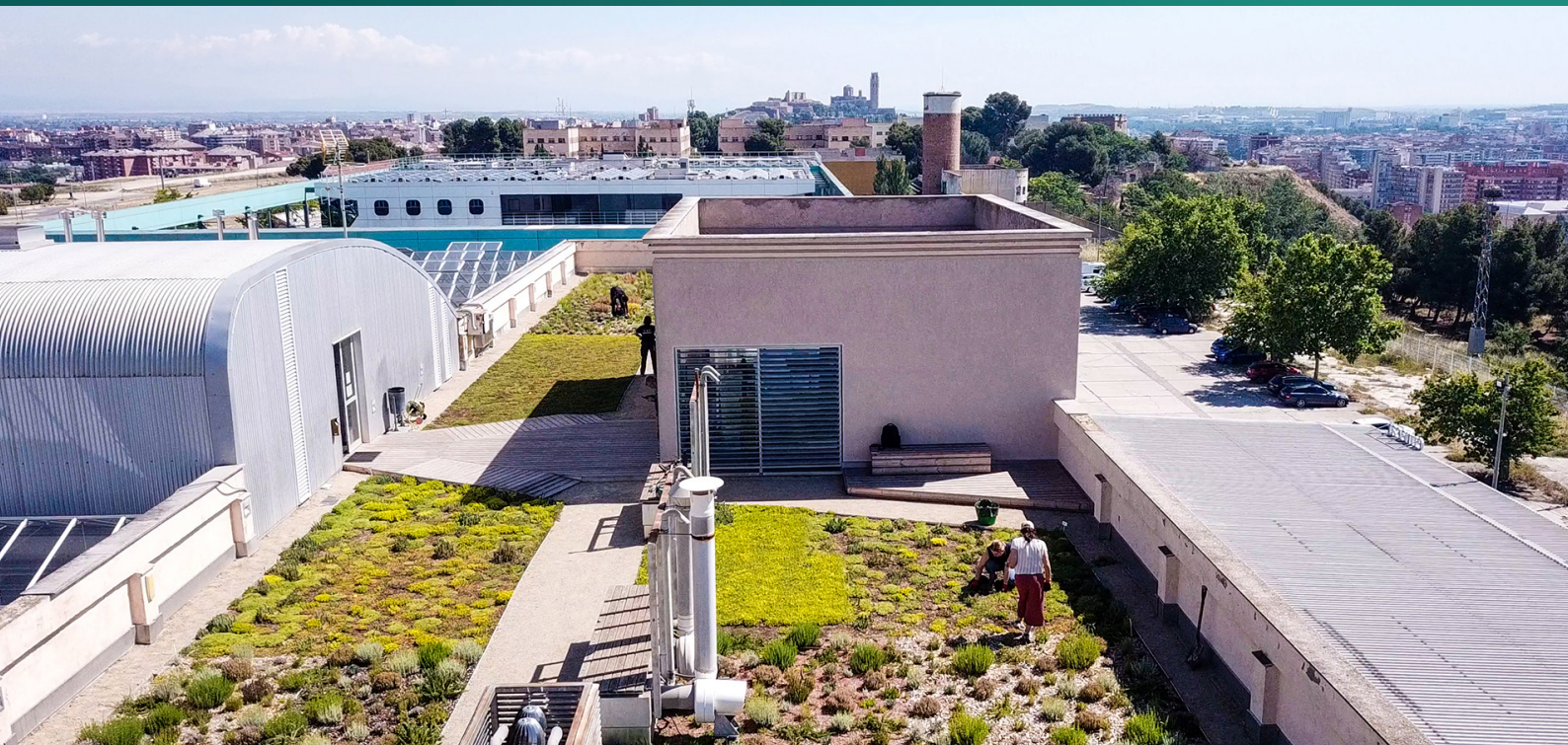


LAYMAN'S REPORT

Towards the New European Bauhaus by advancing the lifespan of BIG systems



The Big4life project has received funding from the European Union's Life Programme

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01

THE BIG4LIFE PROJECT

The BIG4LIFE project focuses on Building Integrated Greenery (BIG) systems, that is, green roofs and façades, rooftop gardens and vertical gardens.

How can the BIG4LIFE project contribute to the future of green roofs and façades?

The objective of BIG4LIFE is to encourage the creation of green roofs and façades in cities, particularly in Mediterranean contexts. To achieve this, it addresses a number of key issues that have emerged through decades of experience in implementing BIG systems.

