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Be Ready Strategic Framework for UHI Mitigation and Adaptation in Danube Region Cities

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1. Climate Change and Challenges to Danube Region Cities

Urban Heat Island (UHI) is a phenomenon in which built-up urban areas record markedly higher air and surface temperatures than the surrounding rural environment. The average temperature difference is **4–6 °C**, but during heatwaves night-time temperatures in cities can exceed those in the countryside by as much as **10 °C** (e.g. Budapest and Belgrade registered night-time deviations around 10 °C in July 2024). UHI is therefore a major threat to public health and quality of life and is considered the fastest and most wide-spreading amplifier of climate-change impacts in the Danube region. Manifestations include a growing number of tropical nights (Podgorica already records ~30 per year, Budapest ~35) and more frequent heatwaves, which translate into direct health impacts (the 2022 European heatwave caused an estimated **61,000 excess deaths**, most of them in densely populated cities).

The UHI effect is tightly interwoven with global climate change: planetary warming increases the frequency and intensity of heatwaves, which UHI then magnifies in urban areas. Rising night-time temperatures in city centres and more frequent extreme heat confirm that climate risks manifest most acutely in densely built environments. UHI is **not only a physical or technical problem** but also a systemic governance challenge at the intersection of public health, spatial planning, energy, social justice and climate adaptation. Mitigation measures must therefore be embedded in broader strategic frameworks and policies.

This strategic framework proposes a vision and key policy directions for the coming **3–5 years**, helping municipalities of all sizes across the Danube region boost their resilience to urban heat island (UHI) effects. Building on lessons learned from the partnership of the Be Ready project, the document reflects critical insights on how to address UHI and proposes recommendations that cities in the Danube region can adopt to improve their preparedness and adaptive capacity to climate change. In addition, the framework aims to facilitate the preparation of Local Action Plans in each partner city, supporting their efforts to mitigate UHI effects beyond the project end.

The framework aims to enhance the resilience of Danube regions cities to climate change by supporting new policy approaches to climate resilient development and transformation; offering guidance on how to use different tools for small but powerful interventions to UHI; responding flexibly to a changing climate services landscape; building new narratives on climate change with the engagement of citizens and stakeholders.

A cohesive strategic framework supported by implementation tools is essential to embed urban cooling as a permanent, systematic element of urban development rather than a series of one-off demonstrations. This framework therefore provides the strategic foundation by articulating key recommendations and mechanisms that will translate individual measures and pilot projects into integrated programs to improve city resilience.

1.1 Document conceptualization and development

The framework is the result of a comprehensive research and analysis of existing policy and strategic documents for climate adaptation and mitigation at local, regional and national level across the project partner countries. The framework reflects the general directions given in national, regional, and EU climate change adaptation strategies.

Regional and EU-level documents have also been reviewed.

In addition, partners have conducted **13 structured interviews** with **national and regional** (Danube region) **authorities**, such as national ministries and parliaments, the PA5 Coordination office etc., to ensure alignment of the proposed strategic priorities with those of national governments across the Danube region.

Specific examples and recommendations from the Be Ready city pilots and project implementation have been used to formulate preventive and mitigation measures in urban context for cities and municipalities in the Danube region. From the initial phases of developing a shared methodology for UHI risk and vulnerability assessment and the subsequent city UHI reports, through the collection of good practices and the creation of the online Be Ready Heat Island Vulnerability Assessment Toolkit, partners have reached a common understanding of effective prevention and mitigation components to support climate adaptation planning and policy.

The strategy is based on the general directions given in national, regional and EU climate change adaptation strategies. Thus, the main strategic objectives for increasing resilience of the Danube Delta have been shaped in line with higher-level policies. At the same time, the strategy is developed to be mainstreamed into relevant political documents on the local level. It aims to empower public authorities in the Danube Region to implement available UHI solutions with a ready to use framework for innovation policy and urban interventions at the city-region level.

Transboundary cooperation and a participatory approach have received special attention as only a coordinated response across the region will be efficient. Additionally, the project integrated resilient development into action planning and emphasized the importance of enabling conditions to support effective adaptation.

