Life SuperHero

LIFE19 CCA/IT/001194

SUstainability and PERformances for HEROTILE-based energy efficient roofs

LAYMAN'S REPORT

May 2026

With the contribution of the LIFE Programme of the European Union.

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LIFE SUPERHERO: project factsheet

LIFE SUPERHERO is co-financed by the LIFE Programme of the European Union.

Full project title:

SUstainability and PERformances for HEROTILE-based energy efficient roofs

Project acronym:

LIFE SUPERHERO

Project reference:

LIFE19 CCA/IT/001194

Topic:

Climate Change Adaptation

Sector:

Urban adaptation/planning

Goal:

LIFE SUPERHERO promotes the use of Ventilated and Permeable Roofs and HEROTILE-Based Roofs as an effective passive cooling solution for climate adaptation and mitigation, reducing both summer overheating in buildings and cities and cooling energy use and related costs and greenhouse gas emissions.

Duration:

2020-2026

Budget:

3.03 million Euro

EU contribution:

1.56 million Euro

Countries:

Italy, France, Spain

Project demonstration site:

Two social housing buildings in Via G. Maramotti 23/25, Gavassa, Reggio Emilia, Italy

Main solution demonstrated:

HEROTILE-Based Roofs installed over existing flat roofs, using two types of highly air-permeable clay roof tiles (Portuguese HEROTILE and Marseillaise HEROTILE).

Project strategy:

LIFE SUPERHERO is based on four parallel action pillars: standardisation and regulation; best practice with municipalities; development of a software tool; industrial replicability and transferability for market penetration.

Partners:

- Centro Ceramico (Coordinator) (IT);
- ACER Reggio Emilia (IT);
- Confindustria Ceramica (IT);
- CTMNC (FR);
- EDILIANS (FR);
- HISPALYT (ES);
- Industrie Cotto Possagno (IT);
- Terreal (IT);
- Università Politecnica delle Marche (IT).

Project website and social media:

www.lifesuperhero.eu | facebook.com/lifesuperhero | instagram.com/lifesuperhero
x.com/Lifesuperhero | linkedin.com/Lifesuperhero

1 Summary of project scope and objectives

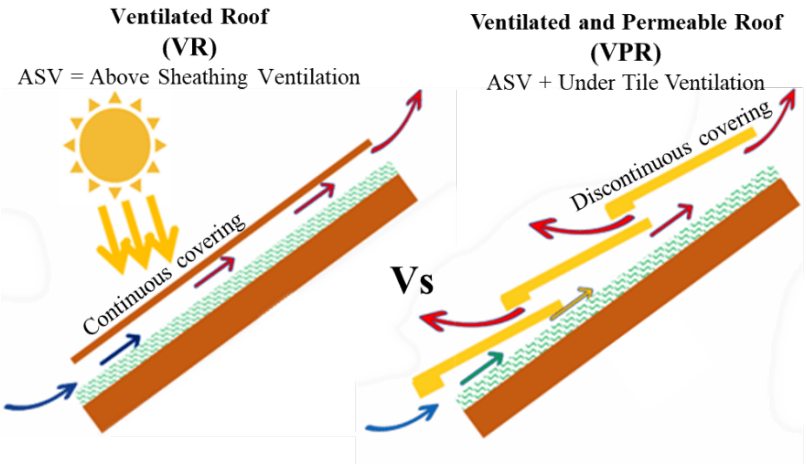
1.1 Project scope

Climate change is making summer heatwaves more frequent and intense. In urban areas, these effects are amplified by the Urban Heat Island phenomenon, increasing outdoor temperatures and worsening indoor summer discomfort.

Air conditioning is often used to cope with overheating, but it increases electricity consumption and related greenhouse gas emissions. For this reason, passive cooling solutions are becoming increasingly important to improve summer comfort, reduce energy demand and support climate adaptation.

Roofs are among the building elements most exposed to solar radiation. In summer, roof coverings can reach high temperatures and transfer heat to the rooms below. Ventilated roofs help limit this effect by allowing air to move beneath the roof covering and remove part of the heat accumulated by the roof.

LIFE SUPERHERO promotes Ventilated and Permeable Roofs, and **HEROTILE-Based Roofs** specifically. These roofs use clay tiles designed to improve air permeability at tile level, allowing air to circulate both below the tiles and through the joints and overlaps between them. This enhances natural ventilation and helps dissipate solar heat.



The project addresses both the technical potential of this solution and the barriers that may limit its wider uptake. Regulations, public procurement criteria, energy calculation methods and building assessment tools often do not fully recognise the cooling benefits of ventilated and permeable roofs. LIFE SUPERHERO therefore focuses on making these benefits measurable, visible and easier to include in building renovation strategies.

Overall, the project provides a practical framework for using ventilated and permeable clay roofs in climate-resilient renovation, combining technical assessment, real-building demonstration, monitoring, decision-support tools and uptake-oriented activities.

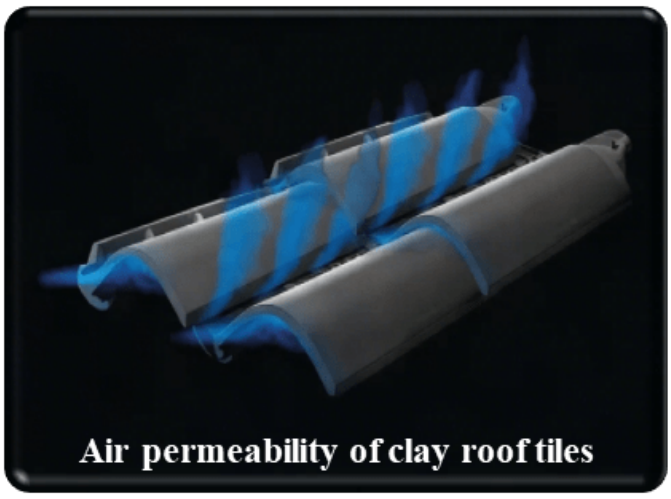
1.2 Objectives

The main objective of LIFE SUPERHERO is to promote the wider use of Ventilated and Permeable Roofs as an effective passive cooling solution for buildings and cities.

