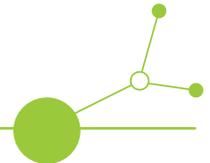


D.3.1.1 Solutions recommended to improve sustainability of heat measures



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EXECUTIVE SUMMARY AND CONTEXT

Cities across Europe are increasingly affected by extreme heat. Heatwaves are becoming more frequent, longer and more intense, posing serious risks to public health, urban comfort and social resilience. Children, elderly people and other vulnerable groups are particularly exposed, especially in dense urban areas with limited shade and green space. Heat is therefore no longer only an environmental issue, but a growing **public health and urban governance challenge** that requires practical and scalable solutions.

This policy brief presents experience from the City of Maribor, where nature-based shading measures were introduced as part of the Ready4Heat project to reduce heat stress in everyday public spaces. The pilot focused on outdoor areas of kindergartens that are highly exposed to direct sunlight during summer heatwaves. By introducing simple nature-based shading structures with vegetation, Maribor demonstrated how **low-cost, realistic and socially accepted solutions** can improve thermal comfort and protect vulnerable users.

The purpose of this policy brief is not to describe a single pilot action, but to translate local experience into **transferable recommendations** for other municipalities. It shows how nature-based shading solutions e.g. trees, vegetated pergolas, green roofs or shaded public spaces can be planned, implemented and scaled as part of broader urban heat mitigation strategies. The key message is that successful heat protection depends less on the specific structure installed and more on **good governance, early stakeholder involvement, clear responsibilities and secured long-term maintenance**.

Heat mitigation measures are highly relevant in the context of existing municipal and regional strategies, such as Heat action plans, SECAPs and urban development plans and are strongly aligned with European policy frameworks, including the EU Mission on Adaptation to Climate Change and the European Green Deal. With the adoption of the Nature Restoration Law, cities are increasingly expected to protect and expand urban green space and tree canopy cover.

The experience from Maribor confirms that municipalities can start small, learn from pilots and gradually scale up measures city-wide. The recommendations presented in this policy brief are relevant not only for Maribor, but for **cities and towns across the region and Europe**, facing similar climate, health and urban challenges. Heat mitigation through nature-based shading is therefore a shared and urgent task that requires coordinated action beyond individual pilot locations.

Local context - Maribor

As part of the Ready4Heat project, the City of Maribor implemented a pilot action focused on reducing heat stress in outdoor spaces used by young children. The pilot addressed a common urban challenge - playgrounds in kindergartens that are highly exposed to direct sunlight and overheating during summer heatwaves.

To improve thermal comfort and protect vulnerable users, Maribor installed two wooden pergolas with climbing plants in selected kindergarten playgrounds. The structures provide natural shading and demonstrate how nature-based solutions can be integrated into everyday public spaces using simple, low-cost measures. Beyond physical cooling, the pilot also supported awareness-raising and learning, as kindergarten staff and children became actively involved in understanding heat protection and caring for vegetation.

This policy brief builds on the experience and lessons from the Maribor pilot. It uses the local example as an entry point to present broader, transferable recommendations on how municipalities can use nature-based shading solutions to improve urban heat resilience, protect public health and enhance the quality of life in cities facing rising temperatures.



HEAT MITIGATION MEASURE - SOLUTION OVERVIEW

Nature-based shading solutions are a cost-effective, flexible and politically feasible response to increasing urban heat. By embedding living shade into urban planning and public space design, municipalities can protect public health, enhance liveability and build long-term climate resilience. The approach is easily replicable, can start small and be scaled up over time, making it suitable for cities of all sizes across Europe.

Nature-based shading solutions are an effective and widely applicable approach to reducing heat stress in cities. They use natural elements, e.g. trees, climbing plants, green roofs, green walls and vegetated corridors, to provide shade and cooling through evapotranspiration. By lowering surface and air temperatures, these solutions help mitigate the urban heat island effect while improving the overall quality of public spaces.

Rather than focusing on single pilot installations, this solution represents a scalable concept that can be adapted to different urban contexts. Nature-based shading can be applied along streets, in schoolyards, playgrounds, parks, public squares, transport stops or around buildings. Common forms include:

- **Tree canopies:** Planting strategically placed trees along streets, parks and squares.
- **Green islands** with fast growing climbing plants in unpaved areas or pots.
- **Green roofs and walls:** Covering building surfaces with vegetation to offer shade and cooling.
- **Urban green corridors:** Creating continuous vegetated pathways that provide shade and connectivity.
- **Pocket parks and green spaces:** Small parks with ample trees that offer shaded areas.