2. Climate Adaptation Strategic Context (EU and Danube-Region Agendas)

- **EU Strategy for the Danube Region (EUSDR).** Encourages cross-border collaboration on environment, risk and adaptation. The framework fully aligns with EUSDR by leveraging platforms for inter-city cooperation and knowledge transfer across borders.
- **EU Climate Adaptation Strategy (2021).** Urges cities to boost climate resilience, emphasizing nature-based solutions and systemic adaptation across all governance levels. The Joint Research Centre (JRC) stresses integrating UHI considerations into urban regulations, dedicating financial lines and setting up monitoring mechanisms.
- **European Green Deal (2019).** Pursues climate neutrality and adaptation, with a focus on urban green infrastructure (e.g. the pledge to plant three billion trees by 2030) and improvements to urban quality of life. UHI measures (green roofs, shading, emissions cuts from cooling) directly support these goals.
- **Territorial Agenda 2030.** Promotes sustainable, resilient spatial development and territorial cohesion. In UHI terms, it calls for inclusive, greener and more climate-proof cities, aligning with the framework's ambition to deliver accessible adaptation options for all settlement types.

Other relevant initiatives include the **EU Mission "100 Climate-Neutral and Smart Cities"**, the **Covenant of Mayors**, and Interreg projects such as **BeReady**. Pilots conducted in ten partner cities (e.g. Sofia, Budapest, Kranj, Varaždin, Niš, Zenica, Galați, Chișinău, Hévíz, Ratiboř) feed directly into this strategy as examples of good practice.

Wider climate synergies. Cooling interventions (urban greenery, water features) also enhance storm-water management, curb flash-flood risk and support drought mitigation. They dovetail with broader adaptation efforts (flood protection, air-quality improvement, energy-efficient cooling) and contribute to the UN Sustainable Development Goals in urban areas.

3. Compliance with EU Horizontal Principles

This Strategic Framework adheres to key horizontal principles that enhance the environmental, social and territorial sustainability of cities. It actively supports environmental sustainability, reinforces social inclusion and public health protection and encourages fair access to climate-resilient urban environments for all residents of the Danube region.

Key horizontal priorities

- **Fundamental rights:** The framework respects fundamental rights as outlined in the Charter of Fundamental Rights of the European Union and other relevant conventions, such as the United Nations Convention on the Rights of Persons with Disabilities.

- **Equality and non-discrimination:** Principles of equality in general, gender equality, and non-discrimination are embedded in the proposed measures to ensure that all individuals and groups can participate in and benefit from UHI mitigation activities.

- **SEA/EIA**: The framework objectives promote urban mitigation measures which are carried out in an environmentally friendly manner, contributing to the EU's climate resilience goals and the Paris Agreement's objectives.

- **Integration and mainstreaming:** The framework encourages integration of climate goals into all relevant urban policies and funding programs, to ensure that climate considerations are a fundamental part of their design, implementation, and evaluation.

- **Just and equitable transition:** The framework proposes integrated models for UHI mitigation that address the needs of disadvantaged people and prioritize equality and accessibility in climate policies and funding.

- **Awareness and education:** The framework has a strong focus on raising public and institutional awareness about climate change and its impacts. It strongly encourages providing accessible information and tools for citizens and local stakeholders to get engaged.

- **Resilience and systemic adaptation:** Moving beyond sector-specific solutions, a systemic approach to resilience at urban level is prioritized. This involves anticipating and addressing climate impacts across all sectors and building overall resilience in communities and critical service systems.

- **Science and evidence-based policy:** There is an effort to ensure that scientific evidence and data are better integrated into UHI assessment and policymaking to guide more effective climate action and adaptation measures.

- **"Do no significant harm" (DNSH):** A core requirement that all mitigation activities do not cause significant harm to any of the EU's environmental objectives, as defined by the DNSH principle.

- **Integration of New European Bauhaus (NEB) principles**: The framework valorizes initiatives that promote a sustainable and inclusive future, built on three

core values: sustainability, aesthetics, quality of experience and style, accessibility and affordability.

II. Framework Vision and Strategic Objectives

Long-term vision (horizon 2030 +). Towns and cities in the Danube region are resilient to extreme heat and urban heat islands. They employ smart combinations of green, blue and technical solutions to cool the built environment, safeguard public health and improve quality of life in a sustainable and inclusive way. Urban cooling is embedded - like waste management or transport planning - as an essential, permanent function of city governance.