Assessment of the positive impacts of BIG systems

First, the project assesses the positive impacts of greenery in buildings and their surroundings. By monitoring several pilot cases, BIG4LIFE identifies and quantifies the environmental, social and economic benefits (the so-called ecosystem services). Green roofs and façades are beneficial, and this needs to be demonstrated and disseminated in order to encourage urban stakeholders to create new ones.

Cost-benefit analysis

Despite the benefits they provide, BIG systems also face difficulties and barriers: garden maintenance costs and technical challenges (risks of water infiltration and structural overloading of buildings), which involve building adaptation costs.

The BIG4LIFE project proposes a cost-benefit analysis to demonstrate and, wherever possible, quantify that the benefits of having green roofs and façades outweigh the costs of creating and maintaining them.

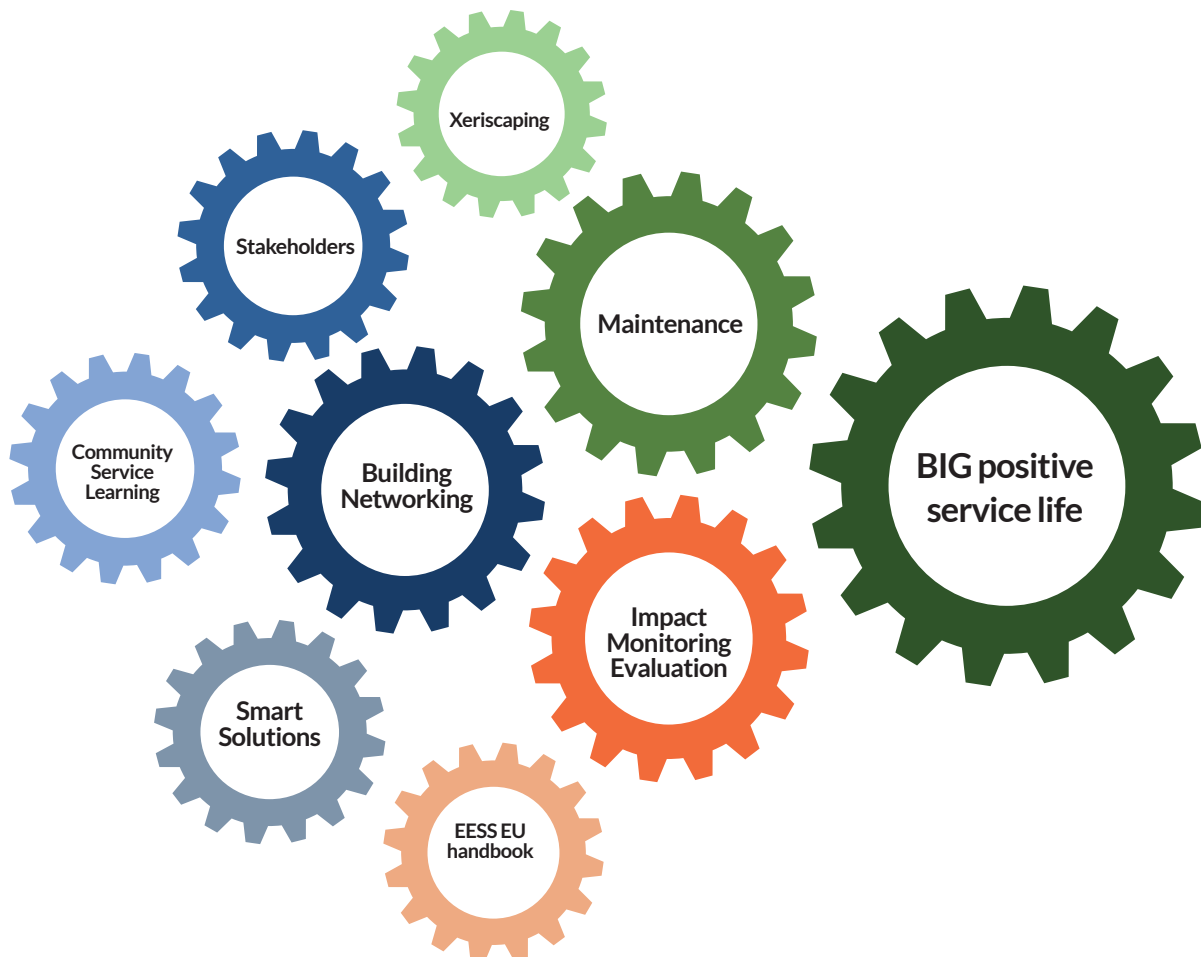


Good maintenance to extend lifespan

Maintenance is an essential aspect. With poor maintenance, building-integrated gardens deteriorate rapidly and cease to provide the ecosystem services that make them valuable. **BIG4LIFE focuses on optimising the maintenance of green roofs and façades in order to extend their lifespan**, make them more sustainable and lasting over time, and ensure the continued provision of socio-environmental benefits.