A Ready4Heat pilot in Maribor illustrates this approach. Vegetated wooden pergolas were installed in kindergarten playgrounds to protect children from direct sun exposure during heatwaves. While modest in scale, the pilot demonstrated how simple, low-cost nature-based shading can improve thermal comfort and usability of public spaces.

The key learning is not the pergola itself, but the principle of integrating living shade into everyday urban infrastructure.

Nature-based shading solutions deliver multiple **benefits** beyond temperature reduction:

- **Health benefits** include a reduced risk of heat-related illness, improved air quality and safer outdoor conditions for vulnerable groups such as children and the elderly.
- **Social inclusion** is strengthened through more comfortable and accessible public spaces that encourage social interaction, outdoor activity and community life.
- **Biodiversity** is supported by creating habitats for birds and pollinators and by improving ecological connectivity within urban areas.
- **Cost savings** are achieved through lower demand for air conditioning, reduced stress on infrastructure and comparatively low maintenance costs over time.



A PRACTICAL PATHWAY FOR MUNICIPALITIES

Key lesson:

Nature-based shading is not a single project, but a repeatable approach. When embedded in municipal decision-making, cross-departmental cooperation and long-term maintenance planning, it can be successfully replicated and scaled in cities of all sizes.

Nature-based solutions are an effective and affordable way for municipalities to reduce heat stress in public spaces. The experience from local pilots, such as shaded playgrounds, shows that success depends less on the specific structure installed and more on a well-organised implementation process. The following steps outline a transferable pathway that municipalities can apply when introducing nature-based shading measures such as trees, pergolas, green roofs or green playgrounds.

Define the need and political mandate

Start by identifying **heat-exposed locations and vulnerable groups**, using heat maps, local knowledge and staff experience. Secure a political decision that recognises heat mitigation as a public health and urban planning priority. This can be done through a council decision, inclusion in a Heat Action Plan or integration into urban development strategies.

Set up governance and assign responsibilities

Successful implementation requires cooperation across departments. Clear responsibility for coordination and long-term maintenance must be assigned from the start.

In practice, this means involving:

- education or social services to identify sensitive user groups,
- green space or environmental departments to define suitable nature-based solutions,
- technical and investment units to check feasibility and safety,
- urban planning or heritage authorities where permits are required

Design the solution and ensure technical feasibility

Select the most appropriate **nature-based shading approach** for each location, considering space, safety and long-term growth. Design should prioritise climate-resilient and non-allergenic plant species, locally suitable materials and simple construction. Technical experts should verify structural stability, planting conditions and compliance with local regulations.

Engage users and the community early

Engage users and staff at an early stage to ensure acceptance and practical input. Teachers, caretakers, residents or facility managers can help identify where shade is most needed and later support basic maintenance. Early engagement increases ownership and reduces resistance.



Secure funding and plan maintenance

Even low-cost solutions require dedicated budget lines. Municipalities should plan not only for installation but also for watering, pruning and care during the first years. Maintenance can be organised in-house or outsourced, but responsibilities and funding must be clearly defined in advance.

Implement, monitor and scale up

Implement the measure as a pilot or first phase, monitor usability and comfort and use the experience to replicate the approach in other locations. Starting small allows municipalities to build confidence and gradually scale up nature-based shading across the city.

ACTORS AND STAKEHOLDER ENGAGEMENT: BUILDING SHARED OWNERSHIP OF HEAT MITIGATION

Effective heat mitigation measures depend not only on technical design, but on the **early and coordinated involvement of the right actors**. Experience from local pilots shows that nature-based solutions work best when municipalities build broad partnerships that combine technical expertise, user knowledge and political support.

