Guidelines for climate adaptation in *Rome* – *Strategies for the mitigation of Urban Heat Islands*

A project for ROMA

Funded by the European Union

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Project overview

This *Intervention Manual* has been developed within the framework of the Technical Support Instrument (TSI) project **"Climate Adaptation – The Urban Heat Island Effect in the City of Rome"**, funded by the European Union via the Technical Support Instrument, managed by the European Commission «Reform and Investment» Task Force, and implemented by a Consortium led by PwC, in cooperation with **Roma Capitale – Ufficio di Scopo Clima**.

Rising temperatures and the growing frequency of heatwaves are already affecting Rome's urban environment and citizens' health. The phenomenon of the **Urban Heat Island (UHI) -** where built-up areas experience significantly higher temperatures than their rural surroundings - poses significant risks for vulnerable populations and for the city's liveability. Addressing these challenges requires coordinated and evidence-based local action, rooted in scientific analysis and stakeholder engagement, and aligned with Rome's Strategy on Adaptation to Climate Change.

Within this context, the project aims to develop **tailored mitigation measures for the UHI effect in two pilot areas** of the city, Centocelle-Alessandrino and the Historical Center, with the goal of improving thermal comfort and environmental quality in public spaces. The pilot areas were selected based on key local characteristics such as demographic composition, physical and morphological attributes, urban structure, configuration and distribution of green spaces, and other environmental and socio-economic factors influencing local vulnerability to climate impacts.

The action plans for these two pilot areas set out recommendations and a roadmap to address the UHI effect, identifying specific measures, key indicators, expected outcomes, and relevant stakeholders to be involved for their implementation.

The *Intervention Manual* forms a core component of these action plans. It provides **practical guidelines and design recommendations** for urban interventions that reduce surface and air temperatures, enhance shading and ventilation, and promote climate-resilient public environments across the city.

This intervention manual has been developed to provide the City of Rome with a strategic framework for mitigating the Urban Heat Island effect across public spaces. More than a collection of technical solutions, the manual serves as a **practical tool to guide municipal departments in embedding climate adaptation into all phases of urban regeneration**.

Urban regeneration offers a critical window of opportunity to reshape the built environment in ways that not only improve urban quality but also strengthen climate resilience. To that end, this manual should be used as a foundational reference across all regeneration initiatives—ensuring that adaptation measures are not treated as peripheral add-ons but are integrated from the outset as core components of the process. Climate adaptation must be seen as a cross-cutting priority throughout the entire regeneration cycle.

Climate objectives must be fully embedded into the masterplan, influencing both the spatial configuration and the typology of interventions.

By applying this manual at every step, Rome can systematically mainstream climate resilience into its urban transformation efforts.

The Manual has been designed as a decision-support tool for local authorities, aiming to facilitate the identification and selection of the most context-appropriate solutions to address urban heat and improve climate resilience across Rome. To this end, the Manual includes a series of approximately 35 two-page information sheets, each dedicated to a specific solution. These solutions were selected based on their relevance to the morphological, urban, and socio-environmental characteristics of Rome, ensuring their applicability and potential impact in the local context.

The solutions are grouped into three main categories: **1) Nature-based solutions (NBS): solutions** that integrate ecosystems into urban environments to reduce the UHI effect through the use of green spaces, tree planting, and blue infrastructure. **2) Grey solutions**, infrastructure-based solutions relying on technologies and materials that contribute to climate risk management and improved thermal comfort. **3) Enabling solutions**, enabling interventions operating at the managerial, informational, and behavioural levels to support climate mitigation in urban areas.

Each information sheet provides a comprehensive overview of the selected solution, including: A technical description of the solution; Governance considerations; Key attributes and features, with particular emphasis on heat mitigation capacity, provision of ecosystem services, promotion of social cohesion, and enhancement of human well-being; Cost estimates, covering both installation and maintenance; A summary of potential co-benefits.

«Cool retrofit» of public spaces

Picture source: Wokman Kapotnya via Unsplash

The term “cool retrofit” of public spaces refers to the redesign of existing urban areas to make them more climate-adapted, inclusive and people-friendly, enhancing community health by encouraging outdoor activities. These measures focus on making better use of existing playgrounds, schoolyards, parks, and squares, often requiring minimal space for new planting beds or green surfaces. Through small, cost-effective, and innovative interventions, public spaces can be revitalised to promote social interaction, community use, and a sense of collective ownership.

Such interventions may include adding vegetation like trees, shrubs, and grass to reduce heat buildup and improve air quality as well as ground de-sealing (replacing asphalt with permeable or vegetated surfaces), installing shade structures, adding water features (mist sprayers, fountains), and integrating high-albedo (reflective) materials. By increasing greenery, these spaces help cool the surrounding environment, lowering local temperatures and thus mitigating the UHI effect. The integration of greenery also fosters biodiversity.

These interventions can create inclusive, welcoming spaces that prioritise vulnerable populations, including children, older adults, and low-income communities who may lack access to private green space or cooling.

NBS

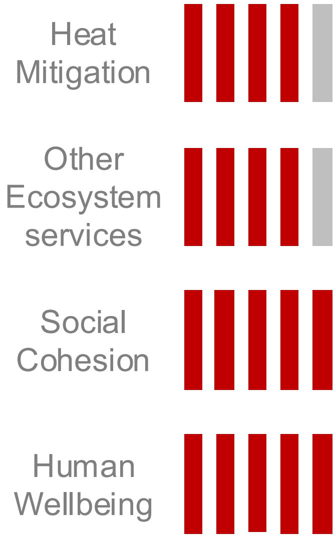
Grey

Enabling

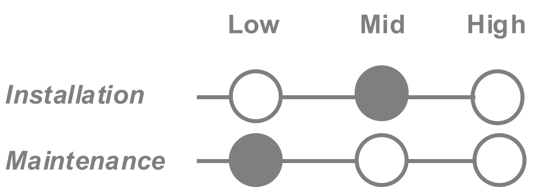
«Cool retrofit» of public spaces

Governance aspects

Cool retrofits are typically implemented on public land and require coordination across municipal departments such as urban planning, education, and environment. Engagement with local communities, schools, and civil society is essential. Financing can come from public budgets, climate adaptation funds, or public-private partnerships, with incentives encouraging local involvement and stewardship.



Costs



Cool retrofit interventions are generally low-cost, especially when applying simple nature-based solutions. Installation expenses vary depending on site conditions and design complexity, while maintenance is modest and can often be shared with local schools, communities, or supported through public green space budgets.

Co-benefits

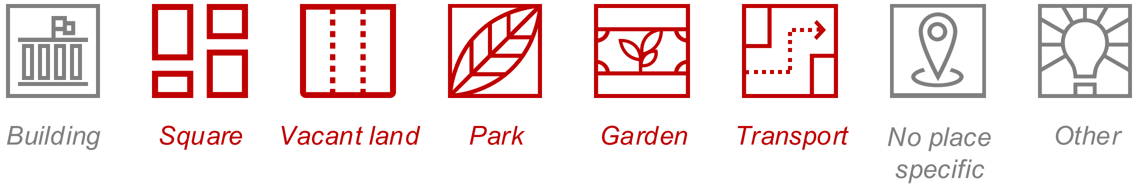
1 **Social cohesion**
Encourage social interaction and foster community engagement.

2 **Biodiversity**
Adds vegetation creating habitats for insects, birds, and small animals.

3 **Quality of life**
Enhances mental health, well-being, and quality of life.

4 **Stormwater management**
Vegetation and permeable surfaces help absorb rainwater and reduce runoff.

Application area



Networks of cool islands and green corridors

Picture source: Hokusai via Pexels

Networks of cool islands and green and shaded corridors refer to the strategic planning and connection of vegetated and shaded urban spaces such as parks and streets lined with trees to create continuous cool pathways throughout cities. These networks mitigate the Urban Heat Island effect by leveraging the cooling capacity of vegetation through shading and evapotranspiration.

Cool islands (e.g. parks or vegetated plazas) reduce surrounding air and surface temperatures, while green corridors act as conduits that distribute this cooling effect across urban areas. The layout, density, and canopy cover of these elements play a crucial role in their effectiveness, with studies showing that continuous tree canopies can reduce local surface temperatures by up to 11–17°C compared to paved areas.

This solution is particularly useful in countering heat stress in densely built-up environments with limited wind flow, such as in Stuttgart, where natural ventilation corridors were created using green spaces strategically aligned with local topography. Cool corridors can be established along streets, railways, riverbanks, and underused infrastructure. They require moderate to large spaces depending on function and scale and can be effectively combined with permeable pavements, bioswales, or stormwater management features to amplify multifunctional benefits.

NBS

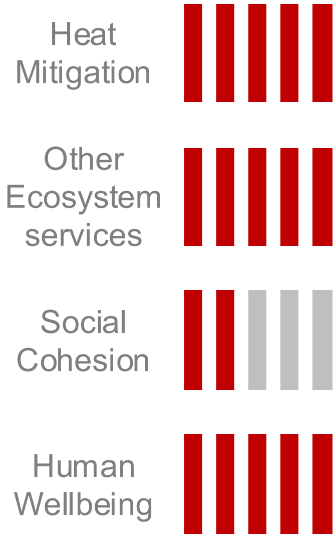
Grey

Enabling

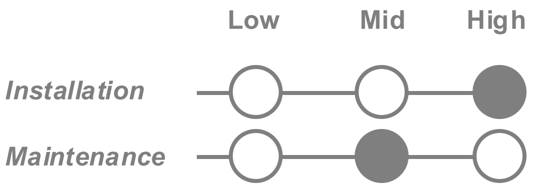
Networks of cool islands and green corridors

Governance aspects

Networks of cool islands and green corridors are typically implemented on public land, although integrating private land may be needed for continuity. Cities must coordinate across departments such as urban planning, transportation, parks and recreation, and environmental/climate offices. Stakeholder engagement should include local residents, mobility advocates, businesses, and environmental groups, ideally through participatory planning workshops or green infrastructure steering committee.



Costs

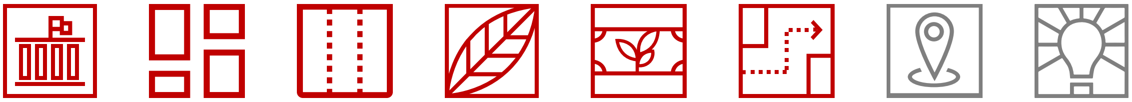


The installation of green and shaded corridors can be costly due to land acquisition, tree planting, irrigation infrastructure, and urban redesign. Maintenance costs are moderate and primarily involve watering young trees and infrastructure upkeep. Long-term benefits outweigh initial investments by reducing heat-related healthcare costs and energy demand.

Co-benefits

1. **Biodiversity**
   Support urban biodiversity by creating ecological corridors.
2. **Physical activity and social cohesion**
   Promote well-being by providing shaded leisure routes.
3. **Air quality improvement**
   Improve air quality by filtering pollutants and facilitating airflow.
4. **Enhanced Walkability**
   Allow for comfortable pedestrian movement, helping maintain tourist accessibility and economic activity.

Application area



Building *Square* *Vacant land* *Park* *Garden* *Transport* *No place specific* *Other*

Superblocks

Barrio de Sant Antoni in Barcelona, Pictures source: Cataleirxs on Wikimedia

Superblocks are a spatial and functional urban reconfiguration strategy designed to reclaim street space from private vehicles and convert it into a network of people-centered, multifunctional public spaces.

A Superblock typically encompasses a 3×3 grid of existing city blocks, where vehicular through-traffic is redirected to the perimeter streets, while the interior streets are calmed, pedestrianised, and repurposed for local use, play, greenery, and community activities. This restructuring is often achieved with tactical urbanism approaches: low-cost, reversible design interventions using planters, furniture, signage, and surface treatments.

Superblocks address multiple urban challenges: they reduce vehicular traffic, air and noise pollution, greenhouse gas emissions, and traffic accidents, while increasing public space, physical activity, and social interaction. For UHI mitigation, superblocks provide space for urban greening, permeable surfaces, and reduced heat-retaining asphalt, creating cooler microclimates. Implementation is most feasible in dense urban grids, but the model can be adapted to various urban morphologies. Superblocks integrate well with green and cooling corridors and climate shelters, forming part of a systemic climate-resilient urban framework.

NBS

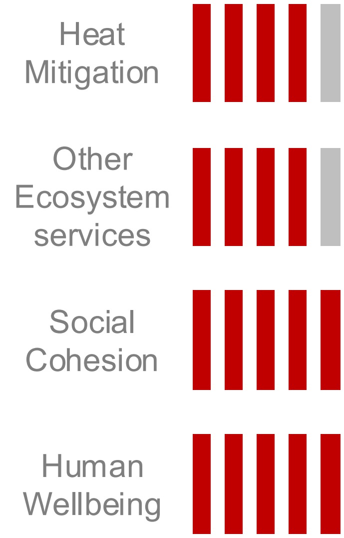
Grey

Enabling

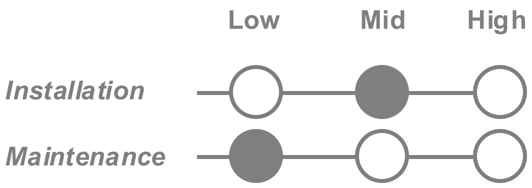
Superblocks

Governance aspects

Superblocks are typically implemented on public streets, requiring strong municipal leadership and multi-departmental coordination. Key departments include urban planning, mobility and transport, public space, environmental services, parks and biodiversity, public health, and citizen participation offices. Implementation success depends on participatory governance, with co-design processes, and local working groups ensuring resident buy-in and adaptation to context. Private sector incentives may be needed for adjacent businesses during transition.



Costs

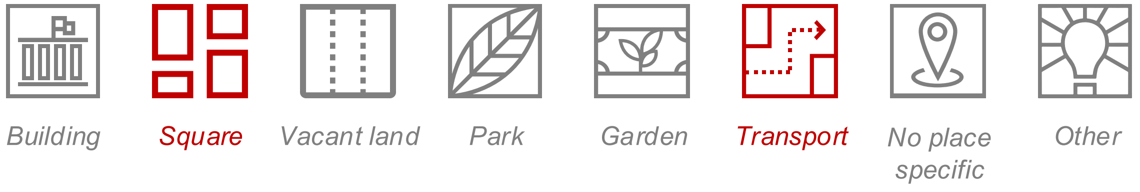


Initial costs are moderate and depend on whether the intervention is tactical (low-budget, reversible) or structural (permanent). Barcelona's 2016–2019 program implemented six Superblocks for €11 million. Maintenance is low, focused on basic cleaning, street furniture upkeep, and greenery care—often shared with local communities or NGOs.

Co-benefits

1. **Pollution reduction**
   Reduce air and noise pollution, creating healthier urban environment.
2. **Enhanced Walkability**
   Reduce motorized vehicles within the interior streets,
3. **Social cohesion**
   Creation of inclusive public spaces, fostering a sense of belonging.
4. **Local economic activity**
   Potential to stimulate the local economy via foot traffic to local businesses.

Application area



Boulevard and street trees

Boulevards and street trees in Budapest and Barcelona, Pictures source: ENEA; Comune di Roma

Boulevards are tree lined avenues, in which trees are arranged on both sides of the route, along streets, bicycle paths, and sidewalks. The canopies of opposite trees often form a (nearly) closed canopy. Tree canopies reduce the quantity of solar radiation that reaches and heats the ground by creating shade. Trees also increase evapotranspiration, which significantly reduces air temperature. Furthermore, street trees can significantly lower the energetic demand for cooling nearby buildings.