By 2030 cities and municipalities have installed the basic elements of **urban climate resilience**: expanded urban greenery, cooling water features, reflective surfaces and shading; and systemic tools (regulations, finance) to keep them viable.

Key objectives for the next 3–5 years (≈ 2025–2030)

1. Reduce health impacts and protect residents.
Lower the frequency and intensity of extremely hot days and nights in built-up areas, with a strong focus on protecting vulnerable groups - such as the elderly, children, and low-income households - during heatwaves. Cities should strengthen local heat-health action plans, integrate social and healthcare services, and ensure coordination with civil protection systems. Early warning mechanisms and emergency response protocols must be in place and accessible to all residents.

2. Integrate UHI solutions into urban planning.
Ensure that cities prepare a local Heat-/UHI-Adaptation Action Plan and embed cooling principles into zoning regulations, building codes, and investment strategies. Planning should proactively reflect health, social, and environmental synergies.

3. Scale up nature-based and innovative measures.
Move beyond the pilot stage by identifying priority sites for tree planting, creation of shaded public spaces, implementation of blue infrastructure (e.g. fountains, ponds), and deployment of cool materials. Cities should implement a package of green, blue and white measures within five years.

4. Strengthen cooperation and interdisciplinary knowledge sharing.
Build a collaborative network across the Danube region to exchange data, methods and

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good practices - via workshops, webinars, or open databases. Encourage integrated training and peer learning between departments responsible for environment, public health, crisis management, and urban planning across Danube region cities.

5. Secure sustainable financing, governance and maintenance. Test and scale funding and governance models that ensure long-term viability of adaptation measures. This includes creating dedicated budget lines for "city cooling", designing multi-year maintenance regimes, and monitoring effectiveness. Cooperation between departments -particularly urban development, health care, social services and emergency response - is crucial to ensure both technical and institutional sustainability.

4. Framework Priorities and Thematic Areas of Intervention

To achieve the objectives outlined above, this framework defines a set of strategic priorities – thematic areas to focus on when planning measures against UHI. Following those priorities will ensure that interventions are comprehensive: they include technical cooling solutions as well as systemic changes in urban planning and governance. As highlighted in the BeReady project analysis, effective UHI responses must integrate fast technical actions (blue-green-white measures, reflective surfaces, sensors, etc.) with policies and community-driven initiatives that channel resources toward the most vulnerable areas. The following priorities therefore cover both physical interventions and enabling activities (planning, data collection and analysis, intra- and inter-city collaboration).

Overview of strategic priorities

1. Expansion of green infrastructure (green solutions).
2. Use of blue infrastructure (water elements and water management).
3. Application of "white" measures (reflective materials and cooling elements in the built environment).
4. Urban planning and design for cooling (climate-adaptive city planning).
5. Temperature monitoring and data tools (sensor networks, mapping and prediction).

4.1 Expansion of Green Infrastructure (Vegetation for Cooling)

Green infrastructure – especially urban vegetation, trees, parks, green roofs and facades – is a critical component for mitigating the UHI effect. Vegetation cools its surroundings via two main mechanisms: it provides shade (reducing surface heating from the sun) and cools the air through evapotranspiration (the release of water vapor from leaves). Studies confirm that urban trees can reduce surrounding air temperature by several degrees

under hot conditions – for example, street tree lines can lower air temperature locally by ~3–4°C. Greenery also improves air quality, offers psychological relief during heat, and supports biodiversity.

Strategic recommendations

- **Increase green coverage in cities:** Set minimum targets for the share of green spaces and tree canopy cover. This can include green quotas in land use plans or building regulations, e.g. requiring a specific percentage of plot area in new developments to be left for greenery or permeable surfaces (or for tree planting). The goal is to achieve a critical level of shading in each city – studies from the Danube region suggest that when urban shading falls below ~11–13% of the city surface, heat accumulates, and cities lose their self-cooling capacity. A target of at least 20% tree canopy coverage (used in some Austrian and Slovak cities) is recommended.
- **Tree planting and maintenance:** Identify the hottest areas (e.g. overheated squares, treeless housing estates, parking lots) and prioritize tree planting with high-shade species. Establish programs for planting street trees and urban parks, including securing long-term maintenance funding. Also support small-scale greenery: community gardens, courtyard greening, mobile greenery (e.g. large planters) in the hottest streets.
- **Green roofs and facades:** Promote greening of buildings – either through mandatory green roofs for new constructions over a certain size, or via voluntary subsidy programs for green roofs on existing buildings. Green roofs not only mitigate UHI (by lowering roof and ambient temperatures), but also retain rainwater and reduce runoff during heavy rainfall.
- **"Green acupuncture" – targeted interventions:** In line with the Be Ready "Green Acupuncture" concept, focus on rapid, targeted actions in areas where they will have the greatest impact. This involves identifying several specific urban hotspots (e.g. overheated central squares, treeless housing courtyards, asphalt-covered schoolyards) and implementing small-scale green measures there – such as tree planting, pergolas with climbing plants, pocket parks on unused plots, or community gardens. These interventions can quickly and affordably improve the microclimate and serve as demonstration pilots.