Key actors and their roles

Municipal heat mitigation measures typically require the involvement of the following actors:

- **Municipal leadership and decision-makers**, who provide political backing, approve locations and secure funding.
- **Urban planning, environment and green space departments**, responsible for selecting suitable nature-based solutions, plant species and locations.
- **Education and social services**, particularly where measures affect vulnerable groups such as children or elderly people.
- **Technical experts, landscape architects and arborists**, who ensure feasibility, safety and long-term performance.
- **Gardeners and maintenance staff**, essential for planting, watering, pruning and long-term care.
- **Public health agencies, NGOs and associations**, contributing health expertise, outreach and awareness-raising.
- **Users and local communities**, such as schools, staff, parents or residents, who provide practical input and daily oversight.
- **Media and communication actors**, who help explain benefits and build public acceptance.



How stakeholders are engaged

Early involvement allows local knowledge to shape design decisions, prevents later conflicts and strengthens acceptance.

Stakeholders should be involved **from the earliest planning stage**, not only during implementation. Practical engagement methods include:

- consultations and site visits to identify heat-exposed locations,
- interdisciplinary working groups bringing together planners, gardeners and service providers,
- participatory design discussions with users of public spaces,
- training and guidance for staff responsible for daily maintenance,
- public communication through local media and events.

Why early and broad involvement matters

Broad stakeholder engagement helps municipalities move from single pilot actions to replicable solutions. When actors understand their role and see direct benefits, they are more willing to support replication and scaling. Early coordination also:

- clarifies responsibilities for maintenance and operation,
- reduces delays related to permits or technical constraints,
- builds long-term ownership beyond the project lifetime.

Transferable lessons for replication and scaling

When engagement is embedded into municipal routines and cross-sector cooperation, nature-based heat mitigation measures can be successfully transferred and scaled across cities and regions.

The main lesson is that stakeholder engagement is a process, not a one-off activity. Municipalities aiming to replicate or upscale heat mitigation measures should:

- establish clear coordination roles within the administration,
- involve users and maintenance staff before final design decisions,
- combine technical expertise with local knowledge,
- use pilots as learning spaces to build trust and capacity.



COMMUNICATION AND AWARENESS: MAKING HEAT MITIGATION VISIBLE AND TRUSTED

Effective heat mitigation measures require not only good design, but also clear and positive communication. Experience from pilot actions shows that public acceptance and long-term support increase when municipalities actively explain why measures are implemented, how they work and who benefits from them.

How municipalities communicate heat mitigation measures

Communication is most effective when it is linked to real-life situations, especially during summer periods or heatwave events, when citizens are most aware of the issue.

Successful communication focuses on visible, practical and timely messages. Municipalities typically combine several elements:

- clear explanations of the problem (heatwaves and health risks),
- simple messages about solutions (shade, cooling, protection),
- visible examples in public spaces that people can experience directly.

Actors involved in communication

Communication works best when it is shared across actors, including:

- **municipal communication or PR departments**, coordinating messages and media outreach,
- **local media** (press, radio, TV), helping to reach a broad audience,
- **schools, care institutions and public services**, acting as multipliers for vulnerable groups,
- **project partners, NGOs and networks**, reinforcing messages through their channels,
- **local politicians and officials**, who provide credibility and visibility.

Communication channels and tools

Traditional media remain particularly effective for reaching older citizens, while social media and visual content support wider awareness and engagement.

Experience shows that a **mix of channels** is most effective:

- local press releases and interviews explaining benefits in simple language,
- social media posts highlighting visible results and human stories,
- on-site signage or plaques explaining the purpose of new measures,
- school or community programmes that link heat protection with everyday behaviour,
- public events, campaigns or thematic days focused on heat and health.



Why positive and visible messaging matters

Positive messaging builds **trust and ownership**. When citizens understand that measures protect health, improve comfort and are affordable, resistance is reduced. Visible solutions, e.g. shaded playgrounds, green islands or cooling spaces serve as everyday reminders that the municipality is acting.

Transferable lessons for replication and scaling

When communication is embedded in municipal routines and linked to visible actions, heat mitigation measures gain public support and can be more easily expanded to other locations and cities.

The key learning is that **communication should be planned as part of the solution**, not as an afterthought. For replication and scaling, municipalities should:

- align communication timing with heat seasons,
- use clear, non-technical language focused on benefits,
- highlight co-benefits such as health, comfort and quality of life,
- involve local institutions as trusted messengers,
- repeat messages consistently across channels.