Boulevard can be used to connect parks and gardens, thus forming green corridors within an urbanised context. They provide several co-benefits, such as air quality improvement, noise reduction, enhancement of biodiversity, carbon sequestration, regulation of the water cycle. However, when they border a high traffic road, they can form a “canyon effect”, thus increasing air pollution under the canopy.

Special attention should be given to the selection of native trees, with low allergenic potential, low BVOC emissions, and which don’t pose significant threats to human health and to the existing grey infrastructure.

NBS

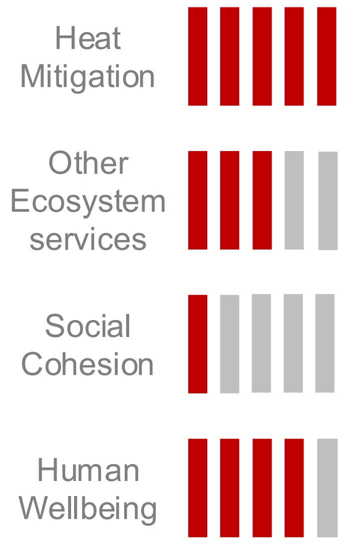
Grey

Enabling

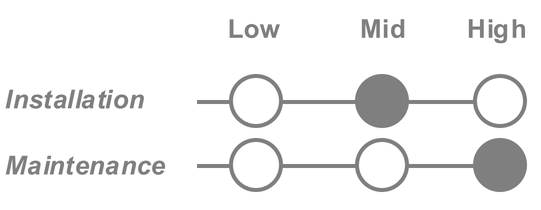
Boulevard and street trees

Governance aspects

The governance of boulevards and street trees is complex, involving multiple actors such as local authorities, utility companies, private contractors, and civic groups, often with overlapping roles and fragmented responsibilities (Pike et al., 2024). Collaborative governance models—built on coordination and shared decision-making—can help align efforts and ensure more equitable access to the benefits of urban greenery.



Costs



Installation cost may vary according to the site.
Maintenance should be quite intensive, including watering during the first 3 years from installation and regular pruning. Also, appropriate replacement cycles should be established.

Co-benefits

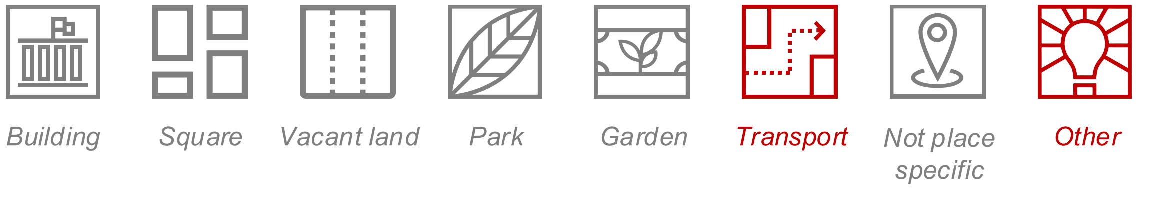
1 **Noise reduction**
Reduce noise from vehicular traffic.

2 **Regulation of water and carbon cycles**
Reduce stormwater runoff volumes and increase C sink.

3 **Biodiversity**
Increase plant diversity and provide habitats for wildlife.

4 **Air quality improvement**
Contribute to the amelioration of urban air quality.

Application area



Tiny forests

Rome S. Lorenzo Tiny Forest, Picture source: Roma Capitale

Tiny forests are compact woodland areas (typically 100 to 150 m²) composed of tall trees from multiple native and well-adapted species, with up to three different species planted per square meter. Tiny forest are extremely dense, and their planting and management follows the method developed by the Japanese botanist Akira Miyawaki. They are not designed for public use, but to create ecological hotspots and climate buffers.

Just like forests, tiny forests provide a wide variety of benefits and ecosystem services, including microclimate mitigation, carbon and water cycle stabilisation, air purification, and support to urban biodiversity. Tiny forests are often used as an example of ecological restoration in extremely urbanised areas and are also frequently used for educational purposes.

Tiny forests have low implementation costs and require little to no management; they should be developed with high levels of community engagement.

NBS

Grey

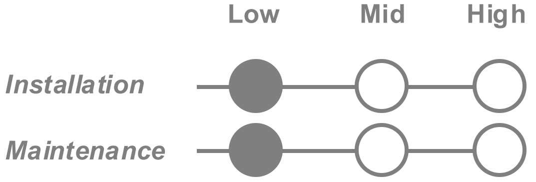
Enabling

Tiny forests

Governance aspects

Tiny forests should be implemented under a collaborative governance system, involving government agencies, local administrations, businesses, academic institutions and schools, non-governmental organizations and citizens (Rauf et al., 2024).

Costs



Due to its smaller size, a tiny forest is significantly more cost-effective than a traditional urban forest. Management is also very limited, since they imitate natural forests and create a self-sustaining community of trees. The selection of appropriate native species is of crucial importance to increase benefits and reduce management.

Co-benefits

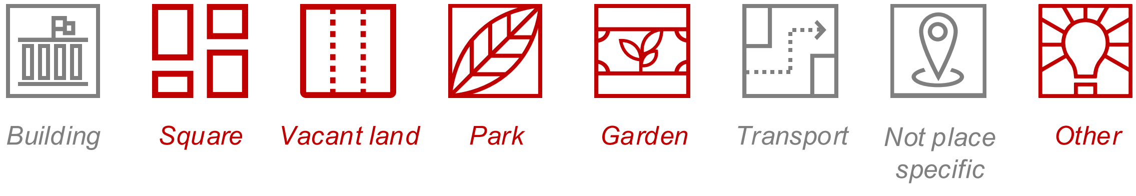
Biodiversity 1
Increase plant diversity and provide habitats for wildlife.

Educational opportunities 2
Help to increase biophylia in children and citizens.

Regulation of water and carbon cycles 3
Reduce stormwater runoff volumes and increase C sink.

Air quality improvement 4
Contribute to the amelioration of urban air quality.

Application area



Pocket parks

A pocket park in Budapest, Picture source: A. Sebastiani, ENEA

Pocket parks are publicly accessible, compact green areas or small gardens—typically under 5,000 m^2 (0.5 hectares)—that offer residents access to meaningful green spaces within walking distance of their homes. Despite their limited size, they play a crucial role in enhancing urban livability by introducing nature into the built environment.

They provide a variety of ecosystem services, including microclimate mitigation, carbon sequestration and water cycle regulation, whilst also offering space for social cohesion and physical activity. Furthermore, they offer mental relaxation and stress alleviation to urban dwellers.

Due to their compact scale, pocket parks are particularly suitable for highly urbanised and densely populated areas, especially when created on abandoned lots or underutilised urban spaces. Their adaptability makes them an effective solution for improving environmental quality and well-being in areas where space is scarce.

NBS

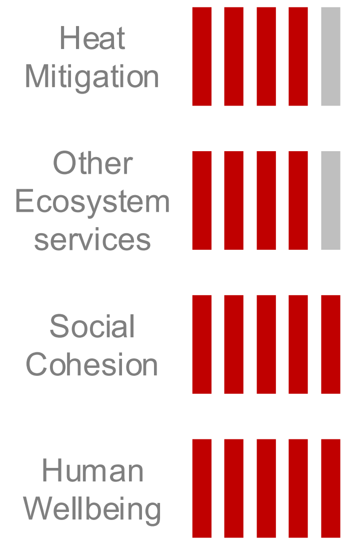
Grey

Enabling

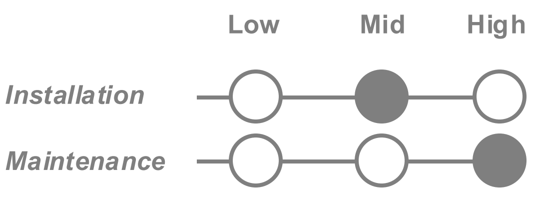
Pocket parks

Governance aspects

Encouraging the participation of citizens and association to the governance of pocket parks is highly recommended as a means to provide benefits to the largest possible portion of nearby residents.



Costs



Installation costs may vary according to the project. Maintanance should be extremely careful (and include trash collection, pruning, trees removal and street cleaning). Native species should be used.

Co-benefits

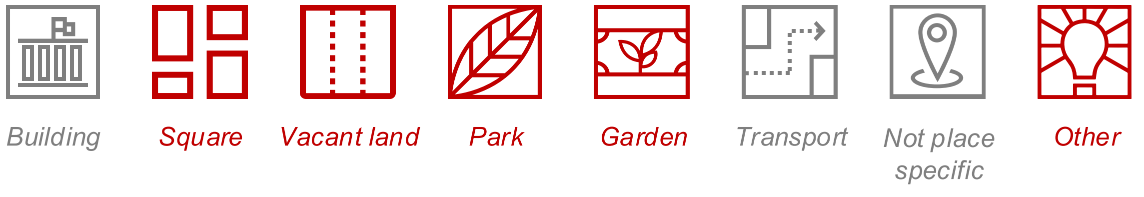
Air quality improvement 1
Contribute to the amelioration of urban air quality.

Biodiversity 2
Increase plant diversity and provide habitats for wildlife.

Regulation of water and carbon cycles 3
Reduce stormwater runoff volumes and increase C sink.

Physical activity and social cohesion 4
Provide space for physical activity and increase social cohesion.

Application area



Medium-large urban parks

Rome Parco degli Acquedotti, Picture Source: Open House Roma

Urban parks are green and blue areas within the city. They can be set wherever there is enough space, as far as compatible with the climatic, historical and landscape context of the area.

Usually, urban parks are designed to provide space for social interaction and physical activities in contact with nature. Urban parks provide a wide variety of benefits, such as air quality improvement, enhancement of biodiversity, carbon sequestration, stabilisation of the water cycle, space for physical activity and social cohesion.

Special attention should be given to the selection of well-adapted species, with low allergenic potential and which don’t pose threats to the human health as well as to the existing grey infrastructure.

NBS

Grey

Enabling

Medium-large urban parks

Governance aspects

Urban parks are typically managed by local public authorities, who are responsible for maintenance, safety, and long-term planning. However, in recent years, various models of collaborative governance have emerged, allowing for shared management of these spaces. This often includes partnerships with citizens' associations, local NGOs, or informal community groups, which may take responsibility for specific zones within a park—such as community gardens, playgrounds, or cultural activity areas.

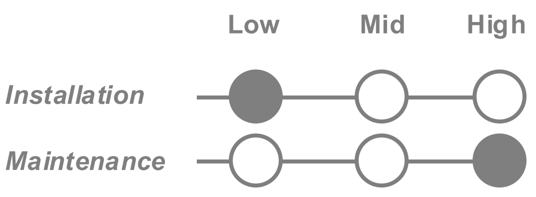
Heat Mitigation

Other Ecosystem services

Social Cohesion

Human Wellbeing

Costs



The maintenance of park facilities (e.g., benches, sports equipment, paths) and vegetation is essential to ensure a high-quality experience for users. As such, it must be carried out with great care, which can make it relatively costly.

Co-benefits

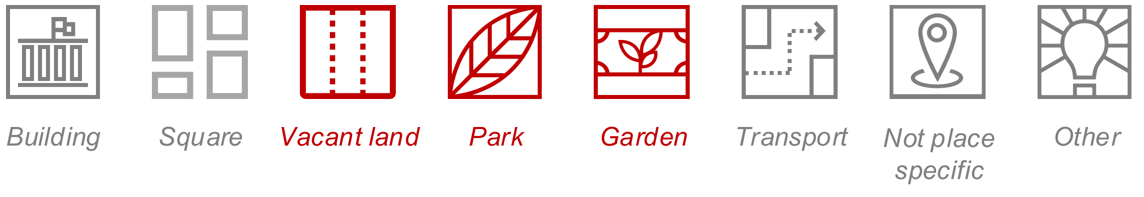
1 Air quality improvement
Contribute to the amelioration of urban air quality.

2 Biodiversity
Increase plant diversity and provide habitats for wildlife.

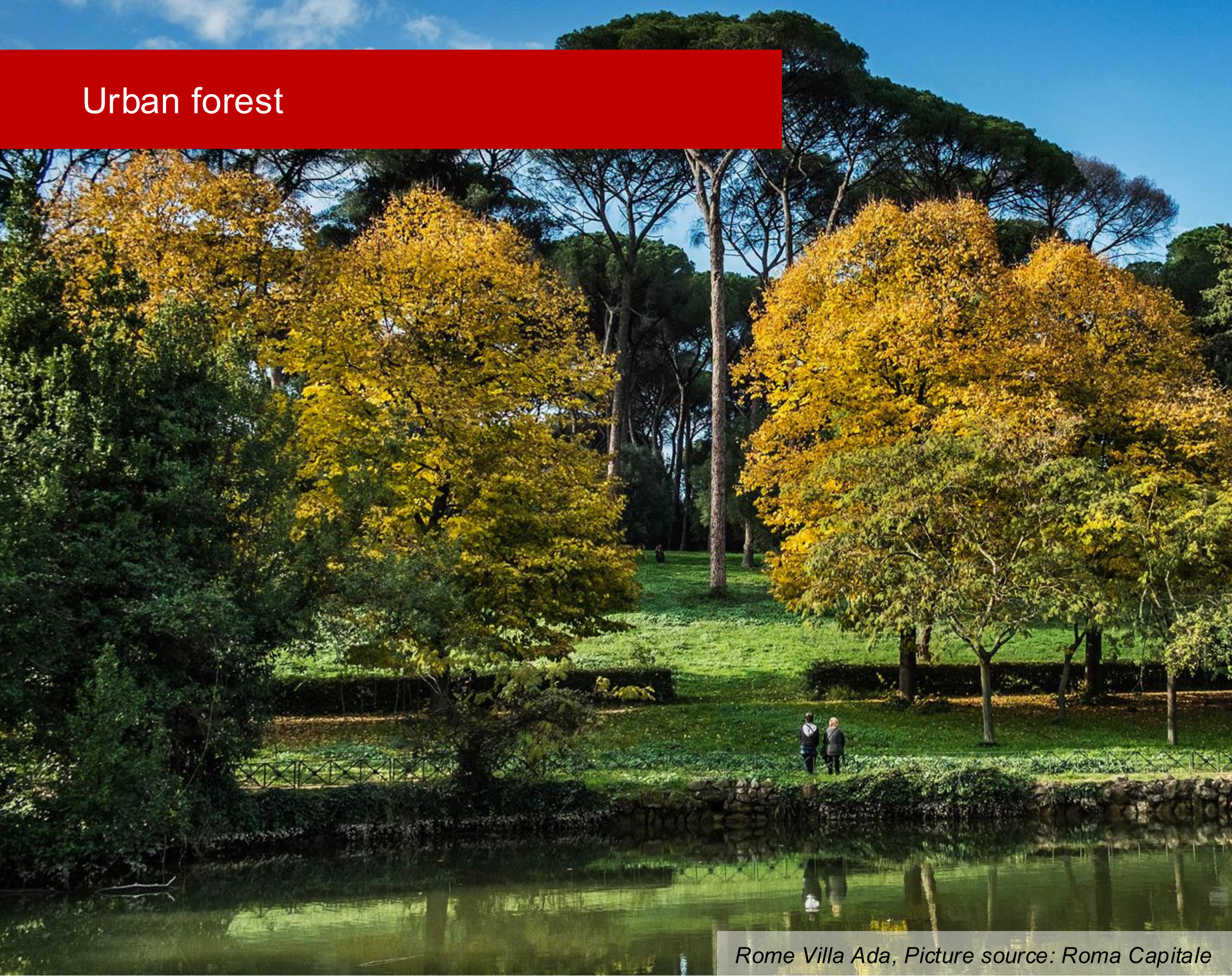
3 Regulation of water and carbon cycles
Reduce stormwater runoff volumes and increase C sink.