More specifically, the project aims to:

- improve the technical understanding and measurability of air permeability in clay roof tile assemblies, supporting future standardisation and assessment procedures;
- demonstrate HEROTILE-Based Roofs on real residential buildings, showing how existing roofs can be transformed into ventilated and permeable roofing systems as part of climate-resilient renovation strategies;
- assess the effects of the solution on roof temperatures, indoor summer comfort, cooling energy need, environmental performance and Urban Heat Island mitigation;
- support designers, public authorities, housing providers, contractors and manufacturers through monitoring data, practical guidance, decision-support tools and dissemination activities;
- contribute to the recognition of passive roof cooling in standards, public procurement criteria, environmental rating systems and climate adaptation strategies, including support for the application process for a European Assessment Document for an innovative air-permeable clay roofing kit.

Through these actions, LIFE SUPERHERO aims to show that clay roof tiles, when properly designed, tested and installed, can become a durable and replicable solution for cooler buildings, lower cooling demand and more resilient urban environments, compatible with photovoltaic systems to be aligned with the European Rooftop Initiative and evolving energy requirements.



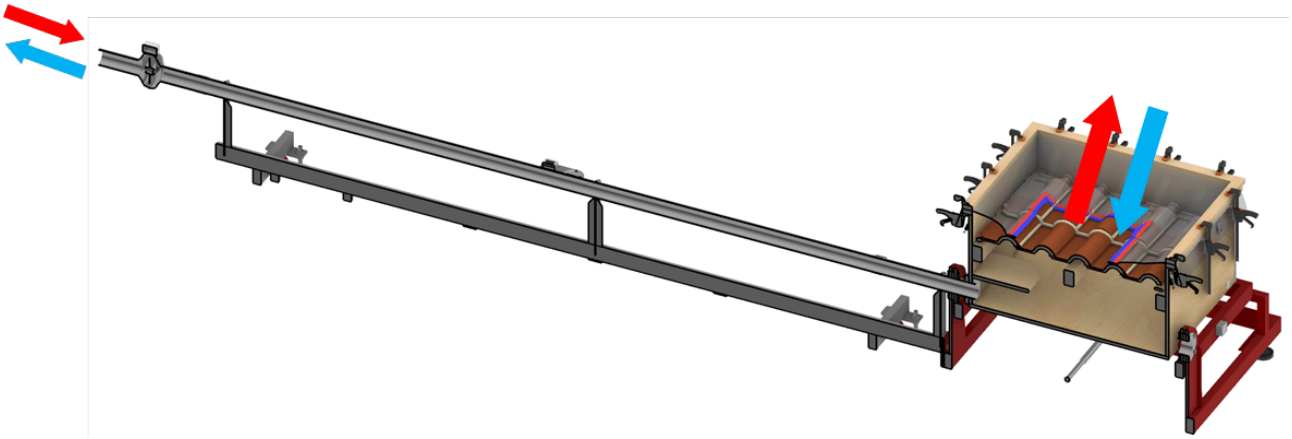
2 Project activities: methodology and outputs

To promote Ventilated and Permeable Roofs as a passive cooling solution, LIFE SUPERHERO carried out activities covering technical testing, standardisation support, real-building demonstration, monitoring, environmental and socio-economic assessment, decision-support tools, practical guidance and industrial replication.

Together, these activities provided a framework to make HEROTILE-Based Roofs easier to measure, design, assess and replicate in climate-resilient building renovation.

Technical characterisation of air permeability

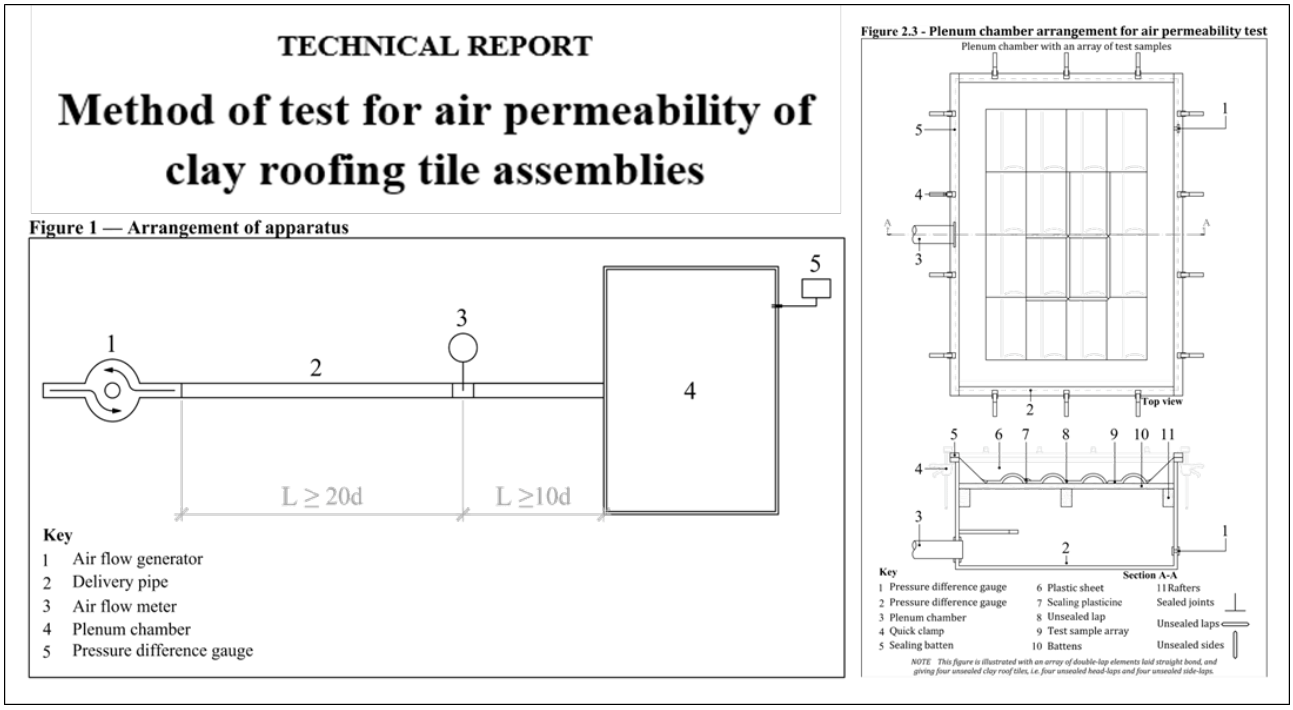
A key activity of the project was the development and application of a laboratory method to measure the air permeability of clay roof tile assemblies. The method was conceived to quantify how much air can pass through the joints and overlaps of discontinuously laid roof tiles under controlled pressure differences.