MAKING NATURE-BASED HEAT MITIGATION MEASURES TRANSFERABLE AND SCALABLE

Key message:

Nature-based shading is not a one-off project but a repeatable and scalable approach. When municipalities start small, secure maintenance and build political support, local pilots can grow into city-wide strategies that improve health, comfort and climate resilience across regions.

Nature-based shading solutions can be successfully transferred and scaled across different urban contexts when certain **enabling conditions** are in place. Experience from pilot actions across countries shows that the key factor is not the specific structure installed, but the **institutional readiness to plan, maintain and expand the approach over time**.

Conditions for success

Successful adoption in other municipalities depends on several common conditions:

- **Political commitment**, recognising heat mitigation as a health and quality-of-life priority.
- **Dedicated funding**, not only for installation but also for long-term maintenance.



- **Available space**, which can include streets, schoolyards, public squares, roofs or small residual spaces.
- **Clear responsibilities**, especially for watering, pruning and care during the first years.

When these conditions are met, nature-based shading measures are feasible in both dense urban areas and smaller settlements.

Barriers and how to overcome them

- **Maintenance requirements**, particularly during the early growth phase of vegetation.
Solution: plan maintenance budgets in advance and share responsibility with public institutions or local services.
- **Upfront costs**, which may compete with other municipal priorities.
Solution: start with small, visible interventions and use results to justify further investment.
- **Limited space in dense areas**, especially in historic centres.
Solution: use vertical greening, pergolas, pocket parks or shading at transport stops.

Scaling pathways: how to grow the solution

A step-by-step approach allows municipalities to scale at their own pace:

Start small: Pilot one shaded playground, park or public space. Test maintenance routines and user acceptance.

Expand locally: Replicate the approach in other schools, streets or squares. Combine shading structures with tree planting, green islands and shaded seating.

Integrate strategically: Embed nature-based shading into urban planning rules, Heat action plans and public space design standards. Require shading and greenery in new developments and renovations.

Adapting to different municipal contexts

- **Small towns** can rely on simple, low-cost solutions with shared maintenance responsibilities and strong community involvement.
- **Larger cities** benefit from strategic planning, cross-department coordination and integration into spatial and climate strategies.



POLICY RECOMMENDATIONS

Key message:

Heat mitigation through shading and nature-based solutions should be treated as a core element of urban policy. When supported by municipal decisions, aligned regional and national frameworks and EU-level strategies and funding, local pilot experiences can be transformed into scalable solutions that protect health, improve quality of life and strengthen climate resilience across Europe.

Municipal level

To effectively address increasing heat risks, municipalities should move from ad-hoc interventions to clear and binding policy decisions. Shading and cooling measures should be **formally embedded in municipal Heat action plans**, recognising heat as a public health and urban liveability issue. Cities are encouraged to establish an **annual budget line dedicated to shading and nature-based cooling measures**, covering both implementation and long-term maintenance. A **responsible municipal unit**, typically within urban planning, green space or environmental departments should be designated to coordinate actions across sectors, manage implementation and ensure continuity. Urban planning offices should **systematically integrate cooling elements such as tree canopies, shaded seating, green roofs and permeable surfaces into the design of new public spaces and urban renewal projects**. **Regular monitoring and plan updates are essential** to respond to changing climate conditions and local needs.

Regional and national level - how can we support municipalities

Scaling up local heat mitigation requires **supportive frameworks beyond individual municipalities**. Regional and national authorities can accelerate uptake by **adapting funding schemes to explicitly include nature-based shading and cooling measures**, particularly for smaller municipalities with limited capacity. **Clear technical guidance, model designs and recommended standards** help reduce uncertainty and implementation delays. **Integrating heat mitigation and urban cooling requirements into building codes, spatial planning regulations and public space standards** ensures that such measures become routine practice rather than exceptional projects.

European Union level

At EU level, urban heat mitigation **aligns strongly with the European Green Deal, Cohesion Policy and the EU Mission on Adaptation to Climate Change**. The **Nature Restoration Law (2024)** provides a clear policy framework by requiring Member States to **halt the loss of urban green space, increase tree canopy cover and strengthen ecosystem services in cities**. **EU funding instruments** under cohesion policy, climate adaptation and urban development programmes **should continue to support municipalities** in implementing and scaling nature-based solutions. **Transnational cooperation and peer learning**, as demonstrated in projects like Ready4Heat, play a crucial role in transforming local experience into widely applicable policy approaches.