4 Physical activity and social cohesion
Provide space for physical activity and increase social cohesion.

Application area



Urban forest



Rome Villa Ada, Picture source: Roma Capitale

Urban forests include any woodland, group of trees, street trees, trees in parks, gardens or derelict corner that mimics the appearance or form of a forest in an urban setting. This NBS can be implemented wherever there is enough space, choosing tree species that are coherent to the climatic, edaphic, historical and landscape context of the area.

Urban forests have the highest potential in reducing the Urban Heat Island effect. Tree canopies reduce the quantity of solar radiation that reaches the ground by creating shade; plus, trees increase evapotranspiration, which also significantly reduces air temperature in cities. Urban forests intercept rainfall, increase infiltration, and reduce flooding. In addition, they sequester carbon, improve air and water quality, and provide critical habitat for a variety of species.

Urban forests make positive contribution to the physical, mental, social, and economic wellbeing of urban societies. Their preservation and maintenance are a critical opportunity to make cities and communities resilient to climate change.

NBS

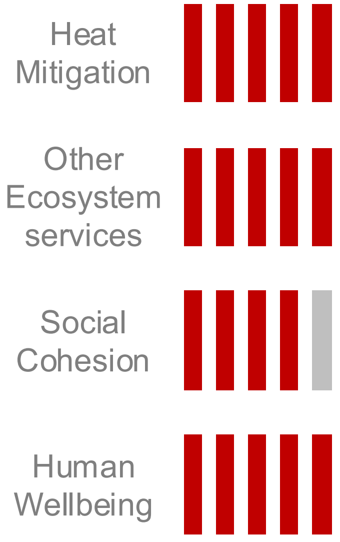
Grey

Enabling

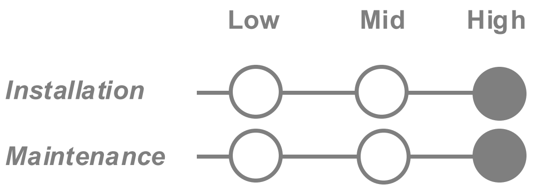
Urban forests

Governance aspects

Integrated governance across municipal, regional, and state levels is crucial to protect, expand, and enhance urban forests. Coordinated policies can align planning, funding, and maintenance efforts—ensuring urban forests contribute to climate resilience, biodiversity, and public well-being across territories. By fostering cross-sectoral collaboration and shared responsibility, such governance frameworks can prevent fragmentation, reduce resource duplication, and maximise synergies between environmental, social, and urban development goals.



Costs



Their costs include:

- Implementation costs, e.g. tree inventory, securing necessary government permits, site preparation, reforestation;
- Maintenance costs, especially in the first five years e.g. irrigation, pruning or thinning, invasive species removal.

Co-benefits

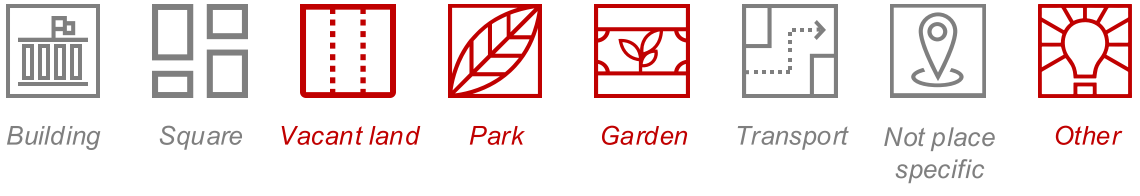
1. **Air quality improvement**
Contribute to the amelioration of urban air quality.

2. **Biodiversity**
Increase plant diversity and provide habitats for wildlife.

3. **Regulation of water and carbon cycles**
Reduce stormwater runoff volumes and increase C sink.

4. **Physical activity and social cohesion**
Provide space for physical activity and increase social cohesion.

Application area



Tree pits

Tree pits in Budapest, Picture source: ENEA

Tree pits are small-scale nature-based solutions that integrate trees into urban environments to deliver a variety of ecosystem services, including urban cooling, stormwater management, air purification, and carbon sequestration. Their compact design makes them particularly suitable for dense, space-constrained urban areas where larger green infrastructure interventions may not be feasible.

In their simplest form, tree pits consist of a single tree planted in native soil, with the capacity to capture and infiltrate stormwater runoff, providing passive irrigation and reducing surface flooding. More advanced configurations may include engineered soil or biofiltration media and be connected to existing stormwater drainage systems, thereby enhancing their performance in managing water quantity and quality.

Beyond their functional benefits, tree pits contribute to urban biodiversity by creating microhabitats for insects and birds, and can be integrated into sidewalks, streetscapes, and plazas without major disruption to urban infrastructure.

NBS

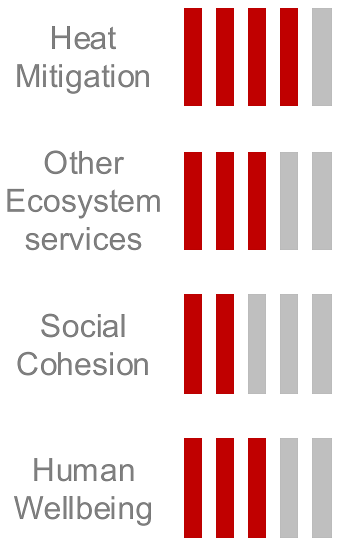
Grey

Enabling

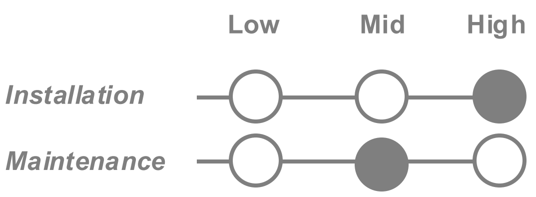
Tree pits

Governance aspects

Local governments play a central role in implementing urban greening policies and are directly responsible for the planning, installation, and ongoing maintenance of tree pits. These responsibilities include selecting appropriate locations based on infrastructure constraints, ensuring compatibility with underground utilities, choosing suitable tree species, and designing pits that support root health and stormwater infiltration.



Costs



Tree pits involve initial costs for excavation, tree planting, soil preparation, and protective structures. Ongoing maintenance includes watering and pruning. Repair or replacement may be necessary due to damage or tree loss.

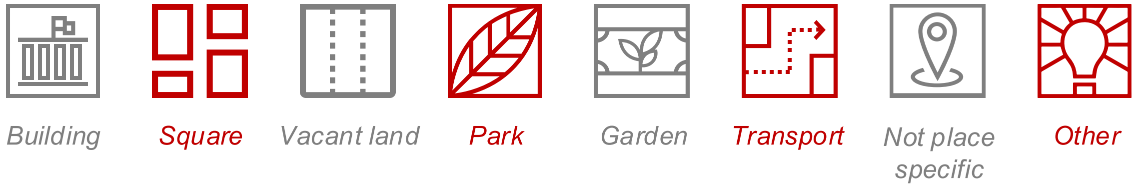
Co-benefits

1. **Stormwater management**
Reduce stormwater runoff volumes.

2. **Air quality improvement**
Contribute to the amelioration of urban air quality.

3. **Biodiversity**
Increase plant diversity and provide habitats for wildlife.

Application area



Green roofs

Keplero High School Green Roof (Rome), Pictures source: RomaToday

Green roofs are building rooftops that are partially or fully covered with vegetation and soil (or a growing medium), planted over a waterproof membrane. They come in three main types: extensive roofs (lightweight, low-maintenance with shallow soil), intensive roofs (deeper soil, more plant diversity, higher maintenance), and semi-intensive roofs (hybrid systems). Green roofs can be integrated into both new and existing buildings, offering a way to convert unused space into multifunctional, climate-resilient infrastructure.

They are a highly effective strategy for Urban Heat Island (UHI) mitigation, as they reduce rooftop surface temperatures by up to 40°C and surrounding air temperatures by 1–2°C through evapotranspiration, shading, and increased albedo. Green roofs also improve building insulation, lowering indoor cooling needs, and can retain 50–90% of rainwater, reducing runoff and flood risk.

Suitable for residential, commercial, institutional, and industrial buildings, green roofs can be combined with solar panels, pollinator gardens, or community growing spaces. Their implementation depends on building structure, load capacity, and waterproofing integrity.

NBS

Grey

Enabling

Green roofs

Governance aspects

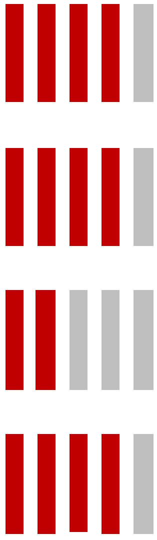
Green roofs can be installed on public, private, residential or commercial buildings, provided structural requirements are met. Implementation often requires financial incentives, such as subsidies or tax breaks, to offset higher construction and maintenance costs. Financing may include public-private partnerships or grants. Integrated planning with urban planning, environmental, and heritage departments should handle permits and maintenance. Stakeholders like residents should be consulted.

Heat Mitigation

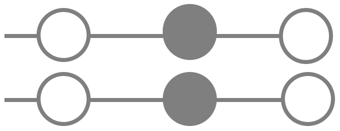
Other Ecosystem services

Social Cohesion

Human Wellbeing



Costs



The cost of installing green roofs varies depending on the roof type, structural complexity and material. Extensive green roofs are cheaper to install and require minimal maintenance. In contrast, intensive green roofs require regular maintenance due to frequent pruning, fertilizing and plant care.

Co-benefits

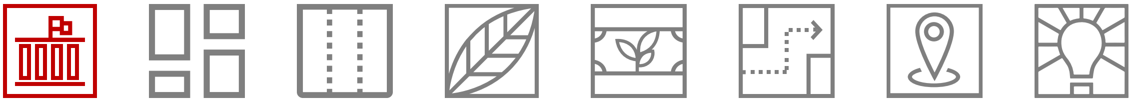
1. **Stormwater management**
By capturing and storing rainwater, they help reduce flood risks.

2. **Biodiversity**
Provide habitat for diverse species.

3. **Social cohesion**
Serve as community spaces, fostering social interaction.

4. **Energy efficiency**
Increase energy efficiency by insulating buildings.

Application area



Building *Square* *Vacant land* *Park* *Garden* *Transport* *No place specific* *Other*

Green façades and walls

Pictures source: Ildiko via Pixabay

Green façades and walls are vertical surfaces covered with greenery, either partially or completely. Ground-based green facades use climbing or self-clinging plants rooted in planters at ground level, while facade-bounded greening utilises special irrigation systems and lightweight substrates to support plants directly on the building's façade. Green walls can be irrigated with greywater or rainwater harvesting systems to enhance sustainability.

These green walls offer significant climate mitigation benefits in urban environments, primarily by regulating temperature and reducing heating and cooling needs. At the neighborhood level, they help mitigate the Urban Heat Island (UHI) effect by providing shade, reducing reflected heat, and supporting evapotranspiration. At the building level, they enhance thermal insulation by attracting and releasing less heat.

Green walls also improve air quality by capturing pollutants, insulate against sound, and protect buildings from temperature fluctuations and UV radiation. Their compact nature is ideal for densely built-up areas, promoting biodiversity by providing habitats for birds and insects. Additionally, innovative systems integrate technologies like bio-photovoltaic panels for energy or food production. Careful attention must be paid to structural loads, water supply, plant selection, and maintenance access.

NBS

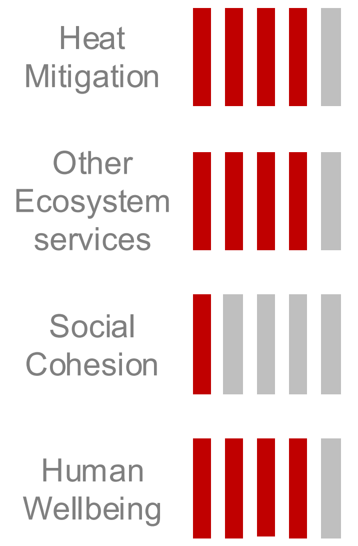
Grey

Enabling

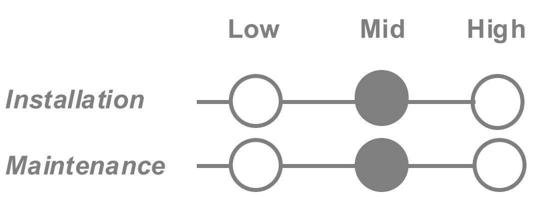
Green façades and walls

Governance aspects

Green walls can be installed on a façade or wall of public and private buildings. Incentives such as grants, recognition programs or integration into energy efficiency schemes can motivate building owners. Financing options include subsidies or grants. Relevant departments include urban planning, building and construction, environment/climate, and housing. Involving architects, residents, and local businesses through consultations ensures broad support.



Costs



The cost of installing green walls varies widely depending on the type. Ground-based green facades are cost-effective, require little maintenance, and adapt well to different climates. In contrast, facade-bounded greening is more expensive due to special irrigation systems and substrates and requires higher maintenance to ensure plant health and system functionality.

Co-benefits

1. **Air quality improvement**
Improve air quality by capturing pollutants and particulate matter.

2. **Energy efficiency**
Reduce the need for heating and cooling in buildings.

3. **Biodiversity**
Provide habitat for species, including pollinators.

4. **Noise reduction**
They help reduce noise pollution by acting as natural sound barriers.

Application area

Green parking lots

Picture source: Freepik

Traditional parking lots, with their sealed soil and the lack of shading, significantly contribute to the urban heat island effect during summer, when incoming solar radiation is high, thus directly affecting human health and wellbeing.

Green parking lots, made by a mixture of grass and trees installed on permeable driveways, are among the most effective solution for UHI reduction in densely urbanised neighbourhoods, since they can significantly lower air and surface temperature. In addition, they contribute to climate adaptation through stormwater management, limiting runoff, decreasing flooding risk and increasing soil infiltration. Consequently, evapotranspiration is increased. Finally, they contribute to supporting urban biodiversity.

This NBS is particularly effective if combined with soil de-sealing, i.e. removal of asphalt and concrete and replacement with permeable paving. However, the suitability of each area should be carefully assessed, also considering the belowground infrastructure (i.e. sewage, water and gas lines).

NBS

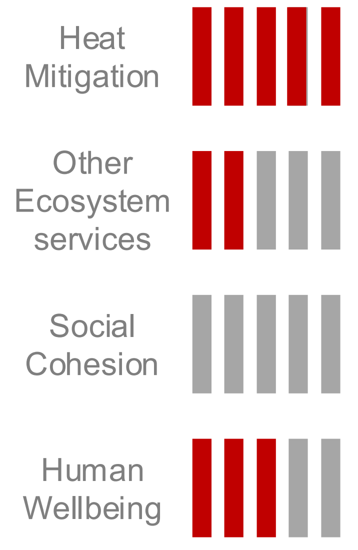
Grey

Enabling

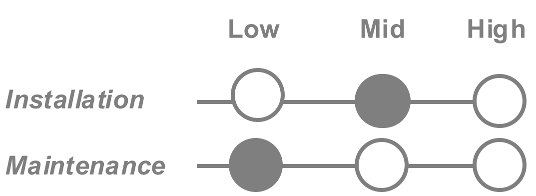
Green parking lots

Governance aspects

The governance of green parking lots can be entirely public or private, depending on their context. Publicly managed lots, such as those in parks or municipal facilities, fall under the responsibility of local authorities and are often part of broader climate or greening strategies. Privately managed lots, like those in malls or office complexes, are overseen by property owners, though they may still be subject to local environmental or zoning regulations. In some cases, public-private coordination may be encouraged via planning requirements or incentives.