The test is based on a plenum chamber covered by an assembly of roof tiles. Air is blown or aspirated through a pipe connected to the chamber, while pressure differences and airflow rates are measured. These data describe the ventilation behaviour of the tile assembly and provide input parameters for energy and airflow modelling.

The protocol was adapted from existing standards, using pressure differences more suitable for assessing natural ventilation phenomena rather than wind uplift resistance. A simple equation was also developed to allow the numerical results of the test to be directly used in common energy performance calculation methods and software tools.

A Technical Report describing this test method was prepared and submitted to the European Committee for Standardization, CEN TC128 SC3, and is currently under consideration. This represents an important step towards improving the technical recognition and possible future standardisation of air-permeable clay roof tile systems.



TECHNICAL REPORT

Method of test for air permeability of clay roofing tile assemblies

Figure 1 — Arrangement of apparatus

Key
1 Air flow generator
2 Delivery pipe
3 Air flow meter
4 Plenum chamber
5 Pressure difference gauge

Figure 2.3 - Plenum chamber arrangement for air permeability test

Key
1 Pressure difference gauge
2 Pressure difference gauge
3 Plenum chamber
4 Quick clamp
5 Sealing batten
6 Plastic sheet
7 Sealing plasticine
8 Unsealed lap
9 Test sample array
10 Battens
11 Rafters
Sealed joints
Unsealed laps
Unsealed sides

NOTE This figure is illustrated with an array of double-lap elements laid straight bond, and giving four unsealed clay roof tiles, i.e. four unsealed head-laps and four unsealed side-laps.

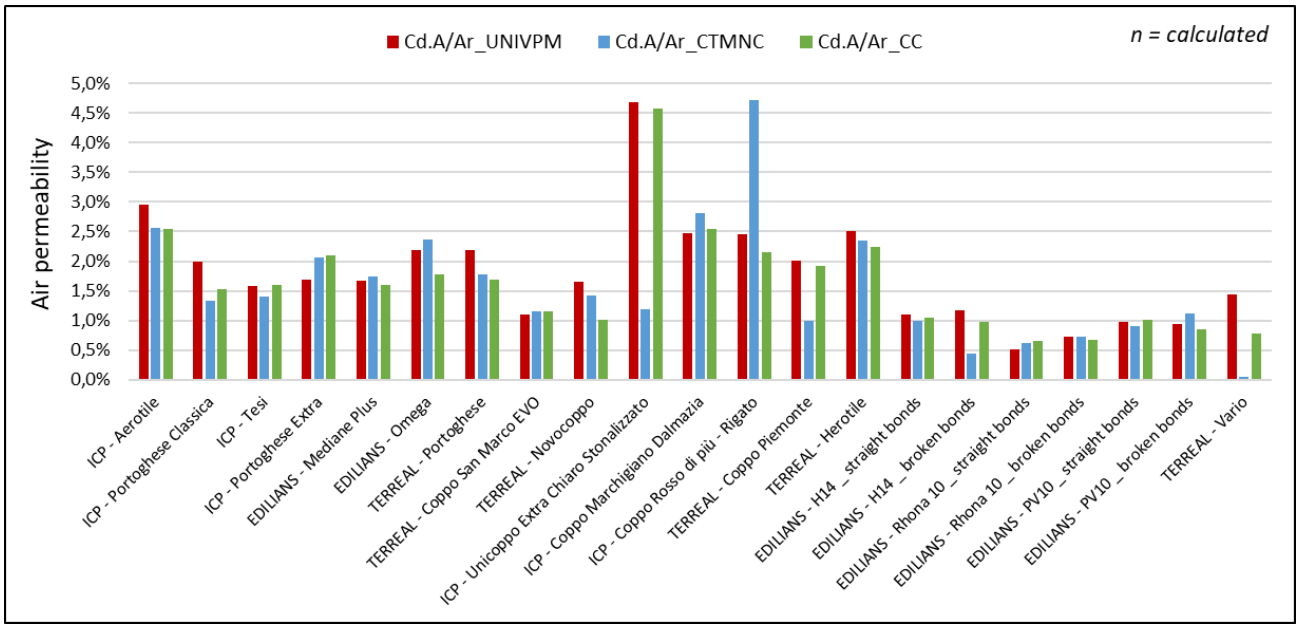
Round Robin testing

The test protocol was applied to different tile configurations and tested in three European laboratories: Centro Ceramico, Università Politecnica delle Marche and CTMNC. The Round Robin Test involved 19 different Portuguese, Coppo and Marseille tiles, including both ordinary tiles and HEROTILE products.

Portuguese Herotile

Marseillaise Herotile

This activity helped verify the robustness of the method and supported its possible use in future technical standardisation activities.



Standards, public procurement and assessment frameworks

In parallel with the laboratory activities, LIFE SUPERHERO worked on the technical and institutional conditions needed to improve the recognition of Ventilated and Permeable Roofs. The project addressed technical standardisation, green public procurement, environmental rating systems and building energy calculation methods, with the aim of making passive roof cooling more visible and easier to assess.