Key messages:

- Heat mitigation through shading and nature-based solutions should be treated as a core element of urban policy



- Clear municipal decisions
- Aligned regional and national frameworks
- EU-level strategies and funding
- Scalable solutions that protect health and improve quality of life

LESSONS LEARNED FROM IMPLEMENTING NATURE-BASED HEAT MITIGATION

Key lesson:

Nature-based heat mitigation is a learning process, not a one-off intervention. With adequate time, care and coordination, local pilots can be used as a reliable and easily adaptable solution that enhance comfort, awareness and climate resilience in various urban environments.

Even small steps to deal with heat in nature can have a big effect, but only if we think about how to put them into practice. The main lessons from pilot actions across different cities show what local authorities should expect, avoid and prioritise when introducing shading and cooling solutions.

Key challenges and how to address them

One of the most common challenges is **delayed impact**. Vegetation-based solutions need time to mature, meaning that full shading and cooling effects are not immediate. This should be anticipated and clearly communicated to users and decision-makers to avoid unrealistic expectations. Another frequent challenge is **maintenance**, especially watering and care during the first years. Without clear responsibility and resources, the long-term performance of nature-based solutions is at risk. Administrative procedures, particularly **public procurement and internal coordination**, can also slow down implementation if roles and timelines are not clearly defined.

What works and what does not

What works well is starting with **simple, low-cost measures** in clearly defined locations and assigning responsibility for maintenance from the beginning. Involving staff or local service providers early increases reliability and ownership. Using pilots as learning spaces, rather than final solutions, helps municipalities adjust designs and processes before scaling up.

What does not work is treating nature-based solutions as “install and forget” measures. Underestimating maintenance needs or assuming immediate results often leads to disappointment and reduced political support.



What should be done differently

Based on experience, municipalities would benefit from **planning maintenance and communication as early as design**, not after installation. Aligning procurement, permitting and budgeting processes in advance can significantly reduce delays. Where possible, planting should be scheduled early in the season to maximise growth and early benefits.

Practical guidance for municipalities

For successful implementation and future scaling, municipalities should:

- clearly define maintenance responsibilities and secure funding for the first years,
- communicate that benefits increase over time as vegetation matures,
- streamline procurement and coordination across departments,
- use pilot projects to build internal capacity and public support before wider rollout.

KEY FINDINGS AND CONCLUSIONS

Nature-based shading and cooling measures represent a low-regret, high-impact policy choice. They are technically feasible, socially accepted and economically justified. When supported by political commitment, integrated planning and long-term maintenance, these measures enable municipalities to transform local pilot experience into robust, scalable solutions that protect public health, strengthen climate resilience and improve quality of life across Europe.

Experience gained from implementing nature-based shading and cooling measures in various urban environments shows that these solutions are **effective, practical and transferable ways** of addressing urban heat risks. Evidence from pilot schemes, combined with broader European experience, provides decision-makers with clear guidance on what works, under what conditions and how these measures can be scaled up.

3 most important findings for decision-makers

1. Nature-based shading works and delivers measurable benefits

Trees, vegetated shading structures, green roofs and permeable surfaces consistently reduce surface and ambient temperatures. Empirical evidence shows that tree canopies can lower local air temperatures by 2-8°C, while green roofs can reduce roof surface temperatures by 20-40°C. These cooling effects translate directly into improved thermal comfort, reduced heat exposure and lower energy demand for cooling buildings. Importantly, these benefits are achieved with technologies that are already available, well understood and compatible with existing urban infrastructure.

2. Feasibility is high, but success depends on governance and planning, not technology

From a technical perspective, most nature-based cooling measures are easy to implement and can be integrated into routine municipal activities such as street redesign, schoolyard renovation or



building refurbishment. The main determinants of success are therefore institutional rather than technical: early political commitment, cross-departmental coordination and clear allocation of responsibilities. Where heat mitigation is embedded into Heat Action Plans, spatial planning documents and public space design standards, implementation becomes faster, cheaper and more consistent.