Costs



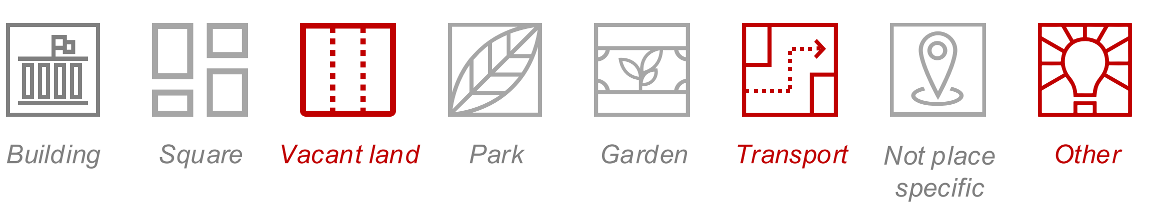
Installation costs may vary and are site-specific. If soil de-sealing is involved, installation cost is higher. The same applies for maintanance (i.e. it is higher if trees are included).

Co-benefits

1 **Stormwater management**
Reduce stormwater runoff volumes.

2 **Biodiversity**
Increase plant diversity and provide habitats for wildlife (if trees are included).

Application area



Green tram track, street verges, areas alongside traffic corridors

Pictures source: Shutterstock

Tram tracks, street verges and traffic corridors can be transformed into greening opportunities, especially in densely urbanised areas where space for other solutions is limited.

Greening these areas provides cooler and cleaner air, restoration of the natural water cycle through stormwater management, and climate mitigation via carbon storage and sequestration. In addition to supporting urban biodiversity, these interventions are also aesthetically appreciated by the public.

As for all NBS, native species, adapted to local climate and soil (e.g. species well adapted to water scarcity) should be used, to guarantee the ecosystem functions as well as to reduce management interventions. Furthermore, vegetation should be arranged to include some degree of structural diversity in the plant community, which is obtained by mixing grasses, shrubs and trees.

NBS

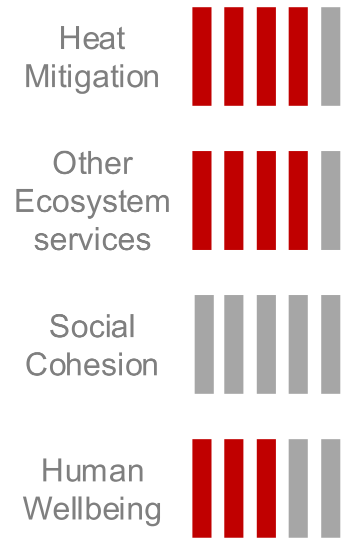
Grey

Enabling

Green tram track, street verges, areas alongside traffic corridors

Governance aspects

This NBS is typically managed by the local public administration or by public transport companies, particularly when implemented at or near transit stops. In most cases, the governance model is embedded within existing operational responsibilities. There are generally no complex governance arrangements to highlight, provided that all relevant safety, accessibility, and maintenance standards are met. The key requirement is that the intervention does not interfere with transit operations and complies with urban design and mobility regulations.



Costs

	Low	Mid	High
Installation	○	●	○
Maintenance	○	●	○

Installation costs may vary and are site-specific. If soil de-sealing is involved, installation cost is higher.
Maintenance should be extremely careful, in order to guarantee safety aspects. Maintenance costs can be reduced by using the right native species.

Co-benefits

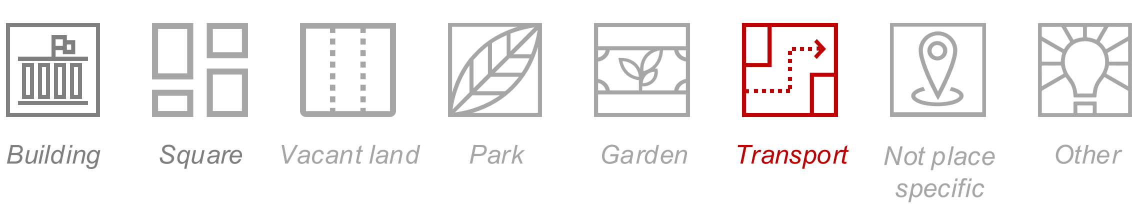
1. **Noise reduction**
Reduce noise from traffic.

2. **Air quality improvement**
Contribute to the amelioration of urban air quality.

3. **Regulation of water and carbon cycles**
Reduce stormwater runoff volumes and increase C sink.

4. **Biodiversity**
Increase plant diversity and provide habitats for wildlife.

Application area



Green bus/tram stops

Geen bus stops in Budapest, Picture source: ENEA

Green roofs on bus and tram stops help provide cooler air for public transport users. They also help reduce surface water runoff, thereby lowering the risk of flooding.

This solution often includes a layer of well-adapted drought resistent vegetation, a layer of soil and a drainage surface for collecting precipitation water. This roof retains up to 90% of the rainwater. During dry periods, the water is used by plants and evaporates, thus lowering the surrounding air temperature. Water not used by the roof vegetation, along with excess rainwater from the surrounding sidewalk, can be retained in a vegetated retention-infiltration tank at the back of the shelter, where climbing plants can be grown. Excess water in the tank is then directed into nearby green areas.

This NBS also supports local biodiversity by providing a “steppingstone” for insects and birds. Green bus/tram stops are particularly desirable in highly urbanised and populated areas, where most of the other cooling NBS aren’t feasible.

NBS

Grey

Enabling

Green bus/tram stops

Governance aspects

Green bus and tram stops are typically managed by local public administrations or public transport operators, depending on who oversees the infrastructure. These interventions are generally integrated into existing mobility or maintenance frameworks, requiring no special governance arrangements.As long as safety, accessibility, and operational standards are respected, green elements—such as vegetated roofs or shading structures—can be effectively included without disrupting transport services.

Costs

	Low	Mid	High
Installation	○	●	○
Maintenance	○	●	○

Maintenance should be extremely careful, in order to guarantee the safety and quality of vegetation. Previous experiences report that watering, cleaning, trimming and even fertilising are required, especially for the first 2-3 years after the installation.

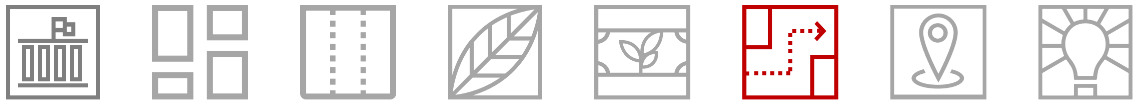
Co-benefits

1 **Biodiversity**
Increase plant diversity and provide habitats for wildlife.

2 **Stormwater management**
Reduce stormwater runoff volumes.

3 **Air quality improvement**
Contribute to the amelioration of urban air quality.

Application area



Building *Square* *Vacant land* *Park* *Garden* *Transport* *Not place specific* *Other*

Urban farming and community gardens

Pictures source: Ecologic Institute

Urban farming and community gardens involve cultivating edible plants such as vegetables, fruits, and herbs within urban areas in courtyards, vacant lots, or designated public land. These spaces can be managed collectively by residents, schools, or NGOs, or maintained individually within a shared framework. In addition to food production, urban gardens typically include vegetation cover and permeable soil, which help intercept solar radiation and promote evapotranspiration—thus contributing to local cooling and UHI mitigation.

Urban gardening supports food security, climate adaptation, and community empowerment while also enhancing green cover in densely built-up areas. They can be used to improve social cohesion and prevent social exclusion by e.g. bringing together residents including those with socio-economic vulnerabilities, disabilities or migration background.

Urban gardens can be created on relatively small and fragmented plots, including rooftops, schools, roadside verges, and public housing estates. In case of uncertain land tenure or soil pollution the gardens can be set up in a temporary manner and the food can be grown in raised beds. Urban gardens can be effectively combined with rainwater harvesting, composting or pollinator habitats, forming multifunctional spaces that deliver environmental and social value.

NBS

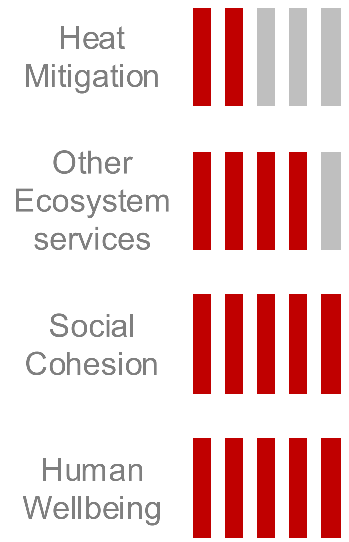
Grey

Enabling

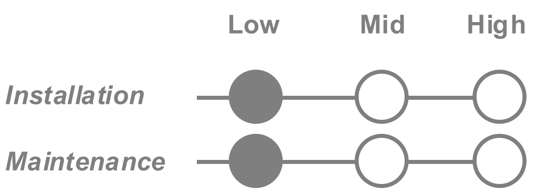
Urban farming and community gardens

Governance aspects

Community gardens are usually implemented on public land, although partnerships with private landholders are also common. To encourage uptake, municipalities may offer start-up grants, land access schemes, or discounted water usage fees. Key departments include urban planning, parks and green spaces, public health, and community development. Stakeholder involvement is central: residents, local schools, NGOs, and social enterprises should be engaged from the start through participatory design and co-management models.



Costs



Urban gardens are inexpensive to establish, especially on existing public land, and can be set up using basic tools and volunteer labor. Their maintenance costs remain low, especially when supported by community involvement or social programs, making them a high-impact, low-cost intervention.

Co-benefits

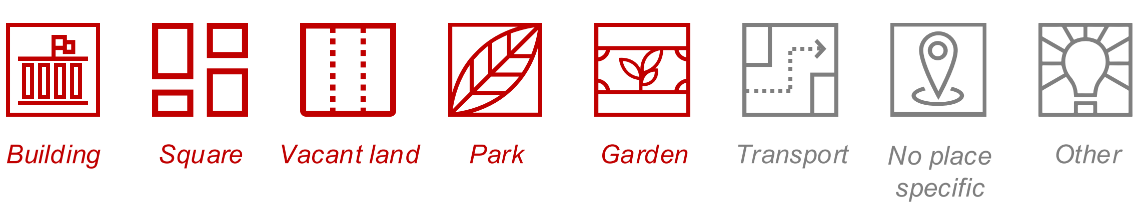
1 **Social cohesion**
Strengthen social ties by fostering collective care of shared spaces.

2 **Biodiversity**
Support pollinators and improve local biodiversity.

3 **Health**
Have positive effects on mental and physical health.

4 **Food security**
Enhance local food security and promote environmental education.

Application area



Mobile vegetable garden

Picture source: Stock images from PwC's repository

The mobile vegetable garden is a modular and movable nature-based solution designed for growing food and plants. It can be easily assembled and relocated by users to personalise public or private open spaces according to their needs and preferences. Its flexible configuration allows for a variety of layouts, fostering social interaction and community engagement in shared spaces.

The movable feature enables users to adapt the setup to changing conditions - for example, by relocating benches from sunny areas to shaded ones - creating a dynamic and responsive environment. Depending on the plant species selected, it can also serve as a tool for local food production, supporting short food supply chains and improving access to healthy, locally grown food.

Thanks to its modularity, this solution can be adapted to different surface types and sizes. It can also be installed on rooftops of public or private buildings (e.g., schools and senior centers), promoting environmental education and strengthening social cohesion.

NBS

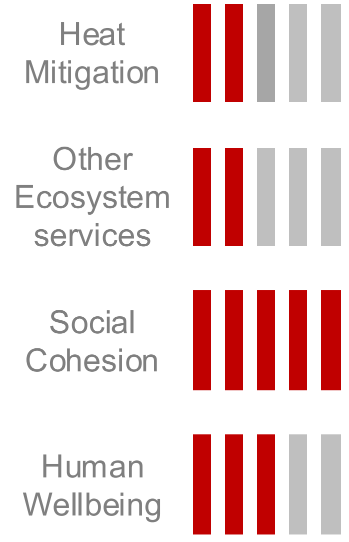
Grey

Enabling

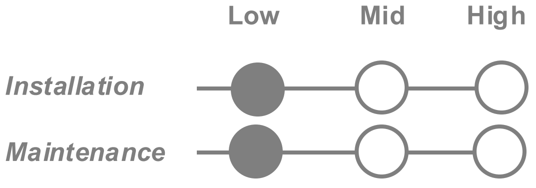
Mobile vegetable garden

Governance aspects

Local governments, neighborhood associations, agricultural groups, public institutions, research institutes, private entities, and citizens can collaborate to promote mobile vegetable garden initiatives in both public and private open spaces.



Costs



The costs will vary depending on the materials available. Other factors include the size of the planter, and the quality and type of materials used. Overall, the total cost may include:

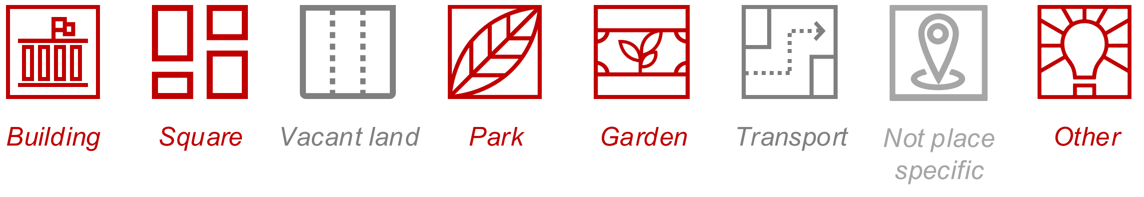
- Raised bed materials;
- Soil to fill the bed;
- Labor for installation;
- General maintenance costs.

Co-benefits

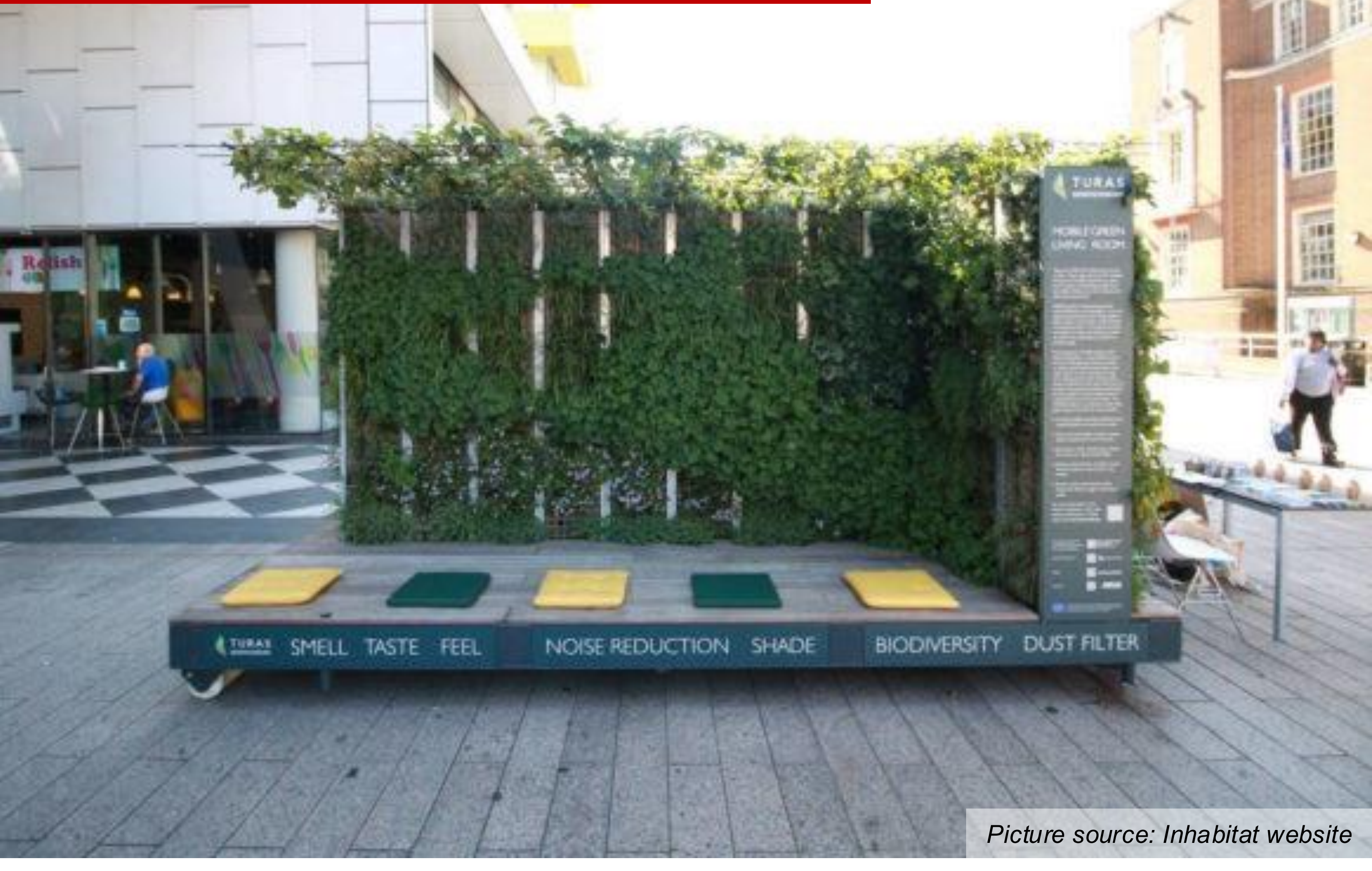
1 **Environmental education**
Promote a connection to nature.