4.2 Use of Blue Infrastructure (Water Elements and Water Management)

Blue infrastructure refers to the use of water and water-related features to reduce urban temperatures. Water has high heat capacity and provides a cooling effect through evaporation – water bodies and features can significantly mitigate local heat. Additionally,

blue infrastructure may serve flood protection purposes (retaining stormwater) and enhance urban microclimates.

Strategic recommendations

- **Water features in public spaces:** Install small-scale water elements in city streets and squares – drinking fountains, decorative fountains, misting devices, children's splash pads, or water-integrated furniture (e.g. misting benches). These blue acupuncture elements (inspired by pilot projects) can be relatively low-cost and placed in high-heat areas (e.g. transit stops, tourist zones). Ensure proper maintenance and hygiene (e.g. water circulation and filtration).
- **Water bodies and vegetation for evaporation:** Create or restore small water bodies – park ponds, wetlands, daylighted streams – to deliver local cooling effects comparable to greenery. Rain gardens and urban wetlands can capture water, which then evaporates and cools the surrounding air. These features can be combined with vegetation to boost cooling. Studies show that wetlands can reduce air temperatures by ~4–5°C.
- **Stormwater management (SUDS):** Promote Sustainable Urban Drainage Systems (SUDS) – retention tanks, infiltration strips, permeable surfaces. While primarily designed for water management, they also increase soil moisture and enable evaporative cooling. Moreover, they help mitigate climate extremes – after prolonged heat comes heavy rainfall, which can cause local flooding (e.g., in the city of Ratiboř). Cooling interventions should also enhance water retention and reduce flash flood risks.
- **Waterfront and stream revitalization:** Leverage rivers and waterways for urban cooling. Danube and tributary cities should advance riverside revitalization projects – riverfront parks, improved airflow from water to urban core (wind corridors). In smaller towns, consider restoring ponds or creating water reservoirs near built-up areas. Water in the landscape acts as natural air conditioning, helping reduce extreme heat.

4.3 Application of "White" Measures (Reflective and Cooling Surfaces)

"White" measures involve using innovative surfaces, materials, and technologies to reduce solar absorption and heat accumulation in urban environments. These include reflective (cooling) paints and coatings, high-albedo construction materials, light-colored surfaces, shading elements, and building ventilation. The goal is to prevent overheating of surfaces (roofs, walls, pavements), which are major contributors to UHI. Dark impermeable materials like asphalt and concrete absorb large amounts of heat during the day and release it at night. Using light surfaces or special coatings can reduce surface temperature significantly – for example, cool roof coatings can keep roof surfaces 20–

30°C cooler than standard ones during summer noon, also reducing indoor heat and energy use.

Strategic recommendations

- **Cool roofs and facades:** Promote the use of reflective coatings or light materials on roofs and walls. For new buildings, introduce standards on maximum solar absorptance. For existing buildings, support retrofit programs (e.g. subsidies for reflective roof coatings, white membranes, or shading devices).
- **Cool pavements and public space surfaces:** Test and gradually deploy special cool pavement materials for roads, parking lots, sidewalks, and squares. These include pigmented asphalt mixtures, high-reflectivity tiles, or simply painting surfaces white. Pilot new materials on the hottest sites (e.g. large parking areas) and integrate them into city construction standards upon success.
- **Street shading and cooling amenities:** Include shading structures in white strategies to directly improve thermal comfort. Examples: install shade sails or pergolas above playgrounds, sports fields, or crowded squares. Cities should identify suitable sites for public cooling zones or shaded rest areas for vulnerable residents.
- **Innovative materials:** Monitor and test emerging materials – e.g. Phase Change Materials (PCMs) that absorb heat by changing phase and cool surroundings; or water-retaining surfaces that enhance evaporation. Collaborate with research institutions and companies to pilot innovative solutions in local conditions.