3. Long-term performance requires secured maintenance and realistic expectations

Nature-based solutions require time to mature. Trees and climbing plants do not deliver full cooling benefits immediately and maintenance especially watering during the first two to three years is essential. Municipalities that fail to plan maintenance budgets or assign responsibility risk undermining the credibility of the measure. Conversely, those that communicate clearly that benefits increase over time tend to maintain public and political support even during early phases.

Benefits across policy domains

The benefits of nature-based cooling measures extend well beyond temperature reduction. **Health benefits** include lower risks of heatstroke, dehydration and cardiovascular stress, particularly for elderly people, children and outdoor workers. **Environmental benefits** include improved air quality, reduced ozone formation during heatwaves, better stormwater infiltration and increased urban biodiversity. **Economic benefits** arise from reduced energy consumption, avoided healthcare costs and slower degradation of infrastructure exposed to extreme heat. **Social benefits** include the reactivation of public spaces during summer, increased outdoor activity and stronger public acceptance of climate policies due to visible, everyday improvements.

Limitations and how to address them

Decision-makers should also be aware of limitations. Space constraints in dense urban areas can restrict tree planting, but alternatives such as vertical greening, shading structures and pocket parks can compensate. Upfront investment costs may appear high in annual budgets, yet long-term savings often outweigh initial expenditures. Political resistance or public concerns—related to maintenance, pollen or parking loss can be mitigated through early stakeholder engagement, co-design and transparent communication.

Scaling and replication pathways

Experience shows that the most effective pathway is **phased implementation**. Municipalities benefit from starting with highly visible, low-risk interventions such as shaded schoolyards, bus stops or street segments. Once benefits are demonstrated, measures can be expanded to larger areas and embedded into planning regulations, procurement rules and development guidelines. At later stages, cities can combine shading with broader strategies such as green corridors, cooling networks and nature restoration projects.

Follow-up actions for long-term sustainability

To ensure lasting impact, municipalities should:

- institutionalise heat mitigation within Heat action plans and spatial planning frameworks,
- establish permanent budget lines for maintenance and replacement,
- use data (heat maps, exposure analysis) to prioritise interventions,



- monitor performance and adapt designs as climate conditions evolve.

Regional, national and EU-level support remains essential to accelerate scaling. Funding instruments, technical guidance and peer-learning platforms help municipalities move from isolated projects to **systemic urban heat resilience strategies**.

TOP 5 POLICY MESSAGES

Urban heat is a public health issue, not only an environmental one

Heatwaves pose a serious health risk, particularly to children, the elderly and vulnerable groups. Implementing urban heat mitigation measures can directly reduce heat-related illnesses, healthcare costs and pressure on emergency services.

Nature-based shading solutions are effective, affordable and fast to implement

Trees, vegetated pergolas, green roofs and other nature-based shading measures can significantly reduce local temperatures while improving air quality, urban comfort and biodiversity often at lower cost than purely technical solutions.

Municipalities can start small and scale up over time

Effective heat mitigation does not require large-scale investments from the outset. Pilot actions in kindergartens, schools, public squares or transport stops can deliver quick benefits and build the basis for city-wide implementation.

Long-term success depends on secured maintenance and clear responsibilities

The main risk of failure is not implementation but insufficient maintenance. Municipalities must assign clear responsibility for upkeep and ensure stable funding for watering, pruning and care especially during the first years.

Cooling cities improves quality of life and public acceptance of climate action

Shaded and cooler public spaces encourage outdoor activity, social interaction and well-being. Visible and tangible benefits increase citizens' trust and acceptance of climate adaptation measures. Heat mitigation is about people, not only about infrastructure or climate targets. **Visible actions build trust**, showing citizens that municipalities are responding to real needs. **Everyone benefits from cooler cities**, through healthier public spaces and better quality of life.



SHOWING THE IMPACT OF COOLING SOLUTIONS IN PRACTICE

Data and visual evidence are crucial in demonstrating that nature-based shading measures are attractive, effective and scalable solutions. The Ready4Heat pilot in Maribor provides concrete indicators that demonstrate the relevance of local demonstrations to broader policy.