Xeriscaping techniques and collaborative strategies

This optimisation of maintenance is based on two principles: on the one hand, **xeriscaping techniques, which make it possible to create gardens that consume very little water** and are therefore particularly adapted to Mediterranean climatic conditions; on the other hand, collaborative strategies. BIG4LIFE emphasises how synergies among the different stakeholders involved in the design, construction, management and use of BIG systems contribute to their proper maintenance and operation.



In this way, BIG4LIFE is fully aligned with the **objectives of the European Union's LIFE Programme**, which funds the project and which, since the programme was created in 1992, has focused on protecting the environment and climate while seeking to improve citizens' quality of life. **BIG4LIFE is also framed by the New European Bauhaus initiative**, launched in 2020, which brings European efforts towards the transition to sustainability into urban environments, emphasising aesthetic and inclusive dimensions alongside environmental considerations.

02

BUILDING INTEGRATED GREENERY (BIG) SYSTEMS

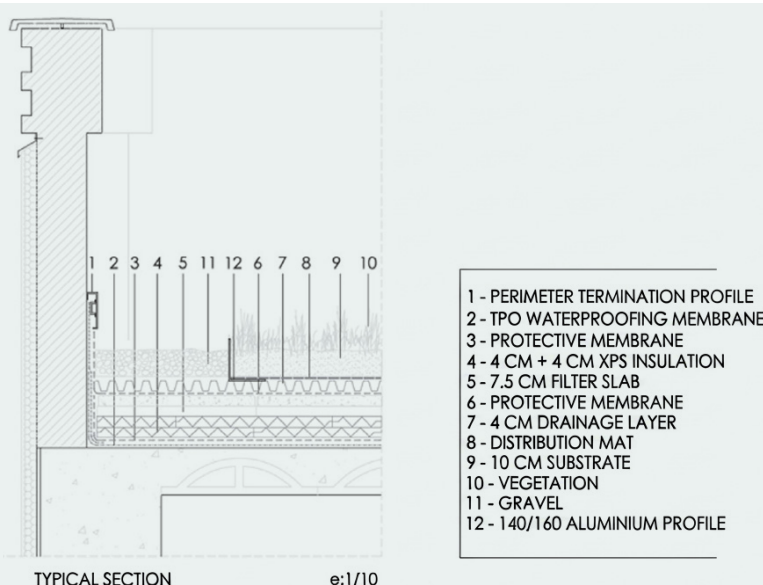
What they are and how they work

Green roofs are generally classified into three main types according to substrate depth, load-bearing requirements, the plant species that grow on them and maintenance needs:

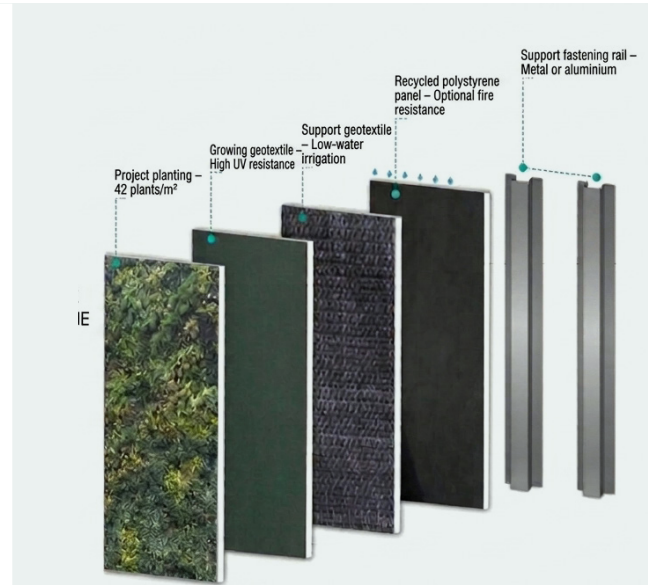
- **Extensive:** Designed to be largely self-sufficient, they use vegetation requiring very little maintenance (such as sedum and succulents) and little soil or substrate (4–15 cm), with a low structural load. They periodically require drainage outlets to be cleaned and weeds to be removed.
- **Intensive:** These roofs function as genuine elevated gardens or accessible terraces. They can accommodate lawns, shrubs and even small trees. They require greater substrate depth (generally 15 to more than 40 cm), have a much higher structural load and require regular maintenance.
- **Semi-intensive:** An intermediate option combining characteristics of the two above. They allow a greater variety of plants (such as grasses and perennial herbs) and require moderate maintenance.