4.4 Urban Planning and Design for Urban Cooling

The urban structure and built environment of a city significantly influence how heat is either accumulated or dissipated. Historic city centers with narrow "street canyons," high building density, and lack of open spaces and greenery tend to trap heat and intensify the UHI effect. This strategic framework therefore emphasizes the need to integrate thermal resilience principles directly into spatial planning, urban design, and architecture. This is a preventive approach: planning and adapting cities to avoid overheating in the first place, rather than reacting to the consequences afterward.

Strategic recommendations

- **Protect and create wind corridors:** Urban plans should include open lines for air flow through the city (ventilation corridors). High-rise buildings and poorly placed developments often block natural airflow. Zoning plans may define non-buildable zones or height restrictions along corridors leading from cooler outskirts or water bodies into the city center. The city of Brno already requires a UHI "non-

worsening" test for major projects, which must demonstrate that a proposal does not deteriorate local thermal conditions (e.g. by blocking a wind corridor).

- **Reduce impervious surface share:** Land use regulations should limit the extent of dark, non-permeable surfaces. In addition to green quotas, cities can mandate that large parking lots are not fully asphalted – a percentage of the area should be green (trees, grassy strips) or use permeable, light-colored materials. The aim is to break up extensive "heat accumulator" zones.
- **Smart placement of cooling elements:** When designing public spaces, integrate water features and tree rows instead of a flat open area. New neighborhoods should be planned around central cooling zones (e.g. a park or pond). The aim is to integrate heat adaptation into urban design from the outset.
- **Urban climate modeling and microclimate assessment:** Larger cities should use urban climate modeling tools when evaluating new developments. Simulations of airflow and heat accumulation can reveal where urban hotspots may emerge. This "climate-proofing" of urban planning allows timely design adjustments (e.g. adding greenery, changing building orientation).

4.5 Temperature Monitoring, Data and Research

To effectively target and evaluate UHI measures, a reliable system for monitoring temperatures and related parameters is essential. Many smaller cities in the region currently suffer from data gaps – for example, Ratiboř in the Czech Republic had only two meteorological stations until recently. Limited sensor networks mean cities are "flying blind" and lack detailed mapping of urban heat zones. Thus, building monitoring capacity and data systems is a standalone priority.

Strategic recommendations

- **Establish sensor networks:** Cities should gradually install a network of monitoring points (weather stations, thermometers) covering different urban zones – dense development vs. parks, city centers vs. peripheries. Modern micro-sensors are relatively affordable and can be mounted on public lighting poles, buildings, etc. The goal is to create a real-time urban heat map identifying the most overheated areas. Data should be open and shared to enable community initiatives and researchers to contribute to analysis.
- **Utilize satellite data and modeling:** In addition to ground sensors, satellite data (e.g. from the Copernicus program) can be used to monitor surface temperatures and drought indicators. Combining sensor data and satellite imagery allows calibration of models and forecasting – e.g. predicting which neighborhoods will be most at risk during upcoming heatwaves. Scientific institutions, universities and

meteorological services should be involved in developing a regional UHI prediction model.

- **Shared indicators and data portal:** To facilitate information sharing among Danube cities, we propose creating a unified online portal (e.g. expanding the BeReady platform) for climate data. Each city would report key indicators: number of tropical days/nights, maximum recorded temperatures in central vs. peripheral areas, green space coverage, etc. Defining common KPIs and monitoring protocols will ensure data comparability. Example indicators include: the temperature gap between city center and rural outskirts (aiming to reduce it), or the number of days with temperatures over 30°C in dense built-up zones.
- **Research and innovation:** Encourage involvement of local universities, experts and innovative companies in UHI solutions. This includes joint research projects (e.g. testing new surfaces, health impact studies, socioeconomic vulnerability assessments), student competitions for urban cooling designs, open-data hackathons, etc. The scientific community can provide evidence and new ideas to continuously improve UHI strategies.