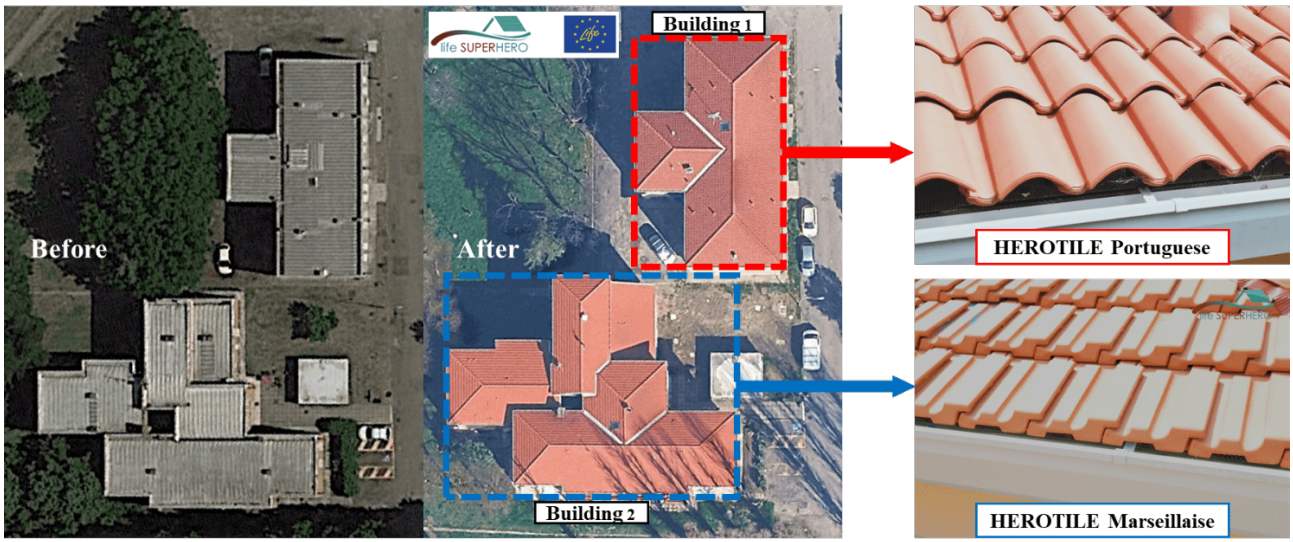
These activities supported the inclusion of Ventilated and Permeable Roofs in broader policy and market frameworks, helping to reduce non-technical barriers to their wider application.

Real-building demonstration

The project demonstrated HEROTILE-Based Roofs on two existing social housing buildings in Reggio Emilia, Italy. The intervention transformed the original flat roofs into lightweight pitched ventilated roofs covered with HEROTILE clay roof tiles.

Two different tile types were used in the demonstration buildings: a Portuguese HEROTILE on one building and a Marseillaise HEROTILE on the other. This made it possible to apply the HBR concept under real renovation conditions and with different clay tile configurations.

The demonstration showed how existing roofs can be transformed into ventilated and permeable roofing systems as part of climate-resilient renovation strategies.



Monitoring and data management

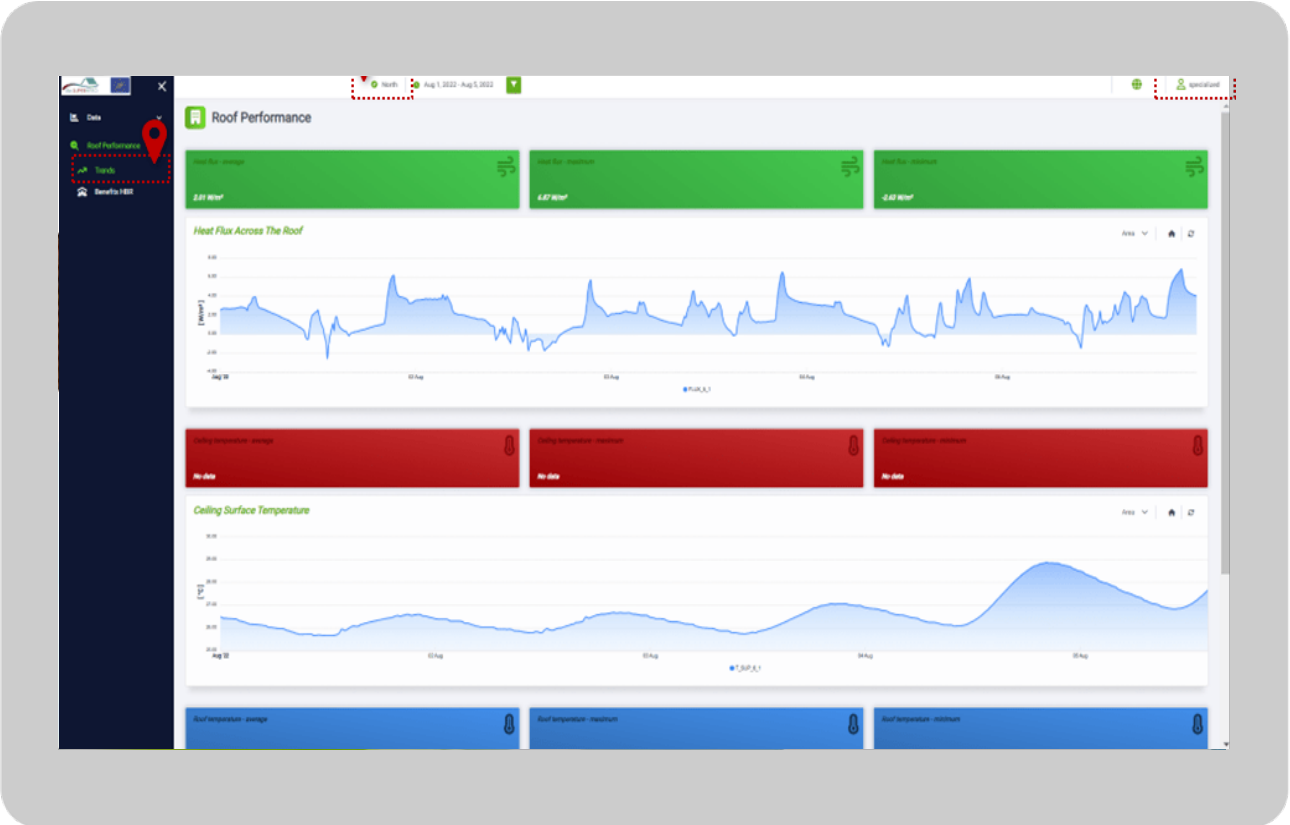
The demonstration buildings were monitored before and after the renovation. The monitoring covered three main phases: the original buildings with unventilated flat roofs, the buildings after envelope renovation with external insulation and new windows, and the buildings after the installation of the HEROTILE-Based Roofs.

The monitoring system collected data on roof thermal performance, indoor environmental quality, outdoor weather conditions, cooling energy use and occupants' behaviour. These data made it possible to compare the effects of the different renovation steps under real operating conditions.