A green roof is a construction system that incorporates vegetation on a building. Technically, it functions as an ecosystem structured in several functional layers:

- **Load-bearing structure:** must support the weight of the roof, especially when the substrate is fully saturated.
- **Vapour barrier:** prevents moisture from inside the building from condensing on the structure.
- **Thermal insulation:** reduces heat loss or heat gain.
- **Waterproofing membrane:** prevents water infiltration into the building.
- **Root barrier:** a specially designed membrane that prevents roots from penetrating the waterproofing layer.
- **Drainage and retention layer:** stores the water required by plants and evacuates excess water towards the drains.
- **Geotextile filter:** separates the drainage layer from the substrate, preventing soil from clogging the water channels.
- **Substrate:** lightweight soil or a specific engineered growing medium (not conventional topsoil) that provides nutrients and supports the roots.
- **Vegetation:** selected according to the type of roof.



Typical section of a green roof



Layers of a green wall iPanel (© Verdtical)

02 BUILDING INTEGRATED GREENERY (BIG) SYSTEMS

The irrigation system is a fundamental component of green roofs. Extensive roofs can generally survive on rainwater, but they often incorporate drip irrigation programmed for the summer months. Intensive roofs always require irrigation.

Green walls generally comprise the following components:

- Support system: a metal substructure separated from the wall that creates an air cavity, prevents dampness and allows ventilation.
- Waterproofing and protection layers: waterproof and root-resistant membranes that prevent water and roots from damaging the building structure.
- Growing system: modules, planters or geotextile mats attached to the structure, where the substrate is placed and plants are inserted.
- Substrate: the material in which plants take root. Lightweight systems often use hydroponics (such as rock wool) instead of soil.
- Automatic irrigation: drip pipes integrated at different heights and controlled by timers that ensure constant moisture.
- Collection and drainage system: a lower gutter and a tank collect excess water. A pump is often included to recirculate and optimise water and nutrients.
- Vegetation: specifically selected according to the climate (orientation, sun exposure and wind).

Environmental, social and economic benefits

Green roofs and façades provide many environmental benefits, such as improved thermal insulation of buildings, reduction of the urban heat-island effect and the resulting energy savings; recovery and reuse of rainwater; increased urban biodiversity; CO₂ sequestration and climate-change mitigation; and reduced air pollution. They also provide social benefits (especially accessible green roofs, which promote spaces for enjoyment, health and well-being and encourage community encounters) and even economic benefits (they can generate local food and energy and create jobs linked to the green economy).

Ecosystem services provided



Biodiversity



Jobs



Wellbeing



Urban Heat Island



Energy saving



Water efficiency



Run-off



Participation



Economic viability

The BIG4LIFE project monitors and assesses the following benefits in the pilot cases studied:

1. Air quality: BIG systems capture air pollution.
2. Biodiversity: BIG systems promote urban flora and fauna.
3. Urban resilience: BIG systems reduce the urban heat-island effect and surface-water runoff.
4. Jobs: related to maintenance and gardening tasks required by BIG systems.
5. Energy savings: thanks to improved thermal insulation of buildings.
6. Greenhouse-gas sequestration, including CO₂.
7. Noise pollution reduction.
8. Citizen participation: green roofs provide opportunities for leisure, environmental education and urban horticulture.
9. Health and well-being: linked to contact with nature.
10. Renewable energy: produced through solar panels integrated into BIG systems.
11. Water-use efficiency: BIG systems enable rainwater recovery and reuse.
12. Water quality: BIG systems purify rainwater by capturing heavy metals and improving the pH of acid rain.
13. Economic resources: BIG systems can produce food or give rise to paid social activities.