2 **Biodiversity**
Increase plant diversity and provide habitats for wildlife.

Application area



Mobile green living room



Picture source: Inhabitat website

The Green Living Room can be applied to different urban settings, offering multiple benefits in terms of climate change adaptation, aesthetic improvement, and increased nature awareness. It helps regulate the urban heat island effect through leaf evapotranspiration and shading, promotes a net gain in urban biodiversity, reduces stormwater runoff, supports the reuse of rainwater through a sustainable irrigation system, and contributes to air purification. City residents also gain the opportunity to interact directly with nature.

The concept involves mobile vegetation elements that can be combined with technical shading structures to create temporary green comfort zones. Green walls, a water tank, and shading roofs are integrated into movable containers that also function as benches. These containers can be quickly and easily transported using city-owned vans. Thanks to solar-powered irrigation technology, the elements are independent from local technical infrastructure and can be arranged in various spatial layouts.

NBS

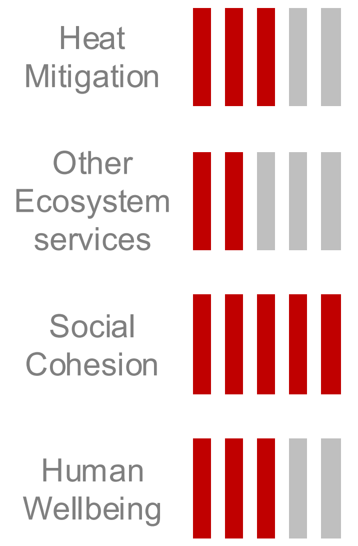
Grey

Enabling

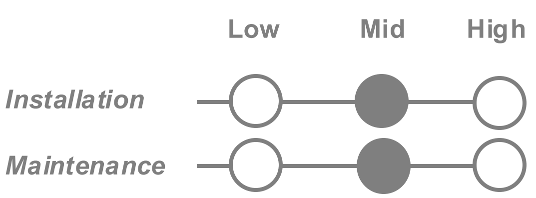
Mobile green living room

Governance aspects

The implementation of "Mobile Green Living Rooms" requires collaboration between local public administrations and private actors, such as design firms or event organisers. These temporary, modular structures often occupy underused public spaces, making coordination across municipal departments essential. Political support is key to enable permits, mobilise resources, and ensure integration into broader urban strategies. In some cases, public-private agreements or pilot frameworks may be needed to define roles and ensure long-term viability.



Costs



The costs are associated with the construction and maintenance of the "Mobile Green Living Rooms." A limiting factor for installing the structure is the high level of care required for selecting vegetation, performing related pruning work, and monitoring of the irrigation system. However, by designing the Urban Living Room with a seasonal feature, maintenance needs can be reduced. In central locations, the demand for pruning is typically higher.

Co-benefits

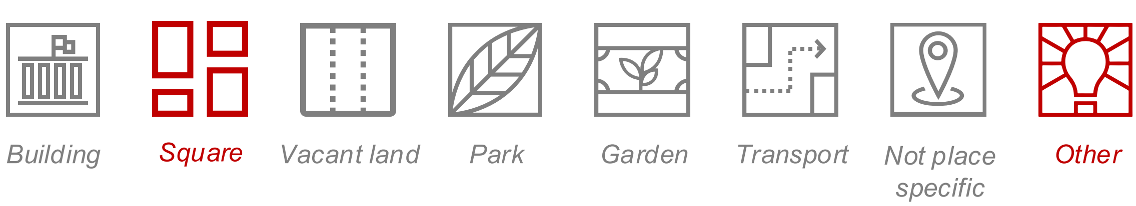
1. **Biodiversity**
Increase plant diversity and provide habitats for wildlife.

2. **Air quality improvement**
Contribute to the amelioration of urban air quality.

3. **Social cohesion**
Enhance social cohesion.

4. **Environmental education**
Promote a connection to nature.

Application area



Green furniture

Green furniture in Gasholder Park, London Ph. John Sturrock

Green furniture in Budapest, Picture source: ENEA

Green urban furniture is an innovative NBS that enhances urban resilience while improving the quality and functionality of public spaces. This concept incorporates vegetation, water management systems, and sustainable materials into urban furnishings. The choice of vegetation, materials, and coulors plays a key role in reducing heat absorption and retention, thereby helping to mitigate the effects of urban heat islands.

One of the most common forms of green urban furniture is green benches and seating areas, which incorporate built-in planters or moss walls, populated using native species. These structures not only provide comfortable seating but also contribute to urban cooling and help improve air quality.

At the same time, these installations support biodiversity, creating microhabitats for insects and birds in dense urban settings. Green urban furniture enhances both city aesthetics and environmental resilience, also favoring social cohesion.

NBS

Grey

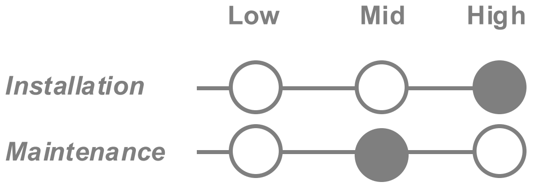
Enabling

Green furniture

Governance aspects

Local governments lead urban greening efforts, overseeing the planning, installation, and maintenance of green furniture. In some cases, private investors may contribute—especially in commercial areas—through sponsorships or development agreements, provided roles and responsibilities are clearly defined.

Costs



The costs of green urban furniture may include the purchase cost of the furniture itself, the initial investment, and the cost for operation, maintenance, and repair.

Co-benefits

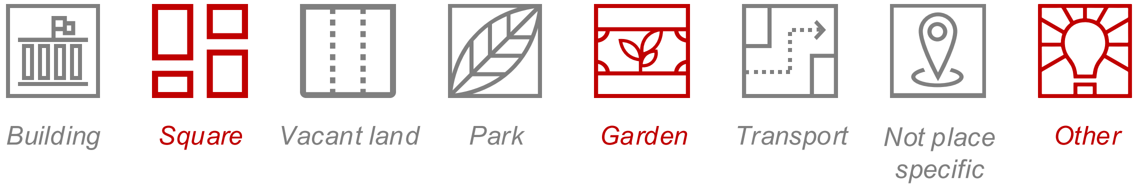
Biodiversity 1
Increase plant diversity and provide habitats for wildlife.

Social cohesion 2
Enhance social cohesion.

Air quality improvement 3
Contribute to the amelioration of urban air quality.

Stormwater management 4
Reduce stormwater runoff volumes.

Application area



Vegetated pergola

Picture source: AI generated

Vegetated pergolas are nature-based solutions that use structural elements - such as pillars, beams, tensile fabrics, and lattices - to support climbing vegetation and create shaded areas in urban spaces. A vegetated substrate can also be added to the roof to increase green coverage. These structures can be anchored to building façades, installed along streets, or mounted on posts fixed to sidewalks, making them highly adaptable to different urban contexts.

They offer multiple benefits: they reduce local temperatures through shading and evapotranspiration, improve air quality, and contribute to urban biodiversity by acting as ecological corridors or 'steppingstones' for pollinators and other small species. In addition, they offer aesthetic and psychological benefits, creating pleasant and inviting environments for pedestrians and residents.

Due to their compact footprint and modularity, vegetated pergolas are especially valuable in highly urbanised and densely populated areas where space is limited, and the implementation of larger green infrastructure is challenging.

NBS

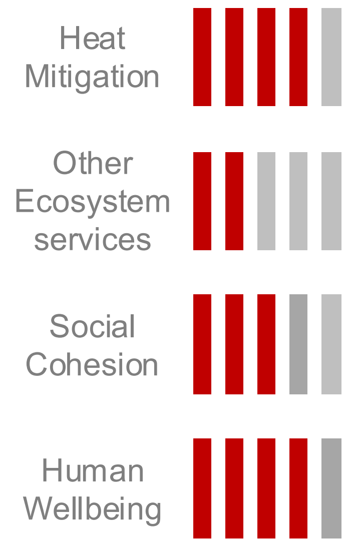
Grey

Enabling

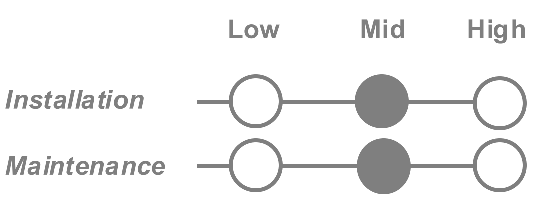
Vegetated pergola

Governance aspects

Local governments implement urban greening policies and are responsible for overseeing the planning, installation, and maintenance of vegetated pergolas. In some cases, private investors may also contribute—particularly in commercial areas—by funding or co-developing pergolas as part of site enhancements or corporate responsibility efforts.



Costs



Costs may involve both the construction and maintenance aspects of the vegetated pergola. Maintenance tasks include supplying water to the plants during the growing season, keeping the planters clean and good condition, pruning and training the creepers to form a continuous cover, and adding fertilizers to the soil.

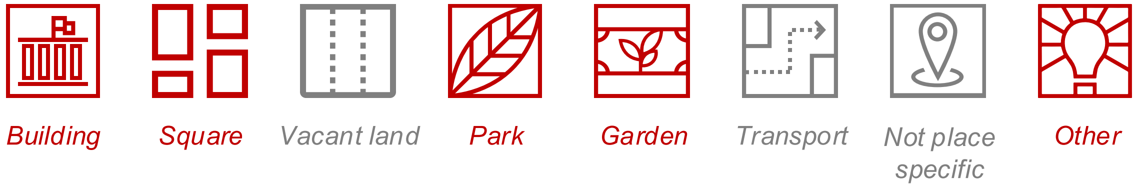
Co-benefits

1. **Biodiversity**
Increase plant diversity and provide habitats for wildlife.

2. **Air quality improvement**
Contribute to the amelioration of urban air quality.

3. **Social cohesion**
Enhance social cohesion.

Application area



Bioswales

Picture source: Aaron Volkening via Flickr

Bioswales are shallow, vegetated channels designed to manage and treat stormwater runoff. They consist of gently sloped trenches filled with engineered soil and planted with native vegetation. As stormwater flows through a bioswale, it slows down, allowing sediments to settle and pollutants to be filtered by the soil and plants. This process not only improves water quality but also promotes groundwater recharge.

By replacing impervious surfaces with vegetated areas, bioswales help mitigate the Urban Heat Island (UHI) effect through shading and evapotranspiration, leading to localised cooling. They are particularly effective in urban settings where heat retention is exacerbated by concrete and asphalt surfaces.

Bioswales can be installed along streets, parking lots, and within medians or other landscaped areas. They require space proportional to the area of runoff they are intended to manage, typically ranging from 1 to 5% of the impervious area. Bioswales can be combined with other green infrastructure elements like rain gardens and permeable pavements to enhance stormwater management and urban cooling.

NBS

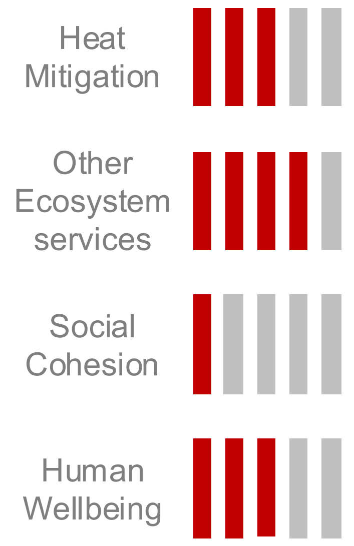
Grey

Enabling

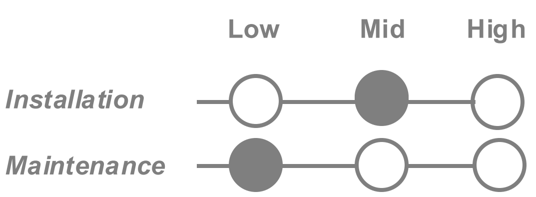
Bioswales

Governance aspects

Bioswales are commonly installed on public land, such as alongside streets, but can also be implemented on private properties with appropriate incentives (e.g. grants, or stormwater fee reductions). Key municipal departments involved may include departments in charge of urban planning, public works, environmental services and urban green management and transport department. Engaging stakeholders such as local residents, businesses, and community groups through participatory planning and education could contribute to successful implementation and maintenance.



Costs



Installation costs for bioswales are moderate, influenced by design complexity and site conditions. Utilising native plants can reduce maintenance needs and costs, as they require less water and care. Overall, bioswales offer a cost-effective solution, primarily for stormwater management with added environmental benefits.

Co-benefits

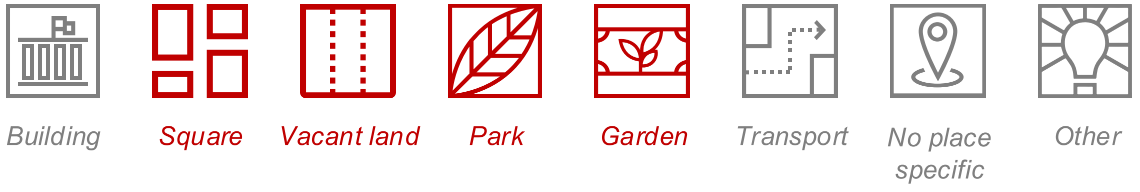
1. **Stormwater management**
By slowing and absorbing runoff, they decrease the risk of flooding.

2. **Reduced water pollution**
Filter pollutants from stormwater, enhancing the quality of water.

3. **Biodiversity**
Provides habitat for various species.

4. **Aesthetic Value**
Green spaces created by bioswales enhance the visual appeal of urban environments.

Application area



Retention ponds

Urban retention pond at Potsdamer Platz in Berlin, Picture source: Ewa Iwaszuk, Ecologic Institute

Retention ponds, also known as wet ponds or detention basins with permanent water storage, are engineered basins designed to collect, retain, and treat stormwater runoff from surrounding impervious surfaces. Unlike temporary detention basins, these ponds maintain a constant pool of water that allows sediment and pollutant settling and supports biological uptake by aquatic vegetation.