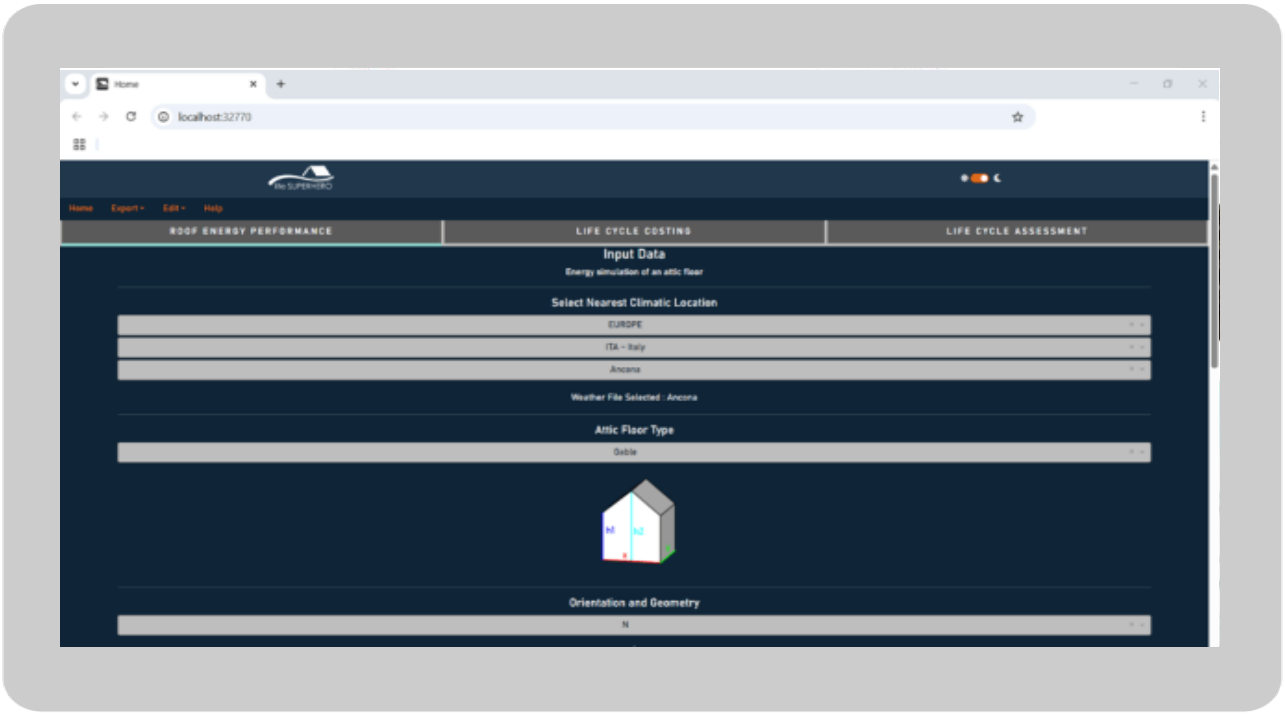
The monitoring activity demonstrated the effectiveness of the proposed solutions in reducing air-conditioning activation frequency, surface roof temperature and internal ceiling temperature. The detailed numerical benefits are presented in the following section of this report.

Decision-support tools

LIFE SUPERHERO also developed digital tools to support the use and dissemination of project results. The **HU-BES platform** was created to make monitoring data accessible and understandable for both expert and non-expert users. It allows users to visualise and compare data, supporting transparency, awareness and future replication.



In addition, the **SUPERHERO software tool** was developed to help designers, consultants and public administrations compare different roof solutions in terms of energy, environmental and economic performance. The tool supports decision-making in renovation and climate adaptation strategies.



Environmental and socio-economic assessment

The project assessed the wider sustainability implications of HEROTILE-Based Roofs through environmental and socio-economic analyses. These activities considered the life-cycle performance of the roof solution, its potential contribution to reduced cooling energy demand, and its possible effects on renovation markets, employment and social housing conditions.

These assessments place the demonstrated solution within a broader sustainability perspective, considering not only technical and energy performance, but also environmental, economic and social relevance.

Practical guidance for renovation

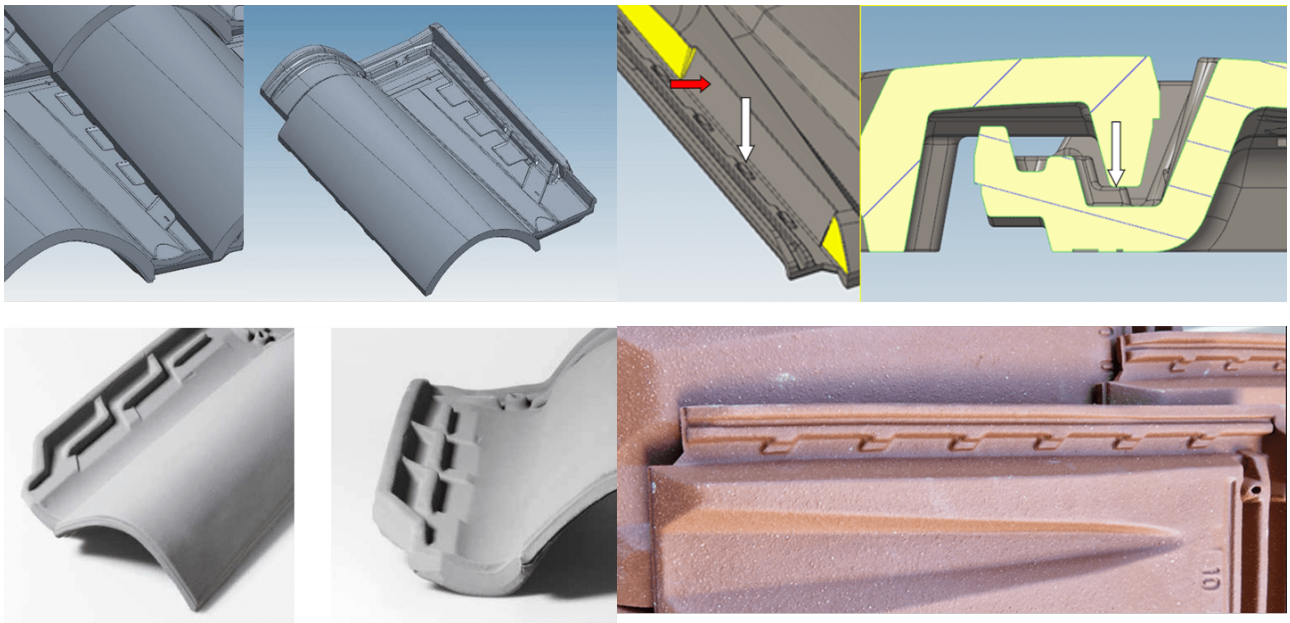
The project produced guidance to support the design and installation of HEROTILE-Based Roofs in renovation contexts. This guidance helps municipalities, housing providers, designers and contractors understand how the solution can be implemented in practice.