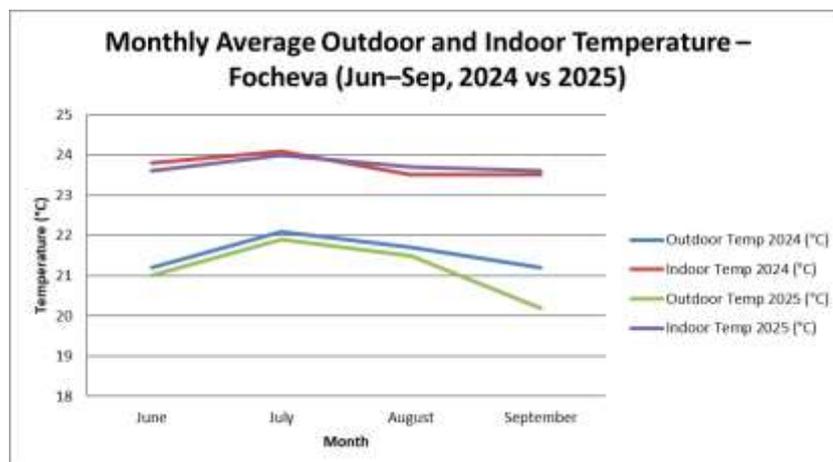
Key message:

Each pilot is more than a case study - it is a proof of concept. Maribor experience shows that nature-based shading delivers measurable cooling, high user acceptance and strong educational value. When replicated and scaled, such measures can form a core component of urban heat resilience strategies across cities and regions.

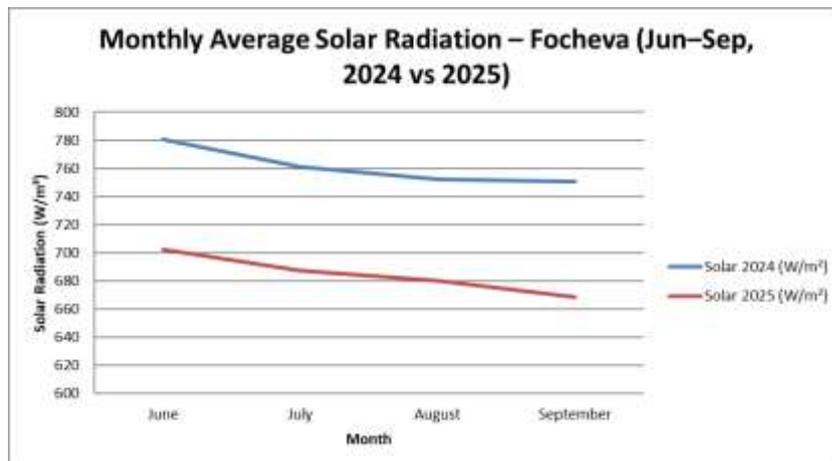
Pilot impact at local level

Nature-based shading solutions, such as vegetated pergolas and similar green shading structures, are an effective measure to reduce heat stress in highly exposed outdoor spaces, particularly those used by vulnerable groups. When integrated into playgrounds, schoolyards or other public areas, these solutions provide immediate thermal buffering by reducing direct solar exposure and stabilising microclimatic conditions.

Evidence from monitored implementations shows that shaded outdoor areas can be up to 5°C cooler than fully exposed surfaces during warm and transitional summer periods, even before full vegetation coverage is reached. This demonstrates that the structural shading effect alone already delivers tangible cooling benefits, which further increase as plants mature and evapotranspiration intensifies.



In addition to outdoor cooling, nature-based shading contributes to more stable indoor temperatures in adjacent buildings by limiting solar heat gain. This reduces thermal stress indoors and supports overall comfort without relying on energy-intensive cooling systems. The combination of outdoor shading and indirect indoor cooling highlights the multifunctional value of these solutions.



Importantly, such measures are particularly effective in spaces with daily, intensive use, such as childcare facilities, schools, public transport waiting areas and neighbourhood gathering points. By protecting users during peak heat conditions, nature-based shading solutions support public health objectives while remaining technically simple, adaptable and suitable for replication across different urban contexts.

User perception and behavioural impact

Qualitative feedback complements the quantitative data. Teachers and staff reported that shaded areas are perceived as visually and psychologically cooler, children spend more time outdoors during hot days and calmer behaviour is observed. Importantly, the pilot increased awareness among staff and parents about climate adaptation, turning the pergolas into **everyday learning and demonstration tools** rather than isolated infrastructure elements.