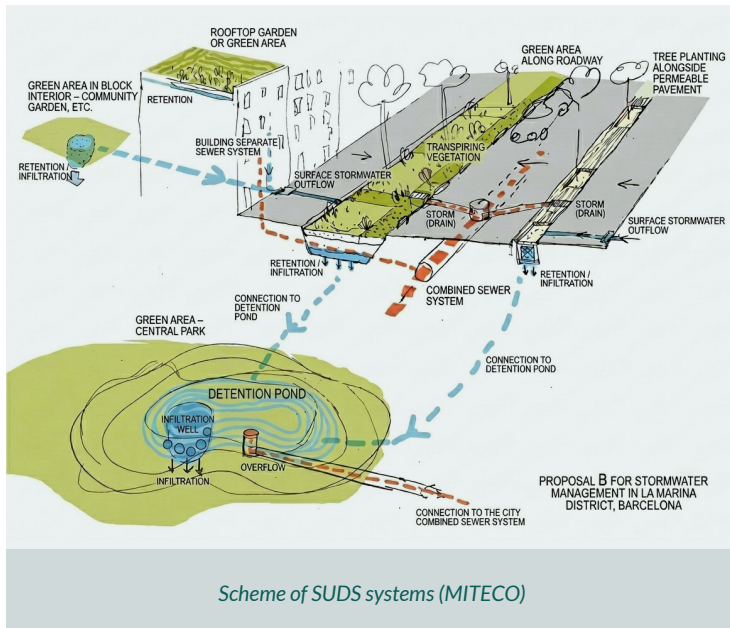
Importance in the Mediterranean and European context

Green roofs and façades are part of what are known as nature-based solutions. These are defined as actions inspired and supported by nature that use natural ecosystems to address societal challenges (such as climate change, biodiversity loss or natural-hazard management) in a sustainable and effective way. They are an important strategy for the naturalisation of cities, alongside, for example, increasing greenery in the network of squares and streets.

In the European context, this naturalisation of cities is fundamental. From an urbanisation perspective, the compact-city model is sustainable in many respects: it reduces urban sprawl across the territory, thereby supporting biodiversity, and reduces travel commuting and energy consumption. However, this means that many citizens live in dense cities. Increasing the presence of greenery is essential to compensate for this high density and provide greater quality of life, well-being and health for their inhabitants.



02 BUILDING INTEGRATED GREENERY (BIG) SYSTEMS



From the perspective of the climate emergency, green roofs and façades make a decisive contribution to making cities more resilient and adapted to climate change. The main climate impacts to which cities must adapt include heatwaves (intensified by the urban heat-island effect, which increases temperatures in large urban agglomerations) and extreme precipitation events, whether prolonged droughts or very heavy rainfall over short periods. On the one hand, BIG systems help reduce the effects of high temperatures, both inside buildings, by improving thermal insulation, and in the urban environment, as vegetation cools ambient temperatures through evapotranspiration.

On the other hand, by capturing and reusing rainwater, they improve water-use efficiency, which is essential during droughts, and, when large amounts of rain fall in a short period, they help prevent flooding by reducing surface-water runoff reaching streets or the rainwater drainage system.

This role of green roofs and façades in increasing urban resilience is particularly relevant in Mediterranean cities, an epicentre of climate change where rising temperatures and droughts alternating with episodes of extreme rainfall are becoming increasingly evident every year.



03 METHODOLOGICAL INNOVATION: SMART TECHNOLOGIES AND COLLABORATIVE NETWORKS

The BIG4LIFE project also stands out for the methodological innovations it puts into practice. These include both technological innovation and social innovation.