5. Policy, Legislation and Integration of UHI into Strategic Documents

UHI is not merely a technical challenge; it affects city governance as a whole – from healthcare and emergency response to spatial planning, construction, energy, and social policy. Without adequate political support and regulatory frameworks, cooling measures risk remaining isolated pilots that may disappear over time due to budget cuts or lack of interest. Effective policies can create the conditions for the long-term maintenance and scaling of measures: providing legal mandates, dedicated funding, and guarantees for fair distribution of resources, which allows mitigation of UHI in cities to be scaled and sustained.

The strategic framework therefore recommends cities take the following steps in the field of policy and legislation:

5.1 Integration of UHI into binding regulations and plans

Key planning and construction documents should be revised or complemented to reflect UHI considerations. This includes incorporating anti-overheating measures into land use plans, strategic documents (climate strategies, Sustainable Energy and Climate Action Plans – SECAP), and potentially adopting a dedicated Urban Heat Adaptation Strategy. Cities should adopt legally enforceable tools such as municipal ordinances or construction regulation amendments, introducing mandatory elements (green roofs,

shading, water features in new developments, restrictions on dark surfaces, etc.). Experience from Vienna, Brno and Bratislava shows that a “legal trigger” in the form of mandatory provisions is essential – these are among the few cities that have already embedded UHI criteria into building permits. Without rules, implementation risks being voluntary and insufficient.

5.2 Ring-fencing of financial resources

Political leadership should ensure that specific budget lines are earmarked for city cooling, rather than relying on ad-hoc financing from general maintenance budgets. For example, Sofia has a budget line for cooled roofs, guaranteeing the continuity of these programs. A dedicated budget brings stability – smaller municipalities often finance cooling measures only once and discontinue them after the project ends.

5.3 Equity and social justice in policies

Regional data shows that the most vulnerable populations (seniors, low-income groups) often live in the hottest urban blocks and have the least access to cooling (less greenery, no air conditioning). City policies must apply an equity lens – mechanisms to ensure that support is directed first where it’s most needed. In practice, this means prioritizing densely populated districts lacking greenery when planning new parks; targeting green roof subsidies at socially disadvantaged areas; establishing air-conditioned centers for seniors during heatwaves, etc. Financial mechanisms should include elements of solidarity – such as participatory budgets focused on green projects in low-income neighborhoods. Podgorica launched grants for misting systems and tree planting in poor districts, linking UHI strategy with social policy.

5.4 Multi-level integration and coordination

It is important to align city-level policies with national and regional levels. UHI should also be addressed in regional and national climate strategies. EU cities can co-finance larger projects through cohesion funds and National Recovery Plans – which requires including UHI measures in these documents to make them eligible. In line with JRC recommendations, UHI integration into policies should also leverage cohesion funds and other sources. Coordination with national authorities ensures synergies and prevents conflicts (e.g. if the state issues construction regulations, they should reflect heat adaptation needs to align with municipal efforts).

Summary: "No rules, no budget – no impact."

This motto sums up the importance of policy in bridging the gap between pilot projects and full-scale implementation. The strategic framework thus urges city leadership to

create enabling policies: adopt necessary regulations, allocate funds, and systematically embed UHI mitigation into strategic documents. Policy and governance are the metaphorical bridge that turns isolated demonstrations into mandatory urban programs.

6. Mechanisms for Collaboration and Stakeholder Engagement

6.1 Inter-city and international cooperation

The Danube region is diverse, yet it faces common climate challenges. Cities should not act in isolation; rather, they should benefit from cooperation and knowledge exchange. The strategic framework proposes a **Danube Network of Heat-Resilient Cities.** Establishing a platform (formal or informal) bringing together cities engaged in this initiative. This network could host regular events (conferences, workshops) on UHI, enabling cities to exchange experiences, showcase new projects, and learn from others' successes and mistakes. It is essential to involve non-EU cities in the region, facilitating transfer of European know-how to the Western Balkans and beyond. EUSDR and other macro-regional frameworks can offer institutional backing for such cooperation.

6.2 Large–small city partnerships

A helpful mechanism is twinning or mentoring, where larger cities (metropolises) support smaller regional cities. For example, Vienna could act as a hub of expertise – sharing methodologies (e.g. Vienna's UHI strategy plan) and assisting smaller towns in preparing their action plans. Larger cities could also share resources: include smaller municipalities in funding applications or provide access to their data platforms.