Key performance indicators and scalability potential

The pilot provides a clear proof of concept that can be translated into wider implementation:

- **Temperature reduction:** up to 5°C cooler in shaded outdoor areas during peak heat.
- **Vulnerable people protected:** 349 children and staff directly benefiting from improved thermal comfort.
- **Green infrastructure added:** two nature-based shading structures integrated into daily-use public spaces.
- **User satisfaction:** high acceptance and reported improvement in comfort and outdoor usability.

Scaling the impact

If replicated, the impact grows significantly. For example:

- Scaling from 2 to 100 pergolas across a city could directly protect around 17.000 children and staff in schools and kindergartens during heatwaves.
- Deploying similar shading measures at bus stops, playgrounds or public squares could extend protection to thousands of additional daily users.



- When combined with complementary measures such as tree planting, green islands or shaded seating, the cumulative cooling effect can significantly reduce urban heat exposure at neighbourhood scale.

Suggested communication visuals for policy briefs and decision-makers

To support decision-making, municipalities are encouraged to use:

- **Before/after photos** of shaded and unshaded spaces,
- **Heat maps** showing temperature differences at pilot locations,
- **Simple KPI infographics** summarising cooling effects, users protected and costs,
- **Scaling diagrams** illustrating how small pilots translate into city-wide benefits.

REFERENCE

This policy brief is supported by project-developed materials and strategic planning documents that inform the design and scaling of nature-based heat mitigation measures.

A key source is the **List of urban tree species**, prepared as an annex to the Strategy and Heat Action Plan of the Municipality of Maribor. The document provides guidance on climate-resilient tree species suitable for different urban locations, along with minimum requirements for planting and early maintenance. While developed for local conditions, it serves as a transferable reference model that can be adapted by other municipalities.

Additional sources include **municipal Heat action plans**, technical guidelines for nature-based solutions and monitoring data used to assess cooling effects and user comfort. Together, these materials support evidence-based decision-making and the replication of effective heat mitigation approaches across different urban contexts.

ANNEXES

The following stakeholders were actively involved in the Ready4Heat project in Maribor, including the preparation of the Heat Action Plan as well as the planning and implementation of pilot activities. The list reflects a **cross-sectoral and multi-level approach**, combining education, health, social care, planning, infrastructure and civil society actors.

Education and childcare institutions

- Vrtec Jadvige Golež Maribor (Kindergarten Jadvige Golež, Maribor)
- Vrtec Ivan Glinšek Maribor (Kindergarten Ivan Glinšek, Maribor)
- Vrtec Borisa Pečeta Maribor (Kindergarten Borisa Pečeta, Maribor)



- Vrtec Tezno Maribor (Kindergarten Tezno, Maribor)
- Vrtec Pobrežje Maribor (Kindergarten Pobrežje, Maribor)
- Vrtec Otona Župančiča Maribor (Kindergarten Oton Župančič, Maribor)
- Vrtec Studenci Maribor (Kindergarten Studenci, Maribor)
- Vrtec Jožice Flander Maribor (Kindergarten Jožica Flander, Maribor)

Health and social care organisations

- Nacionalni inštitut za javno zdravje - NIJZ (National institute of public health)
- Zdravstveni dom dr. Adolfa Drolca Maribor (Primary health care centre Maribor)
- Univerzitetni klinični center Maribor (University clinical centre Maribor)
- Društvo gluhih in naglušnih Podravja Maribor (Association of deaf and hearing-impaired of the Podravje Region)
- Društva invalidov (Associations of persons with disabilities)
- Zveza društev upokojencev Zgornje Podravske regije Maribor (Upper Podravje regional association of pensioners)
- Društva upokojencev (Associations of pensioners)
- Društvo multiple skleroze Slovenije (Multiple sclerosis association of Slovenia)

Regional, municipal and planning bodies

- Regionalna razvojna agencija Podravja (Regional development agency of Podravje)
- Skupnost občin Slovenije (Association of municipalities of Slovenia)
- Zavod za urbanizem Maribor (Urban planning institute Maribor)
- Urbanistična podjetja (Urban planning companies)
- Podjetja za infrastrukturno načrtovanje (Infrastructure planning companies)

Utilities and service providers

- Nigrad d.o.o. (Public utilities company Nigrad)