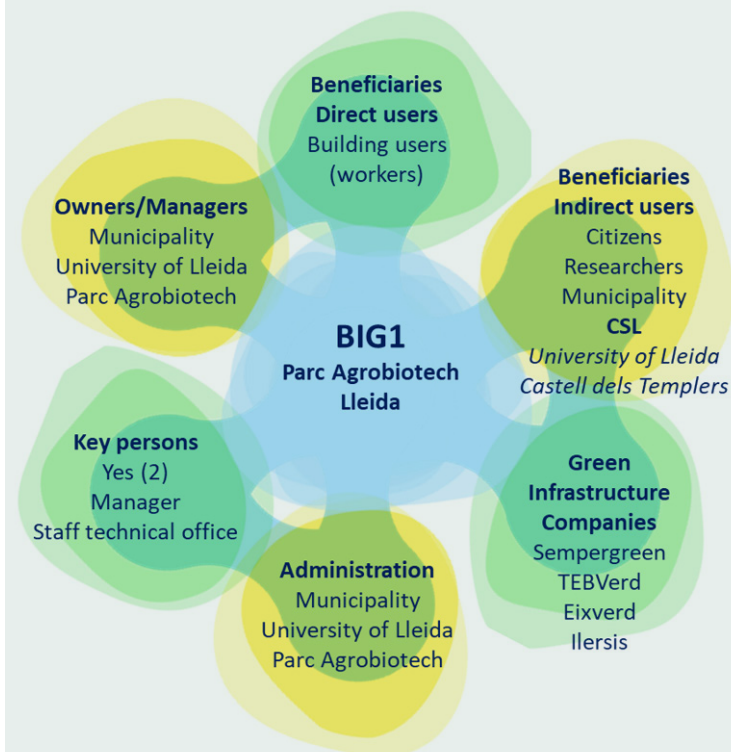
Regarding technological innovation, BIG4LIFE has installed equipment and smart control systems in the different pilot cases to monitor maintenance tasks and assess ecosystem services generated by BIG systems that can be automated. These sensors include biotrapping cameras that detect the presence of animals, air-quality monitoring stations, weather stations to monitor temperature and humidity, rain gauges to quantify collected rainwater, systems that detect greenhouse-gas exchange between buildings and the atmosphere, people counters, and more.



Regarding social innovation, BIG4LIFE stands out for the strong involvement of local communities and all stakeholders connected with BIG systems (creators, builders, managers, maintenance staff, users, etc.) in restoring, maintaining and monitoring green roofs and façades. Through Service-Learning initiatives, numerous groups of students have learned about the project and participated in the design, improvement, maintenance or monitoring of specific pilot cases. Numerous training, exchange and discussion sessions have also been held with stakeholders on the maintenance of BIG systems and the monitoring of the ecosystem services they provide as part of capacity-building activities.

In this way, one of the central ideas of BIG4LIFE is put into practice: collaborative networks are essential for well-maintained green roofs and façades with an extended lifespan and optimal provision of socio-environmental benefits.

Stakeholders

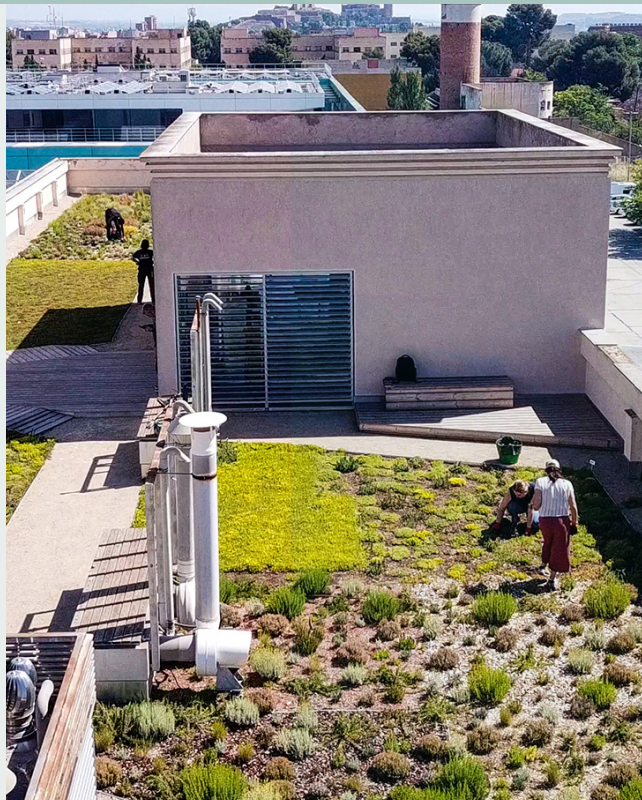


04 PROJECT PILOT CASES

BIG1_Parc Agrobiotech (Refurbished and monitored) Designer: Pich-Aguilera Architects, J.M.Puigdemasa

An extensive, accessible and walkable 3,000 m² green roof on a building with offices and laboratories for scientific activities, located on Gardeny hill in Lleida. BIG4LIFE refurbished a 600 m² area, replacing the green-roof construction system.

The original roof had a water-storage tank that collected rainwater and was intended to irrigate the vegetation from the roots through capillary action. It had problems due to insufficient rainfall and the risk of water infiltration. The intervention removed the tank and installed thermal-insulation and waterproofing layers, as well as a new drip-irrigation system. The result is a pleasant space for spending time around a meeting room with views over the city and the Lleida plain.