- **Cross-border pilot projects:** Encourage joint projects between two or more cities from different countries on specific themes (e.g. joint UHI mapping methodology, coordinated urban tree planting campaign – such as a Danube Heat Resilience Day). Joint projects foster stronger partnerships and are eligible for funding through programs like Interreg.
- **Participation in international initiatives:** Cities should engage with existing networks and platforms that offer expertise and visibility. These include the Covenant of Mayors, UN's Making Cities Resilient 2030, the EU Cities Mission, and more. Membership in such networks often helps access funding and expert advice.
- **Regional cooperation for non-EU countries:** Although non-EU countries cannot access all EU funds directly, partnerships with EU cities can provide them with know-how and sometimes indirect support. For instance, the World Bank's City Resilience Program in Serbia increased city resilience, and coordination with the BeReady project

allowed knowledge transfer and training for Balkan officials. Such synergies are valuable and should be expanded.

6.3 Engagement of Sectoral Actors and the Public

The success of the strategy depends on gaining wide support across societal sectors. Municipal authorities cannot do it alone – healthcare professionals, planners, developers, academics, NGOs, citizens and businesses all have a role to play. The strategic framework identifies key actors and suggests ways to engage them.

- **Healthcare and social services**

Public health must be a core partner – city hospitals, emergency services and health authorities should help develop Heat Health Action Plans aligned with UHI strategies. These plans include measures such as early warning systems, cooling centers for seniors, extended clinic hours during heatwaves, etc. Health professionals can also identify vulnerable populations and provide data (e.g. on heat-related illnesses) for evaluating interventions.

- **Construction and developers**

The private sector plays a dual role – it brings innovation (materials, cooling tech) and must comply with regulations (e.g. greenery, reflective surfaces). Dialogue with developers is crucial: cities must present the strategy, explain benefits (e.g. lower cooling costs with green roofs), and promote voluntary standards. Cities can also create certifications or awards (e.g. “Heat-Resilient Building of the Year”). Including builders in norm development reduces resistance and fosters investment.

- **Urban planners and transport engineers**

These professionals must be integrated into local action plan teams to ensure UHI resilience is embedded in all spatial and transport concepts (see 4.4). For example, city architects should assess new projects for thermal comfort. Workshops can introduce latest research (e.g. on airflow in different urban layouts).

- **Academic and research institutions**

Universities provide vital data and assessment capacity. Cities should establish cooperation agreements with local universities (climate science, architecture, ecology departments). Students can produce analyses as part of thesis work, while scientists can monitor and evaluate interventions. This win-win partnership brings expertise to practice and enables research in real conditions.

- **Business sector and innovation**

Besides developers, other businesses should be involved – e.g. industrial zones or shopping centers can plant trees in parking lots or install misters. Cities can motivate them through awareness and small incentives (e.g. tax discounts for green roofs). Smart city startups can find new market niches in UHI adaptation (e.g. sensors, apps warning citizens about heat, shading materials). Cities may run innovation challenges to pilot promising solutions.

- **Community and NGOs**

Public involvement is key to long-term sustainability. NGOs can raise awareness (tree planting campaigns, heat-risk info for seniors), organize volunteering (tree planting, park maintenance), and act as intermediaries between city and citizens. Cities should support local initiatives – allowing communities to care for small parks/gardens (with space and grants). Transparency also enables "citizen science" – residents measuring local temperatures and contributing data, increasing awareness and interest. Public participation in action plan development (meetings, feedback collection) improves acceptance and eases implementation.

In short, the strategy must strive from the outset for broad "societal ownership." Every actor should understand their role and value. Experience from Vienna shows that involving departments and the public from the design phase to implementation increases the chances that measures will be accepted and effective. Cities should therefore establish UHI working groups with representatives from various departments (urbanism, environment, crisis management, health...) and stay in contact with communities and external experts.

7. Implementation Support and Monitoring

Strategic planning for UHI adaptation is only effective if followed by practical, coordinated and monitored implementation.

7.1 Technical and advisory support

Cities, especially smaller ones, often lack the in-house expertise to plan and implement complex adaptation measures. It is therefore crucial to ensure access to qualified advisory services and technical assistance, either through national structures, regional support centers or international partners.