As stormwater enters the pond, it slows down, which allows solids to settle and nutrients and contaminants to be absorbed by vegetation and microbes in the water and sediments. Outflow is typically controlled through a weir or outlet structure that releases water slowly into downstream systems, preventing flooding and erosion.

Retention ponds address both stormwater and heat challenges in urban areas. The presence of water and vegetation supports evapotranspiration and localised cooling, making them a valuable component in urban UHI strategies. They can be installed in larger public or peri-urban green spaces, parks, or low-lying areas. Synergies exist with bioswales, rain gardens, and constructed wetlands, creating integrated blue-green infrastructure systems.

NBS

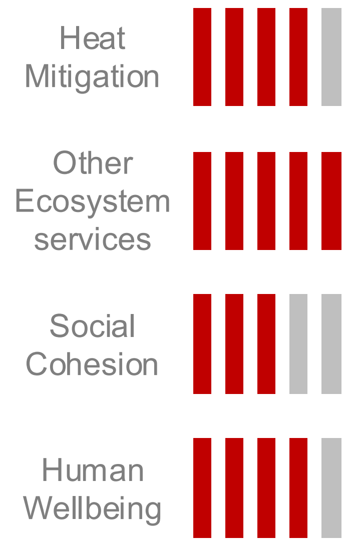
Grey

Enabling

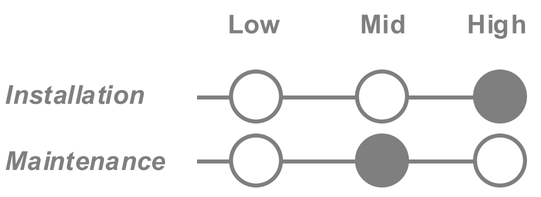
Retention ponds

Governance aspects

Retention ponds are typically installed on public land due to their space requirements, however incentives like stormwater fee reductions or co-financing may encourage private-sector uptake. Departments involved typically include water management, environmental protection, urban planning, parks and green infrastructure, and public works. Stakeholders such as local residents, community groups, and developers should be consulted early through participatory planning, especially for safety, biodiversity, and aesthetic concerns.



Costs



Retention ponds involve high upfront costs (earthworks, lining, landscaping, and water control infrastructure). Maintenance costs are moderate, primarily involving periodic dredging, vegetation management, and water quality monitoring. Their long lifespan and multiple benefits often justify the investment in well-planned sites.

Co-benefits

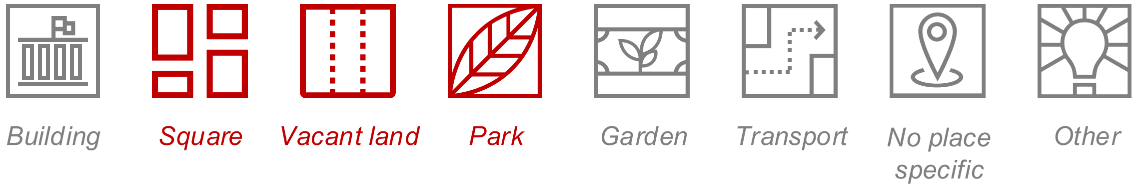
1. **Reduced water pollution**
Filters pollutants from runoff before entering rivers or groundwater.

2. **Stormwater management**
Controls stormwater peak flows reducing flooding risk.

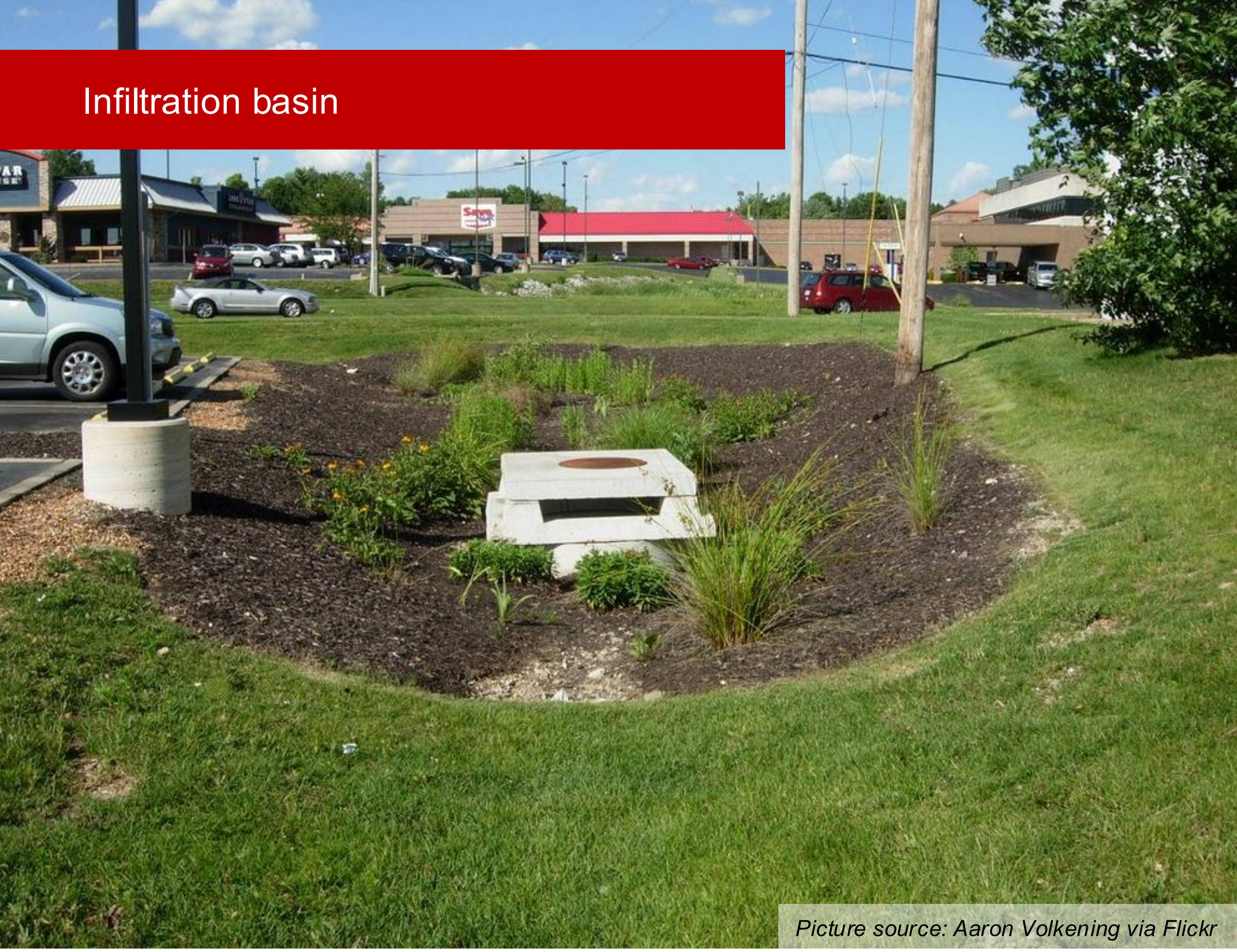
3. **Biodiversity**
Provides biodiversity support via aquatic habitats for flora and fauna.

4. **Aesthetic Value**
Enhances landscape beauty and aesthetic and recreational value of land.

Application area



Infiltration basin



Picture source: Aaron Volkening via Flickr

Infiltration basins are shallow, vegetated depressions designed to temporarily store stormwater runoff and allow it to infiltrate into the ground, recharging groundwater and reducing surface water flows.

Unlike retention ponds, infiltration basins do not maintain a permanent pool of water. Instead, they are engineered with permeable soils or substrates that facilitate the gradual absorption of water into the subsurface within a set period, typically 24–48 hours after rainfall. This process reduces both the volume and rate of stormwater runoff, while also filtering out sediments and pollutants through soil and vegetation layers.

These basins help mitigate Urban Heat Island effects indirectly, by supporting vegetation that contributes to cooling and by preventing hard-surface runoff that exacerbates heat and flooding. Infiltration basins are best suited to areas with permeable soils and moderate slopes, often found in parks, green strips, or undeveloped urban parcels. They can be combined with bioswales, green roofs, or permeable pavements to form a multi-functional stormwater system.

NBS

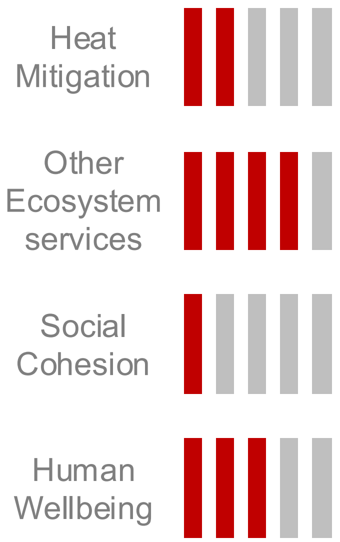
Grey

Enabling

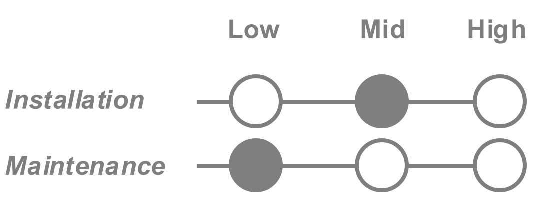
Infiltration basin

Governance aspects

Infiltration basins are generally built on public land, but can be implemented on private lots or new developments through zoning incentives or regulations. Financing can come from EU green infrastructure programs, municipal water utilities, or climate adaptation funds. Municipal departments involved include stormwater management, public works, city greening, urban planning, and environmental monitoring.



Costs



Installation costs for infiltration basins are moderate, depending on site conditions and soil permeability. They are relatively inexpensive to maintain, requiring periodic vegetation care and inspection for sediment accumulation or blockages, making them an efficient and sustainable long-term solution.

Co-benefits

availability

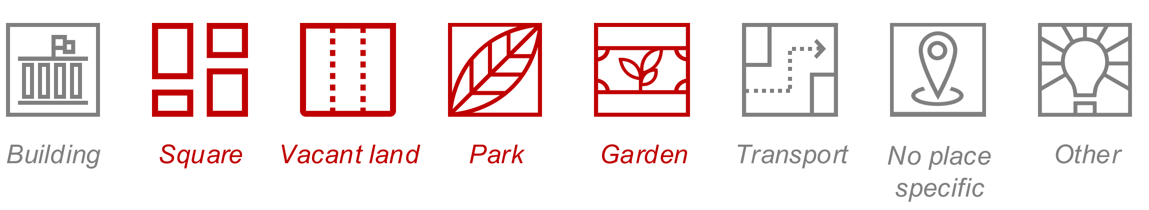
Stormwater management 1
Reduce surface runoff and help prevent localised flooding.

Water availability 2
Support groundwater recharge and enhance long-term water availability.

Biodiversity 3
Provide habitat for pollinators and small fauna.

Reduced water pollution 4
Improve water quality by filtering stormwater through soil layers.

Application area



Grow tiles

Picture source: Urbinat

Grow tiles can be implemented on horizontal or vertical surfaces and, depending on the materials used for the surface, they can be walkable. It is targeted at creating optimal environmental conditions for plants to live in an urban environment and it is designed to minimise maintenance operations.

The solution brings several environmental benefits, such as:

- heat island mitigation, by increasnig evapotranspiration;
- flooding prevention, by increasing permeable surfaces;
- air quality improvement;
- water saving increasing.

Depending on the plant species used, it can also be used for food production and pollination support.

The external surface is designed using parametric techniques that allow to adapt the shape to local climate conditions. For instance, in wet climates, the total area of the holes would be higher as more plants can be irrigated thanks to a higher water availability.

NBS

Grey

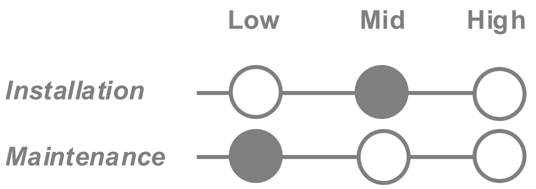
Enabling

Grow tiles

Governance aspects

Local governments are responsible for implementing urban greening policies and for overseeing the planning, installation, and maintenance of grow tiles in public spaces. These systems can also be installed on private buildings, in which case their management and upkeep fall under the responsibility of private actors.

Costs



The costs associated with grow tiles may include construction costs, which can vary depending on the materials chosen for the surface; planting costs, which depend on the type and variety of vegetation selected; and maintenance costs, which are generally low, as the system is specifically designed to minimise upkeep and reduce maintenance requirements.

Co-benefits

1. **Stormwater management**
Flood prevention through permeable surfaces

2. **Air quality improvement**
Contribute to the amelioration of urban air quality

3. **Biodiversity**
Increase plant diversity and provide habitats for wildlife

Application area

Building | *Square* | *Vacant land* | *Park* | *Garden* | *Transport* | *Not place specific* | *Other*

Shading Structures

Picture source: Climate office, Comune di Roma

Artificial Shading Structures, including canopies, awnings, pergolas, and shade sails, are engineered solutions that mitigate UHI effect by blocking direct solar radiation and reducing surface and ambient temperatures. These structures are typically made from high-albedo or reflective materials that minimise heat absorption and reflect sunlight away from urban surfaces.

Strategically placed to provide maximum coverage during peak sun hours, they reduce solar heat gain on pavements, building facades, and public spaces, enhancing thermal comfort and promoting passive cooling.

Shading structures can be installed in a variety of urban settings, such as streetscapes, plazas, playgrounds, and building exteriors, with flexible spatial requirements. They are especially effective when combined with vegetation, like climbing plants or green roofs, which adds evapotranspiration cooling and improves air quality. By reducing the need for mechanical cooling, these structures contribute to lower energy consumption and help create more livable, climate-resilient urban environments.

NBS

Grey

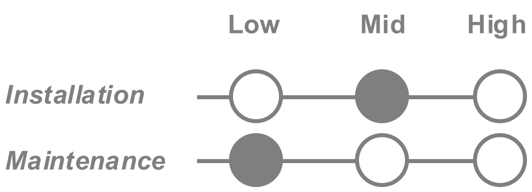
Enabling

Shading Structures

Governance aspects

Artificial shading structures are often installed in public spaces but may also involve private land. Governance requires coordination across planning, transportation, and green departments. Incentives or co-financing may be needed for private involvement. Stakeholder engagement, including local businesses, residents, and accessibility groups, can be done through workshops and participatory planning.

Costs



The cost of shading structures is medium and varies by size and material used. However, compared to trees, shading structures can be implemented faster and generally need a moderate level of maintenance.

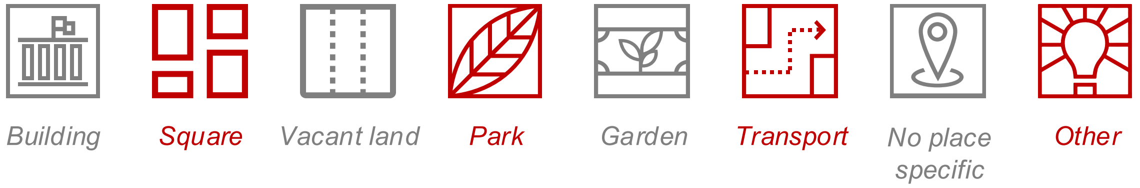
Co-benefits

1. **Enhanced Walkability**
Cooler, shaded streets encourage walking and cycling.

2. **Support for Urban Greening**
Shading structures can support climbing plants or be integrated with green infrastructure.