By translating the demonstration experience into practical indications, LIFE SUPERHERO supports the replication of HEROTILE-Based Roofs in other buildings and urban contexts.

Industrial replication and market uptake

LIFE SUPERHERO involved roof tile manufacturers, industry associations, research centres and public stakeholders to explore the replication potential of the HBR concept. Activities focused on the possibility of improving air permeability through tile geometry while preserving rain tightness, durability and compatibility with existing industrial production processes.

Guidance was also developed for roof tile manufacturers on how the HBR concept can be applied to clay roof tiles through geometric adaptations. This supports industrial replication while preserving the technical requirements of roofing products and their compatibility with existing manufacturing processes.



Finally, the project supported the recognition of Ventilated and Permeable Roofs in technical standardisation, public procurement, rating systems and climate adaptation strategies, including the application process for a European Assessment Document for an innovative air-permeable clay roofing kit.

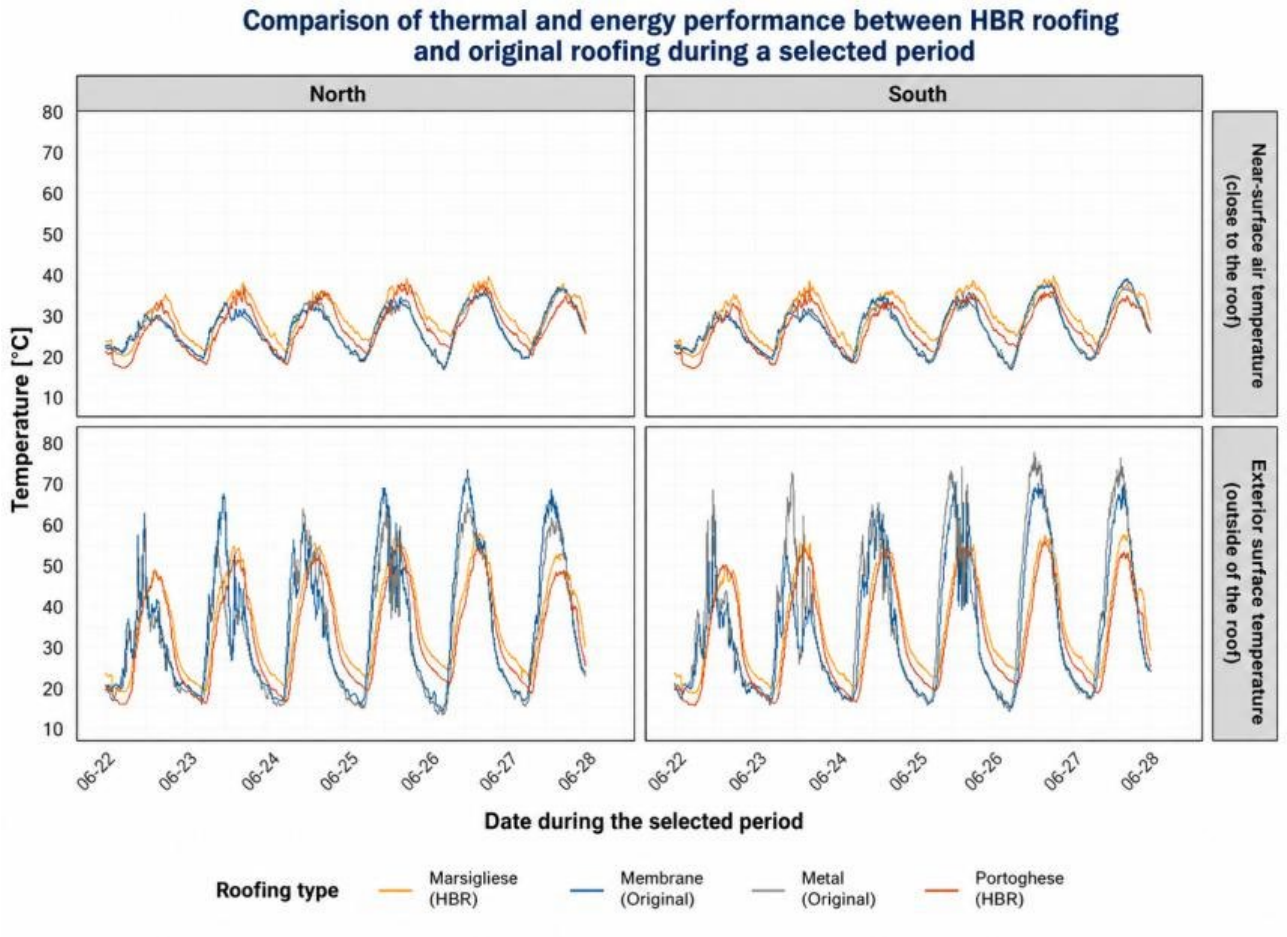
Overall, LIFE SUPERHERO moved the HBR concept from roof-tile innovation to a wider application framework. The project combined laboratory characterisation, real-building demonstration, monitoring evidence, assessment tools, environmental evaluation, practical guidance and policy-oriented actions. These outputs provide a basis for the wider adoption of Ventilated and Permeable Roofs as durable passive cooling solutions for buildings and cities.