BIG2_Ronda Mercè (Refurbished and monitored) Designer: BR29, Pàmpols, Montserrat Giné Architects

Ronda Mercè School is a public nursery school in a single-storey building in Lleida. It has an extensive, non-accessible and non-walkable roof about 600m². BIG4LIFE has refurbished a 200m² area. The project replaced the technical layers (protective, drainage and filtering geotextiles), installed a new irrigation system, and replaced the substrate and sedum to revitalise it.



BIG3_Porxos d'en Xifré (Monitored) Designer: Mata Alta Studio

The rooftop of the residential building at Porxos d'en Xifré in Barcelona's Ciutat Vella district has been transformed into a semi-extensive roof with 1,475 m² of planted area, with sedums, shrubs and some trees. It is walkable and accessible to all residents of the building. It includes solar panels, a composting area, an insect hotel and bird nesting boxes. The irrigation system is automated and there are three tanks for storing rainwater.



BIG4_TEB Verd (Monitored) Designer: Joan Sabaté Architect, TEB Verd Cooperative

The TEB Verd building, located in Barcelona's Sant Andreu district, houses offices and workshops for inclusive productive and social activities. Some of the building's roofs are green. Two are extensive, non-accessible sedum roofs with a 5 cm substrate. The upper roof contains an intensive urban vegetable garden and a Mediterranean garden with 30 cm-deep substrates. All have drip irrigation and are successful green roofs.



BIG5_URBASER (Monitored) Designer: URBASER

The URBASER roof crowns the office section of a larger industrial building located in Barcelona's Sant Andreu district. It is an intensive green roof accessible only to groups of visitors participating in outreach activities organised by URBASER. It includes a small water area, artificial bird nests and insect hotels that help attract urban biodiversity.



BIG6_Pérez Iborra

(Monitored)

Designer: Espai Qbic Arquitectura

The roof of Pérez-Iborra School, located in the middle of Barcelona's Eixample district in a party-wall building, is semi-intensive, accessible to a maximum of 40 people at a time and arranged at different levels. The inner roof is an urban vegetable garden with four planters for hydroponic cultivation in the middle. The roof facing the street is designed as a leisure space. The elevated central roof is an observation area with beds of aromatic and seasonal plants. There is a non-accessible sedum-planted roof with eight solar panels and an insect hotel. The whole set has an automated drip-irrigation system with humidity sensors and eight water tanks, each with a capacity of 200 litres.



BIG7_Auditori l'Artesà

(Refurbished and monitored)

Designer: AMM+ Forgas Architects

The Auditori cultural facility in the centre of el Prat de Llobregat has 444m² of four extensive, non-accessible roofs at different levels, planted with different sedum species. BIG4LIFE has renovated 320m² of the roofs, replanting the vegetation layer using pre-grown sedum mats. Above all, the irrigation system has been improved and the different solar-orientation and wind-exposure conditions of each roof have been taken into account in order to adapt irrigation for efficient water use.



BIG8_Tibidabo green facade (Monitored)

Designer: Mias Architects

The façade of the office building at Tibidabo leisure park provides a 330 m² planted surface facing south. The façade construction system is based on Verdtical iPanels, consisting of a layer of recycled polystyrene and two layers of geotextile. The outer layer contains 36 “pockets” per m² in which flowering species are planted. The selected species consume little water, require minimal maintenance, have low volume to better withstand wind, and have maximum leaf area to capture gases and pollutant particles. The panels have an integrated irrigation system.



BIG9_Cavallers (Refurbished and monitored)

A 180 m² roof located on a residential building in central Lleida. BIG4LIFE carried out adaptation and cleaning work, removing deteriorated plastic between the gravel and planting beds, adding higher-quality substrate and replanting new sedums. It has no irrigation system.

New elements have been added to promote biodiversity, including insect hotels, nesting boxes, a small pond and some logs to provide shelter for fauna. A biotrapping camera has also been reinstalled to continue monitoring animal activity in the area.



05

MAIN RESULTS

Since it began in September 2023, the **BIG4LIFE** project has achieved several noteworthy results:

Rehabilitation of green roofs

The project has rehabilitated the green roofs of the Scientific Park Agrobiotech, Ronda Mercè nursery school and a residential building on Cavallers street in Lleida, as well as the roof of the Auditori l'Artesà in El Prat de Llobregat.



