complex technical information into practical and accessible guidance for everyone.

WORK PACKAGE 4:

Drone-Ready Rooftops

Drone-ready rooftops and urban air mobility



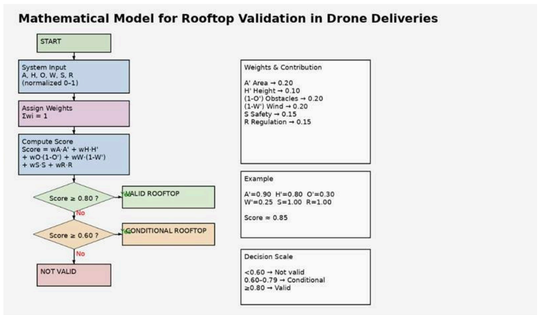




Work Package 4 investigates the emerging role of rooftops within future urban logistics and drone ecosystems, exploring how underutilized rooftop spaces can become active infrastructure supporting new forms of mobility and service delivery. As cities face increasing pressure from congestion, growing delivery demands and limited urban space, rooftops offer opportunities for developing alternative logistics models capable of supporting more efficient and sustainable urban systems.

Within this context, the work examines the potential integration of drone technologies for last-mile delivery operations, emergency response activities and urban air mobility services. Initial assessments indicate strong growth potential and increasing public acceptance, while also identifying opportunities related to smart city integration, new business models and urban infrastructure innovation.

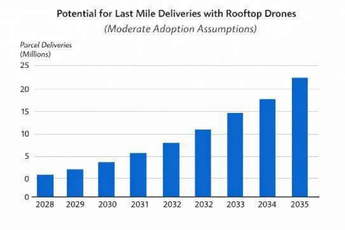




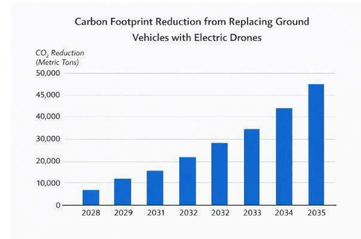
To support future implementation, WP4 is also developing a quantitative assessment framework capable of evaluating rooftop suitability for drone operations.

Through mathematical modelling and spatial analysis, rooftops can be systematically classified according to operational, environmental and regulatory criteria, enabling the identification of interconnected rooftop networks and optimized logistics pathways.

Ultimately, the work contributes to redefining rooftops from passive architectural elements into active urban assets capable of supporting future city infrastructures.



The growth potential is significant. The volume of drone deliveries in the city of Madrid has been calculated (see graph) from 2028 to 2035.



As these are electric vehicles operating in the air, optimizing routes and distances results in significant reductions in the carbon footprint by replacing and substituting ground vehicles, and also helping to reduce road traffic congestion (see graph Madrid case).



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