3 Assessment of the benefits and impacts

3.1 Energy, comfort and climate benefits

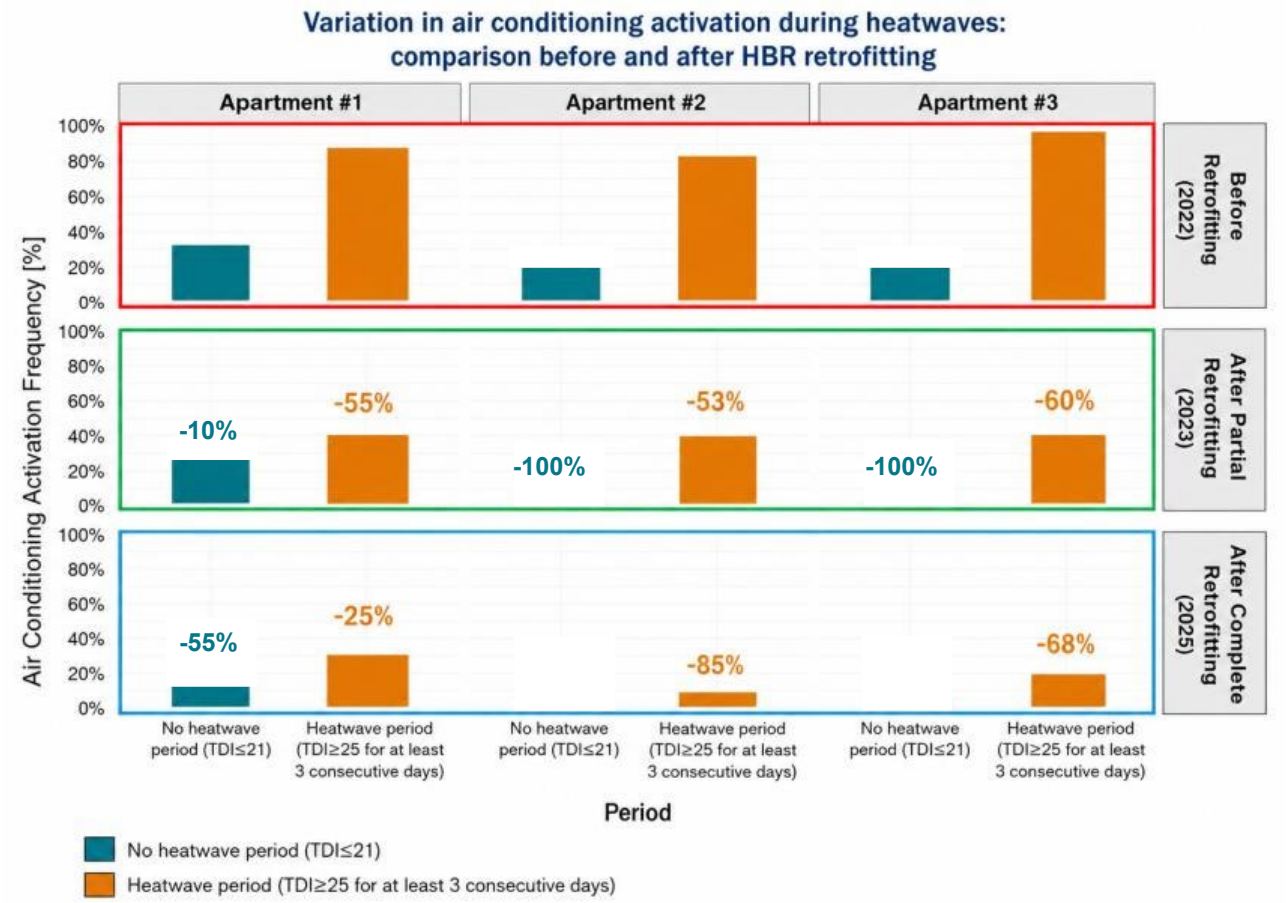
The monitoring activity carried out on the Reggio Emilia demonstration buildings showed clear benefits after the installation of the HEROTILE-Based Roofs.

In a selected summer comparison period in late June, the original roof configuration monitored in 2022 was compared with the HEROTILE-Based Roofs monitored in 2025. The maximum external roof surface temperature was reduced by **18–23%**, with an average reduction of about **20%**. The ceiling temperature of the rooms below the roof was also reduced by **2–8%**.



This reduction in roof and ceiling temperatures also led to a strong decrease in the estimated cooling energy needs associated with roof heat gains. The cooling demand linked to heat entering through the roof, and the related CO_2 emissions, decreased by **44–91%**, with an average reduction of about **67%**. These values depend on tile type, roof orientation and apartment conditions, but they clearly show the positive effect of the HBR system on summer performance.

The project also analysed occupants' behaviour during heatwaves. In the original buildings, air-conditioning use was already high under normal summer conditions and increased further during heatwave periods. After the full renovation, including the HEROTILE-Based Roofs, air-conditioning use remained much lower, showing improved thermal resilience and reduced dependence on mechanical cooling.



Occupants' perception confirmed the monitoring results. After the envelope retrofit, thermal sensation improved from "very hot" to "slightly warm". After the installation of the HEROTILE-Based Roofs, during periods without air conditioning, occupants reported neutral thermal sensation and acceptable comfort conditions. They also reported reduced indoor overheating, lower ceiling temperatures and, in some cases, reduced air-conditioning use.

LIFE SUPERHERO also assessed the contribution of Ventilated and Permeable Roofs to Urban Heat Island mitigation. The thermal behaviour of HBR was included in an urban microclimate model and compared with other roofing solutions. The simulations confirmed that HBR performs better than conventional roofing solutions and can achieve results close to cool roof strategies, while relying on durable clay materials and passive ventilation.

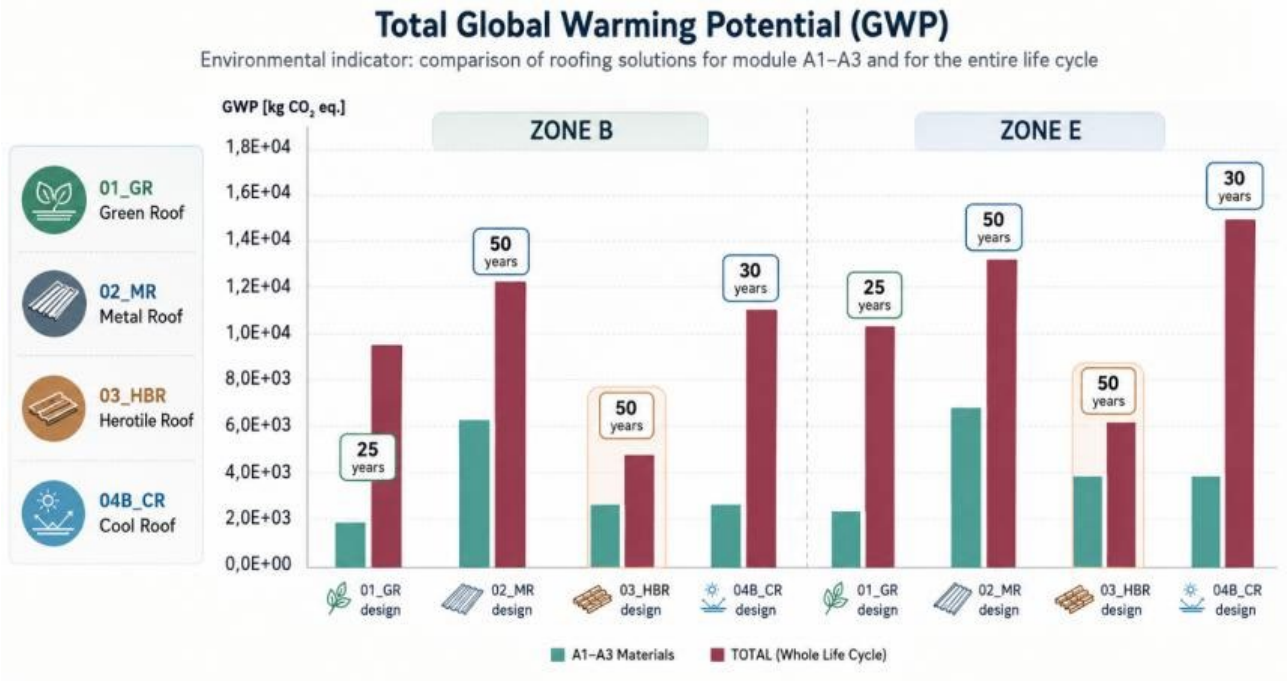
3.2 Environmental, economic and social impacts