Replication

Besides the 9 pilot cases in Catalonia, the BIG4LIFE has replicated the project in a semi-extensive green roof located on the “Innovative Centre for Food Sciences” at the Warsaw University of Life Sciences (SGGW) in Poland.

Equipping pilot cases with sensors

The project's 8 pilot cases have been equipped with smart sensors such as stations for measuring weather conditions and air quality, camera traps for detecting biodiversity, and soil moisture sensors. Beyond the end of the project, these sensors will make it possible to obtain data on the roofs' continued capacity to provide socio-environmental benefits and to optimise their maintenance, for example by regulating irrigation.

For instance, in the pilot case BIG7_Artesà a reduction of 153m³/year in water consumption has been achieved by applying xerogardening techniques and monitoring the irrigation system.

Cost-benefit analyses

For each pilot case considered, BIG4LIFE carries out a cost-benefit analysis that quantifies the environmental and social benefits of greenery on green roofs and façades and compares them with construction and maintenance costs.

The quality of life of 205 inhabitants has been directly improved thanks to the BIG systems refurbished and monitored within the BIG4LIFE project

Capacity-building workshops

BIG4LIFE has organised a large number of workshops to disseminate knowledge and develop skills related to the design, construction and maintenance of BIG systems. Highlights include the Think Green Workshops with the University of Genoa, green architecture workshops with high-school students, technical workshops for landscaping professionals, and the workshop organised with the Catalan Architects' Association (COAC) in 2026.



Collaborative networks

BIG4LIFE has set up 2 collaborative networks for the maintenance and monitoring of BIG systems involving different groups of stakeholders like users, owners and managers, maintenance enterprises, public administrations and academic institutions, volunteering associations...

Participation in professional events

The BIG4LIFE project has been presented and has contributed to disseminating knowledge about BIG systems at numerous professional events, including the Construmat trade fair, the Green Urban Biodiversity Fair in Igualada and the Smart City Expo World Congress in Barcelona 2025.



Community Service-Learning

Monitoring and maintenance activities on the green roof of the Parc Agrobiotech in Lleida have enabled community Service-Learning activities both with young people from the Castell dels Templers Professional Insertion Institute in Lleida and with a senior group of six retired volunteers, also from Lleida.



University activities: outreach and awareness-raising

The BIG4LIFE project collaborates with other LIFE projects related to nature-based solutions. In 2025, a delegation from Portugal's LIFE Programme visited Lleida and Barcelona to learn more about BIG4LIFE. In 2026, the New European Bauhaus Festival in Brussels provided an opportunity to share activities with other European research projects and initiatives. The 2026 World Green Infrastructure Congress will take place in Barcelona and Lleida in October and will serve as the closing event for BIG4LIFE.

A project that highlights the role that green roofs and façades can play in the naturalisation of cities, making them more liveable, healthy and resilient, and shows how collaborative maintenance and monitoring of BIG systems are the best way to ensure a long lifespan and optimise the environmental and social benefits they provide.

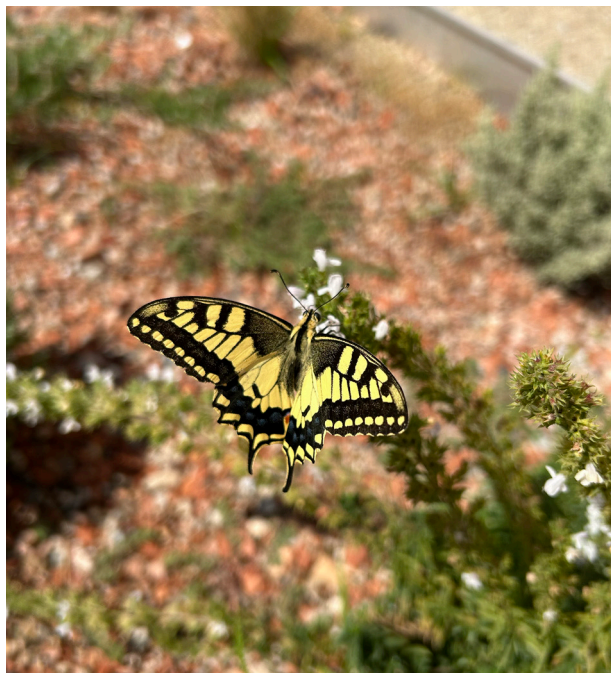


Through all these activities more than 1000 people have been informed and trained during the project.

International collaborations

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