3. **Aesthetic Value**
Shading structures can be designed to enhance the aesthetics of urban contexts.

Application area



Cool roofs (high-albedo or reflective roofs)

Picture source: Polyglass website

Cool Roofs, also known as high-albedo or reflective roofs, are a “grey” infrastructure solution designed to combat the UHI effect. They work by using materials or coatings that reflect more sunlight and absorb less solar heat than conventional roofing.

While traditional roofs can reach temperatures of up to 65 °C, cool roofs can remain over 10 °C cooler, significantly reducing indoor temperatures in non-air-conditioned buildings: this helps lower energy demand for cooling, reduce greenhouse gas emissions, and mitigate smog formation by cooling the surrounding air.

Cool roofs can be installed on existing or new buildings, including residential, commercial, and industrial structures, with minimal space requirements. They are especially effective in densely built urban areas and can be combined with green roofs or solar panels for added environmental benefits. Common materials include white or reflective coatings, tiles, or membranes that can reflect up to 90% of sunlight.

NBS

Grey

Enabling

Cool roofs (high-albedo or reflective roofs)

Governance aspects

Cool roofs are typically installed on private buildings, requiring coordination with property owners. Incentives like tax credits or subsidies can encourage adoption. Financing may involve green funds or public-private partnerships. Municipal planning, building, and environmental departments should coordinate efforts, engaging stakeholders via consultations or community outreach.

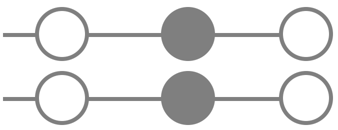
Heat Mitigation

Other Ecosystem services

Social Cohesion

Human Wellbeing

Costs



Replacing a conventional roof that is still in good condition with a cool roof can be costly. However, when a reflective coating is applied as part of routine maintenance or resurfacing, the additional expense is significantly reduced.

Co-benefits

1 **Energy Efficiency**
Reduced indoor temperatures lower the need for air conditioning.

2 **Extended Roof Lifespan**
Reflective materials reduce thermal stress, slowing roof degradation.

Application area

Building | *Square* | *Vacant land* | *Park* | *Garden* | *Transport* | *No place specific* | *Other*

Water harvesting and storage systems

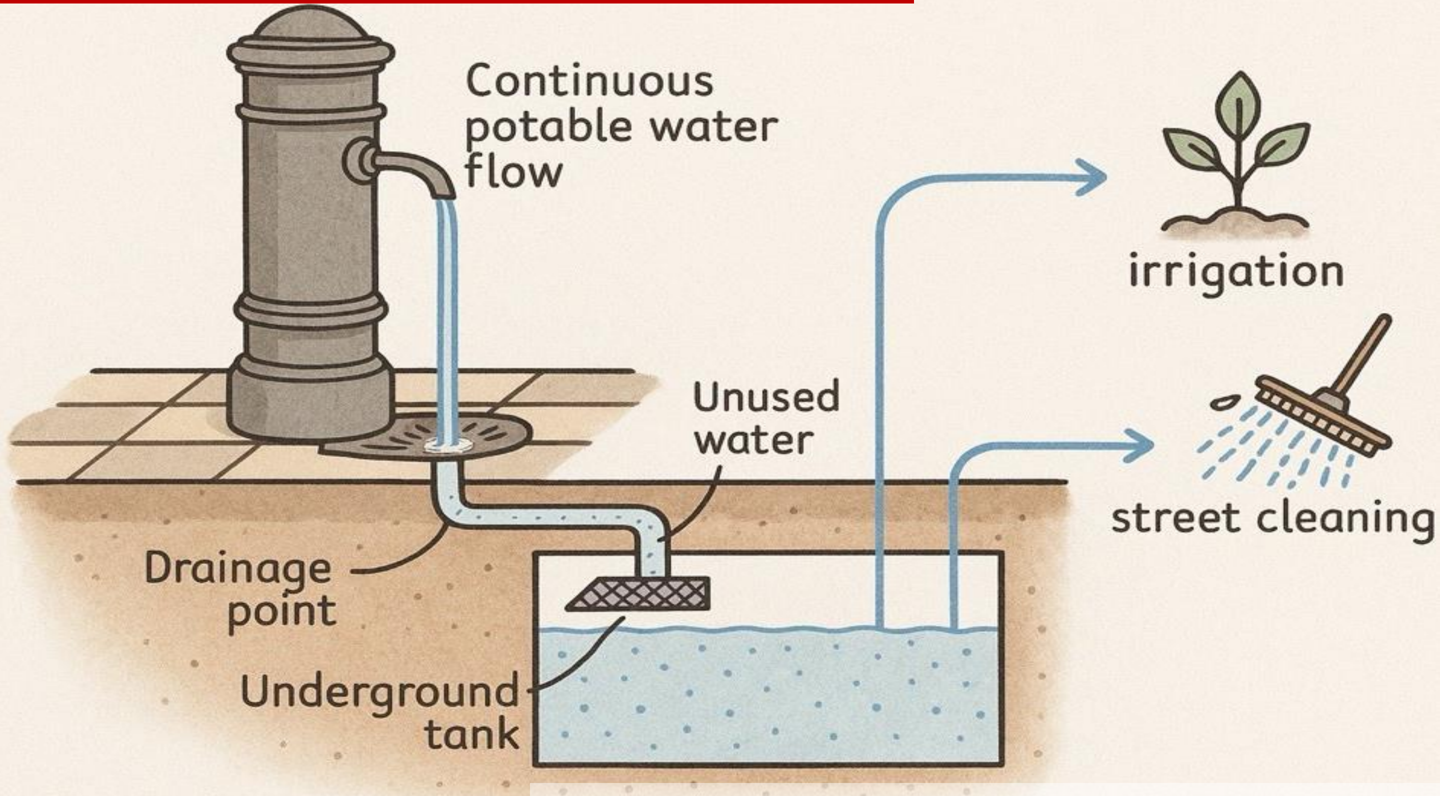


Diagram of wastewater harvesting and storage system of a Nasone

In a typical *nasone*, potable water flows continuously from the aqueduct-fed spout, spilling directly into a drain. While this water is safe to drink at the point of delivery, any portion not consumed is classified as non-consumed potable water or greywater-equivalent and is typically lost to the sewer system. With minor engineering adaptations, this outflow water can be collected, stored, and reused for secondary purposes. Secondary non-potable uses include: irrigating nearby green areas (trees, planters, flowerbeds); supplying ornamental fountains; washing pavements or urban furniture; filling underground cisterns for fire suppression or street cleaning; creating self-recirculating systems. This is achieved by installing an interception system below or near the drainage point, which diverts the non-contact water through a pre-filtration mesh into a holding tank. From there, the water can be gravity-fed or pumped into local reuse systems. In low-lying areas or historic districts, shallow underground cisterns can be retrofitted into public squares or gardens. Pumps and valves regulate the flow, while any overflow is redirected to stormwater or groundwater recharge systems. Additionally, sustainable fountain systems integrate decorative features with rainwater harvesting using components such as a catchment surface, storage tanks or underground cistern, filtration units, and pump system. Water, whether from rainfall or excess fountain flow, is collected, pre-filtered, and stored. This approach helps reduce water waste during droughts, while also addressing the need to keep *nasoni* operational for pressure regulation in the city's water grid and for hygiene purposes, thanks to the continuous flow that keeps the spouts clean.

NBS

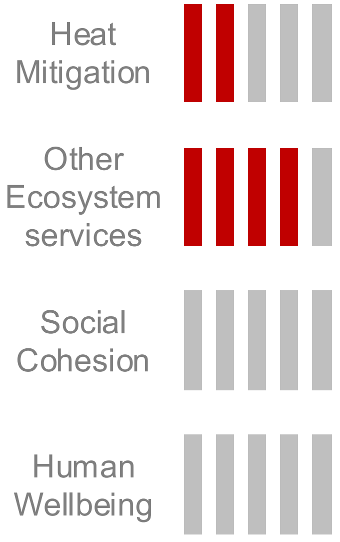
Grey

Enabling

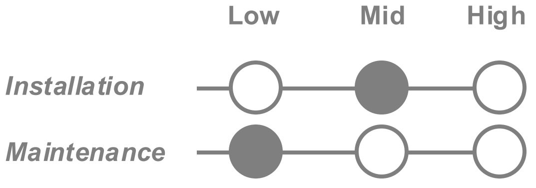
Water harvesting and storage systems

Governance aspects

Reusing *nasone* outflow involves coordination among ACEA, which oversees water quality, and municipal departments responsible for green maintenance. Environmental and health agencies may require monitoring, especially near sensitive areas. All systems must ensure backflow prevention and separation from the potable network, in line with national safety standards.



Costs



The costs of adapting a *nasone* to include water harvesting and storage are relatively low compared to rainwater systems. Components include: Minor plumbing works to intercept drainage; Pre-filtration meshes and debris traps; Small storage tanks (above or below ground); Gravity-fed or low-energy pumps.

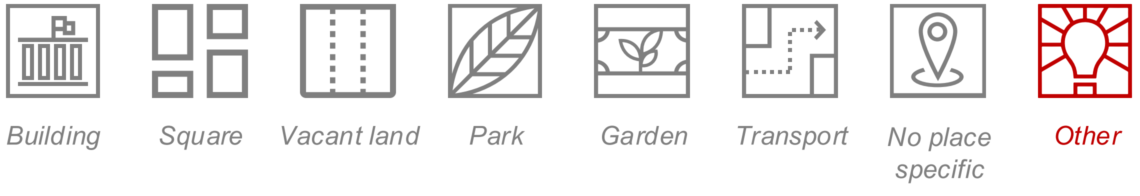
Co-benefits

1 Water Availability and Conservation
Repurpose clean unused water, reducing pressure on potable water and irrigation.

2 Biodiversity and thermal comfort
Support irrigation of green spaces and urban green infrastructure.

3 Infrastructure Efficiency
Relieve strain on the sewage system and avoid overflow.

Application area



Water Features and Misting Systems

Rome Piazza San Giovanni, Picture source: Il Caffè di Roma; Misting systems, Picture source: Vortex

Water features, such as splashpads fountains and misting systems, use recirculated water to cool surrounding air, especially during hot, dry periods when urban surfaces retain and radiate heat.

Misting systems in pedestrian zones, transit stops, or outdoor dining areas can significantly lower perceived temperatures, enhancing thermal comfort and encouraging outdoor activity. Fountains and water walls also contribute to localised cooling and can reduce nighttime heat retention by lowering ambient temperatures.

These features are space-flexible and can be integrated into squares, courtyards, parks, or building entrances. When combined with vegetation or permeable surfaces, they further enhance microclimate regulation. Beyond their cooling function, water features also improve urban aesthetics and livability, making them a multifunctional tool for climate-resilient urban design.

In addition, strategically placed drinking water dispensers enhance thermal comfort and offer relief by providing essential hydration for both residents and visitors during hot days.

NBS

Grey

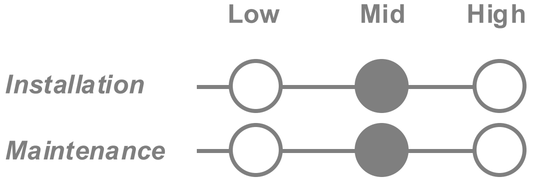
Enabling

Water Features and Misting Systems

Governance aspects

Effective installation of water features in urban public spaces typically requires close coordination between municipal departments and water utilities to manage permitting processes, ensure regulatory compliance, and organise ongoing maintenance. Given their location in public areas, these installations are generally publicly funded and managed. To ensure long-term success and community acceptance, it is essential to engage local stakeholders through structured consultation processes.

Costs



Installation costs vary by solution type. Fountains typically involve higher expenses due to construction and utility needs. Misting systems and drinking water dispensers are more cost-effective, though they still require a water connection and regular maintenance. In all cases, long-term operational and upkeep costs should be considered.

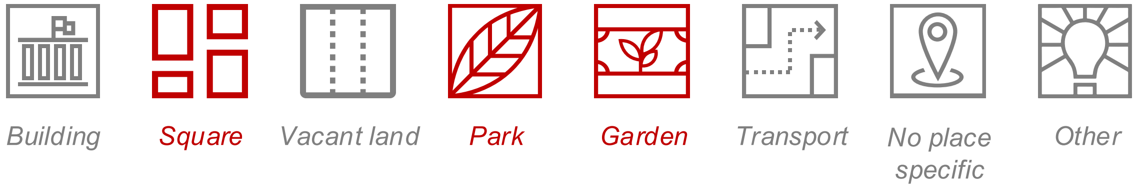
Co-benefits

1. **Improved urban aesthetics**
Fountains and water features can increase the visual appeal of urban spaces.

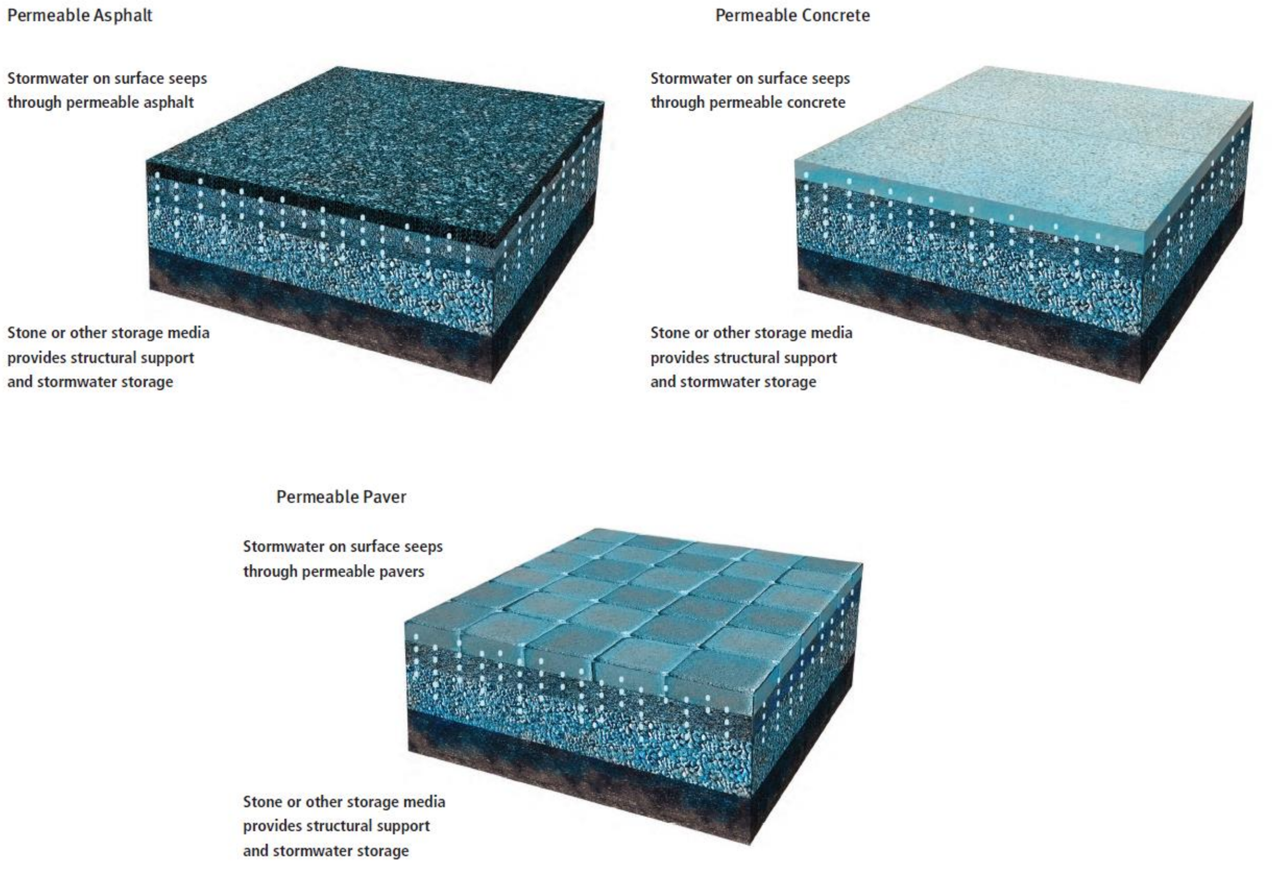
2. **Air quality improvement**
Water features can help reduce the presence of pollutants in the air.