The environmental performance of HEROTILE-Based Roofs was assessed through a comparative Life Cycle Assessment, comparing the HBR/VPR solution with other roofing technologies representative of the European market, including green roofs, metal roofs and cool roofs. The assessment considered the whole life cycle and included the influence of roof design on building energy performance during use.

The results showed that the HBR/VPR solution performs very well over the full life cycle. Considering the **average results across the core environmental indicators**, **green roofs, metal roofs and cool roofs showed impacts** about **2%**, **7%** and **2% higher** than HBR/VPR in Climate Zone B, and about **2%**, **7%** and **17% higher** in Climate Zone E.

This performance is mainly linked to the relatively simple roof build-up, the limited number of layers and the long service life of the clay tile system, which reduce impacts associated with materials, transport and replacement during the building life cycle.

The indicator-level analysis confirmed this positive trend. For the roof-related life-cycle modules, excluding operational energy use, HBR/VPR showed particularly favourable results for several key indicators: **Global Warming Potential** was about **43–62% lower**, **Acidification** about **66–88% lower**, and **Terrestrial Eutrophication** about **60–85% lower** than the alternative roof solutions, depending on the climate zone and roof type considered.



However, the assessment also highlighted one relevant trade-off: Water Use was the main indicator for which HBR/VPR showed a less favourable performance. Therefore, the LCA results should be read as broadly positive, although not uniformly better across all environmental indicators.

Overall, the Life Cycle Assessment confirmed that HEROTILE-Based Roofs are not only effective during use, thanks to reduced heat transfer and lower cooling needs, but also environmentally competitive when the full life cycle is considered.

The socio-economic assessment focused on Spain, France and Italy as representative Southern European markets. It showed that large-scale roof refurbishment using HBR can generate economic activity, reduce cooling energy demand and support employment connected to roof renovation and installation activities. The analysis identified pre-1990 buildings as a particularly relevant target, because they often have the greatest need for energy upgrading.

In warm climates, HBR refurbishment scenarios can lead to cooling energy reductions of up to **33%**, with direct effects on electricity costs for households. This is especially relevant for social housing, where improved summer comfort and lower cooling needs can help reduce energy vulnerability and improve living conditions for occupants.

Taken together, these results show that HEROTILE-Based Roofs can support sustainable renovation at different levels: by reducing life-cycle environmental impacts, lowering operating energy needs, stimulating refurbishment-related activities and improving living conditions for vulnerable households.

4 Transferability and replication of results

LIFE SUPERHERO was conceived not only as a demonstration project, but also as a way to create practical conditions for the wider use of Ventilated and Permeable Roofs in Europe.

The **first level** of transferability concerns the technical and regulatory conditions needed for wider uptake. The air permeability test method, the Round Robin activity and the work on building energy calculation methods support a clearer technical recognition of VPR and HBR solutions. LIFE SUPERHERO also launched the application process for a European Assessment Document (EAD) for an innovative air-permeable clay roofing kit, as a first step towards a possible European Technical Assessment route. In parallel, LIFE SUPERHERO contributed to the inclusion of ventilated roofs in Italian Green Public Procurement criteria as possible solutions for reducing Urban Heat Island impacts, and supported their recognition within GBC Italia through the CP108 "Passive Roof Cooling" pilot credit. This is important because passive roof cooling is still not fully represented in many current assessment and regulatory frameworks.

The **second level** concerns building renovation. In Reggio Emilia, the project showed how existing flat roofs can be transformed into lightweight pitched ventilated roofs covered with HEROTILE clay tiles. This experience was translated into practical guidance covering design checks, site preparation, wooden structure assembly, ventilation details, gutters, accessories and tile installation. In this way, the pilot intervention becomes a useful reference for municipalities, social housing providers, designers and contractors working on similar renovation projects.

A **third level** is provided by the tools developed during the project. The SUPERHERO software helps designers, consultants and public administrations compare different roof solutions in terms of energy, environmental and economic performance. The HUBES platform makes monitoring data from the demonstrator buildings accessible and understandable, supporting awareness, transparency and future replication.

The **fourth level** concerns industrial replication. LIFE SUPERHERO developed guidance for roof tile manufacturers, showing how the HBR concept can be applied to clay roof tiles by adapting their geometry, especially in interlocking systems. These adaptations aim to increase controlled air permeability while preserving rain tightness. The proposed approach is compatible with existing industrial processes and does not

require changes to raw materials, firing cycles or production lines, but mainly limited adaptations of moulds and tooling.

Finally, LIFE SUPERHERO created a basis for market uptake through the involvement of roof tile producers, industry associations, research centres, public bodies and municipalities. The project results were promoted through technical networks, climate adaptation platforms and initiatives such as the Covenant of Mayors, helping public administrations and building stakeholders include passive roof cooling among their renovation and planning strategies.

Overall, LIFE SUPERHERO leaves a complete replication package: a tested roofing solution, monitored evidence, installation and production guidance, assessment tools, and policy-oriented outputs. This package can support the wider adoption of Ventilated and Permeable Roofs as a durable passive cooling solution for cooler buildings and more resilient cities.