3. **Biodiversity**
Can provide habitat or water sources for birds and insects.

Application area



Permeable pavements



Picture source: Philadelphia Green Street Design Manual

Permeable pavements are hard surfaces made from materials that allow water to pass through, thereby significantly reducing or even eliminating runoff compared to traditional impervious surfaces.

These systems typically include a subsurface storage layer - often composed of stone - that not only provides structural support comparable to conventional pavements but also offers temporary storage for stormwater.

Also known as pervious or porous pavement, this solution includes various types such as permeable asphalt, permeable concrete, and permeable pavers. While permeable asphalt and concrete allow water to infiltrate directly through the material, permeable pavers enable water to pass through the joints between individual units.

By promoting evaporation and reducing heat retention, permeable pavements contribute to alleviating the Urban Heat Island effect. They are particularly beneficial in areas with high levels of sealed surfaces and limited space for green infrastructure.

NBS

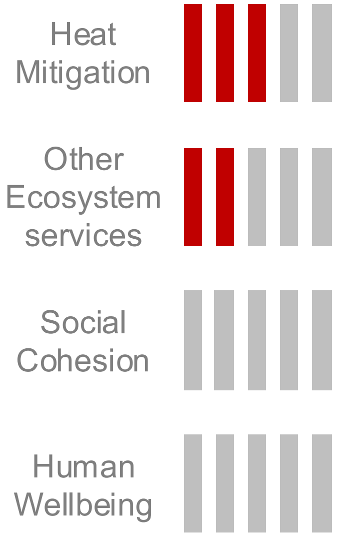
Grey

Enabling

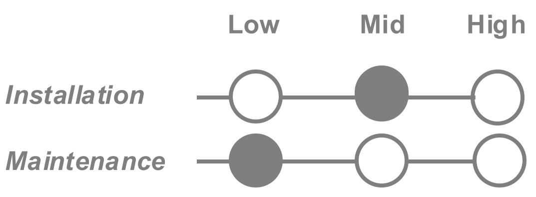
Permeable pavements

Governance aspects

Permeable pavements are most commonly installed on public infrastructure such as streets, squares, and parks, but are increasingly being mandated in new private developments through building regulations or sustainability certifications. Uptake can be encouraged through a range of incentives. Integrating these pavements into both public and private developments requires coordinated planning efforts across departments and a long-term maintenance strategy to ensure functionality over time.



Costs



Installation costs for permeable pavements vary depending on materials and site preparation. While initial costs can be higher than traditional paving, long-term maintenance is minimal. Nevertheless, proper maintenance, including regular debris removal and vacuum sweeping, is essential to prevent clogging and ensure durability.

Co-benefits

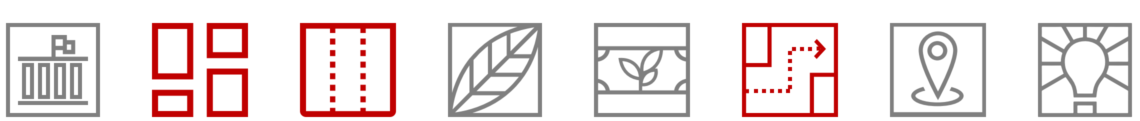
1. **Stormwater management**
Reduce flood risks by collecting, infiltrating, and storing stormwater.

2. **Reduced water pollution**
Prevent pollutants from entering ground water.

3. **Water regulation**
Enhance groundwater recharge and reduce risk of sewer overflows.

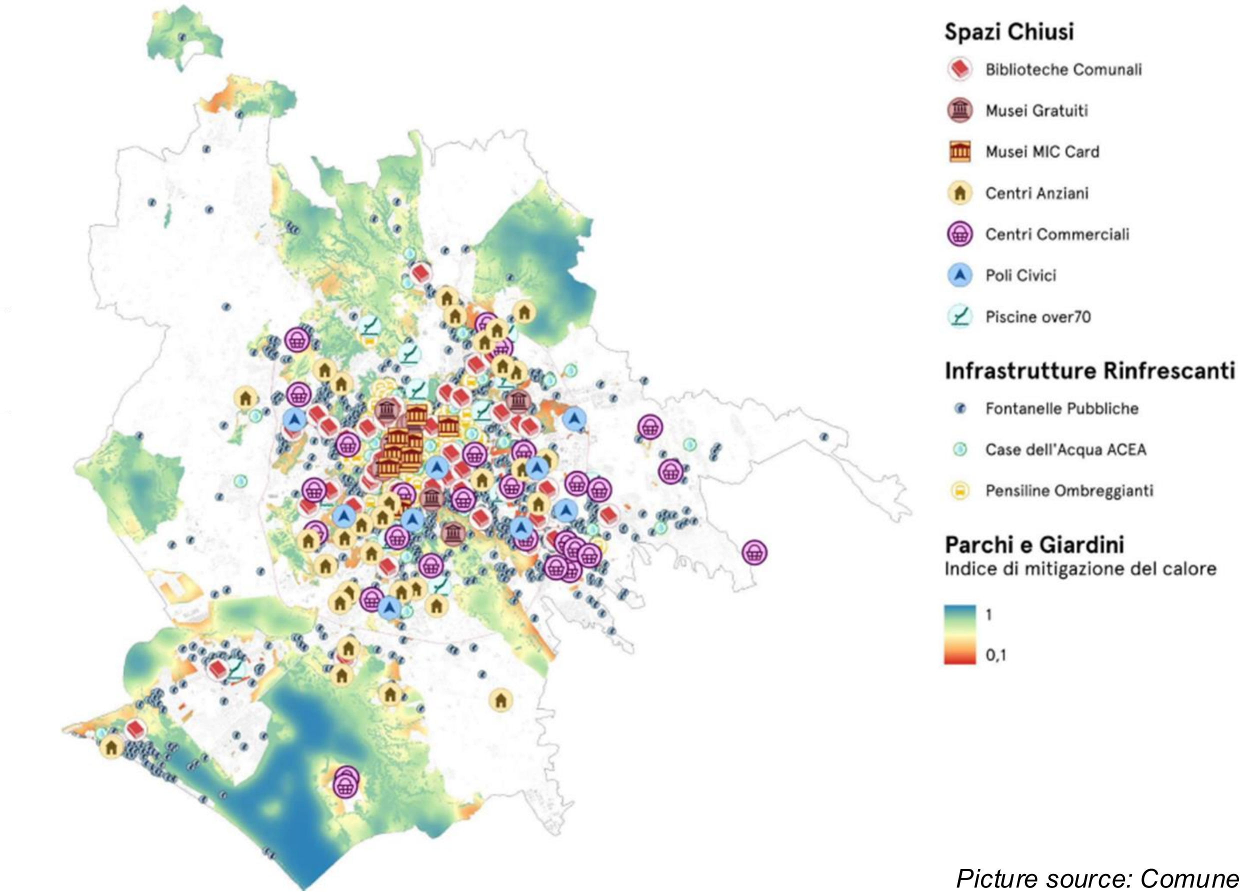
4. **Real estate value**
Permeable pavements can enhance the market value of real estate.

Application area



Building *Square* *Vacant land* *Park* *Garden* *Transport* *No place specific* *Other*

Network of climate shelters



Picture source: Comune di Roma

Climate shelters are designated indoor or outdoor spaces that provide thermal comfort and protection from extreme temperatures. They may be purpose-built or adapted from existing facilities such as schools, libraries, community centers, or green public spaces.

Their core function is to offer safe, accessible refuges during heatwaves or cold spells, especially for vulnerable populations. Shelters are typically equipped with water, shade, cooling infrastructure, seating, and are accessible. In cities like Barcelona and Paris, these shelters have been strategically distributed to ensure that the majority of the population can access one within a short walking distance.

These shelters can significantly reduce the health impacts of the urban heat island effect by offering respite from outdoor thermal stress. They also support psychological well-being and encourage social interaction. They can be located in schools (opened to the public during summer), civic centers, green playgrounds, or even shaded transit stops. They work best when integrated into a citywide adaptation strategy and complemented by awareness-raising campaigns and digital mapping tools. For outdoor spaces, the effectiveness can increase when nature-based design elements such as vegetation, permeable surfaces, and water features are included.

NBS

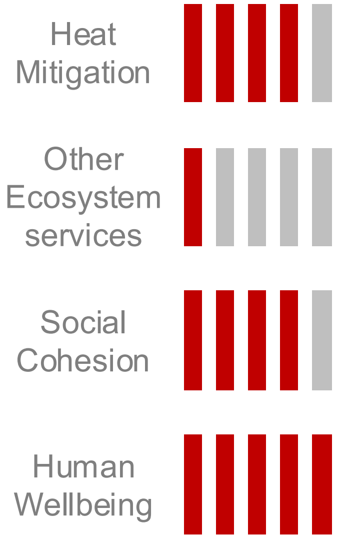
Grey

Enabling

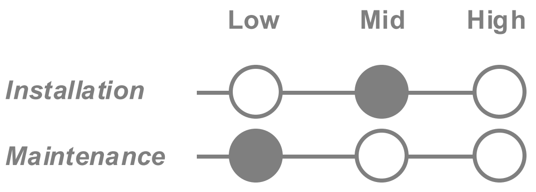
Network of climate shelters

Governance aspects

Climate shelters may be situated in public buildings and outdoor spaces although private facilities (e.g., malls or cafes) can also participate. To engage private stakeholders, cities may offer incentives such as recognition schemes. Financing typically comes from municipal adaptation budgets or resilience programs. Effective operation benefits from clear communication protocols to raise awareness and ensure equitable access.



Costs



Installation costs depend on whether the shelter is newly built, or whether existing infrastructure is being adapted. Some funding is needed for a communication campaign.
Maintenance requires routine cleaning, staff training, and seasonal checks. When integrated with ongoing municipal services (e.g., school maintenance), operational costs can remain moderate.

Co-benefits

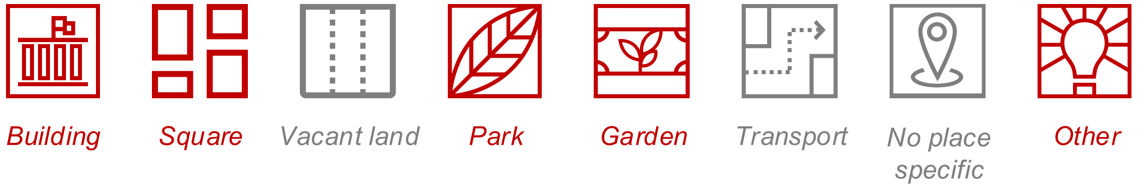
1. **Social cohesion**
Encourage social interaction and build trust across community groups.

2. **Institutional trust**
Strengthen trust in institutions by demonstrating proactive care for vulnerable populations.

3. **Awareness raising**
Enhance public awareness of climate risks.

4. **Urban resilience**
Serve as resilience hubs during multiple emergencies, not only heatwaves.

Application area



Awareness raising and information campaigns

Picture source: Barcelona City Council website

Awareness raising and information campaigns are coordinated outreach strategies aimed at increasing public understanding of urban heat risks and promoting adaptive behaviors during extreme heat events. These campaigns focus on communicating heat health risks, protection measures, and available support services, with a particular emphasis on reaching socially and medically vulnerable groups such as the elderly, children, low-income residents, migrants, outdoor workers, and people with chronic illnesses.

Typically, campaigns include multi-lingual communication materials, local workshops, door-to-door outreach, SMS alerts, radio and TV spots, and social media dissemination. Effective examples from cities like Paris, Barcelona and Athens include co-developed messaging with community organisations, maps of cooling shelters, instructions on self-care and care for dependents, and guidance on when and how to seek help. These campaigns can be launched seasonally (ahead of summer) or during heat emergencies.

Campaigns are especially impactful when they are localised and involve trusted intermediaries such as school networks, family doctors, or community leaders. They can be deployed city-wide or targeted to neighborhoods identified through heat vulnerability mapping, ensuring resources are focused where exposure, sensitivity, and lack of adaptive capacity are most severe.

NBS

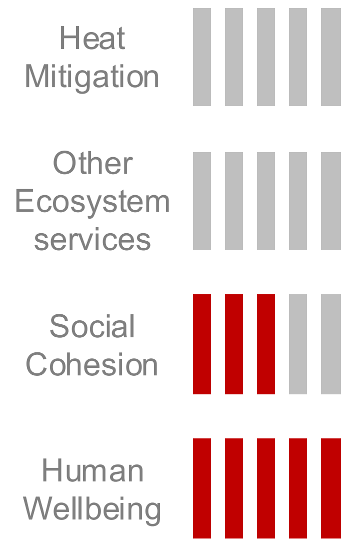
Grey

Enabling

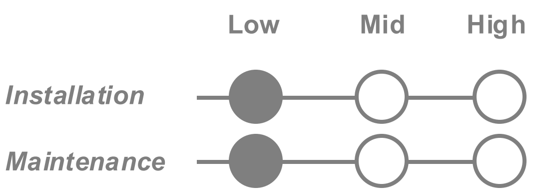
Awareness raising and information campaigns

Governance aspects

Communication campaigns and awareness-raising activities are typically led by municipal communication offices or civil protection departments, often in collaboration with public health authorities and urban resilience teams. Effective campaigns rely on clear institutional leadership and coordinated messaging across departments. Partnerships with local NGOs, schools, health centres, and community-based organisations can help extend outreach and ensure messages reach vulnerable populations.



Costs



Awareness campaigns are low-cost and high-impact, especially when they build on existing public health and social communication infrastructures. Costs are largely related to materials development, translations, and outreach coordination. The return on investment is high in terms of avoided health costs and heat-related harm.

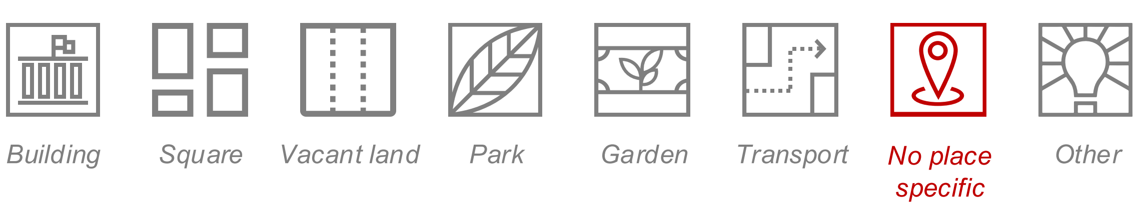
Co-benefits

1 **Improved health**
Reduced emergency healthcare costs through preventive behavior.

2 **Prevention and resilience**
Support behavioral change at household level.

3 **Awareness raising**
Promote climate literacy, raise awareness links between urban heat and climate change.

Application area



This document is an annex attached to the deliverable 'D4 – Draft action plans for the mitigation of the urban heat island effect in two pilot areas' of the project 'Climate adaptation – The Urban Heat Island effect in the city of Rome', funded by the European Union via the Technical Support Instrument, managed by the European Commission «Reform and Investment» Task Force.

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