- **Establishing regional competence centers**: These centers could provide cities with a one-stop shop for guidance on climate adaptation, including UHI mitigation. Inspired by energy agencies or innovation hubs, they can offer consulting, help prepare tenders, provide model documents, and connect cities to experts or suppliers.
- **Municipal helpdesks or technical units**: Larger cities might consider creating in-house UHI adaptation units to coordinate policies, monitor implementation and ensure cross-sector cooperation. These can serve as the institutional backbone of local adaptation governance.
- **Cooperation with universities and research institutions** is also essential for transferring knowledge into practice. Cities can use student projects, doctoral research, or joint pilot testing to test UHI solutions before scaling them up.

7.2 Capacity building and education

Strengthening the skills and awareness of municipal staff and political representatives is a key condition for effective action. The strategy recommends:

- **Regular training for city officials and planners**: Focused on UHI-specific topics such as heat risk assessment, climate-resilient urban design, green infrastructure planning, and legal instruments.
- **Workshops and peer learning formats**: Allowing city representatives to learn from each other's experiences, challenges and good practices. These can be organized through regional networks or macro-regional platforms such as EUSDR.
- **Educational programs for elected officials**: Helping mayors and councillors understand the urgency and feasibility of adaptation measures so that they become political champions of UHI resilience.
- **Awareness campaigns for the public and private sector**: These should focus on practical benefits of UHI measures, increase public engagement and foster behavioral change (e.g., in use of shading, pavement choices, tree care).

7.3 Monitoring, evaluation and learning

To ensure accountability and effectiveness, it is essential to monitor implementation progress and evaluate the impact of UHI adaptation measures.

- **Define measurable indicators**: Cities should use both quantitative and qualitative indicators to track performance – e.g. number of trees planted, surface albedo increased, number of buildings with green roofs, temperature reduction in pilot areas, etc.

- **Integrate UHI into existing monitoring systems**: Where cities already monitor climate plans (e.g. SECAPs), UHI metrics should be included. Ideally, UHI-related KPIs should be harmonized across cities in the region to allow comparison and peer learning.
- **Use digital tools and open data**: Remote sensing, GIS platforms and sensor networks can provide real-time data on surface temperature, greenery distribution and other relevant metrics. Publishing these data openly encourages civic participation and citizen science.
- **Set up feedback mechanisms**: Involving stakeholders in regular evaluations ensures that measures remain relevant and publicly supported. For example, community surveys or focus groups can reveal which spaces feel cooler, what interventions are appreciated, and where further action is needed.

7.4 Phasing and scaling of measures

Implementation should be understood as a **multi-phase and adaptive process**, not a one-time intervention. Cities are encouraged to plan for:

- **Quick wins and pilots**: Short-term, visible actions (e.g. installing misting systems, mobile shading, or cooling pavements) help build public support and demonstrate commitment.
- **Medium-term integration**: Embedding UHI criteria into land use plans, construction permits, and infrastructure investments.
- **Long-term transformation**: Reshaping the urban fabric through systemic interventions – e.g. retrofitting grey infrastructure, redesigning public spaces, implementing nature-based solutions at scale.

Scaling up successful pilots requires political will, funding continuity, and integration into broader urban strategies (transport, housing, health, etc.).

7.5 Financing implementation

This section outlines practical financing instruments:

- **Municipal budgets and ring-fenced funds**: Ensure predictability and continuity.
- **National and EU funding**: Cities should align their UHI projects with operational programs (e.g. ERDF), Just Transition Mechanism, LIFE, Horizon Europe, or Recovery and Resilience Facility.
- **Public-private partnerships (PPP)**: Involving developers or large businesses in green infrastructure (e.g. co-funding green corridors around malls or office parks).

- **Green bonds and climate funds**: Where feasible, cities can explore innovative instruments such as climate municipal bonds or leverage national green investment funds.
- **Crowdfunding and participatory financing**: For smaller-scale projects (e.g. shading playgrounds, urban gardening), cities may engage communities in co-financing solutions, increasing both funding and ownership.
- **European Investment Bank (EIB)**: **EIB Climate Adaptation Loans**: Low-interest loans for municipal infrastructure (e.g., urban parks, stormwater management).
- **ELENA (European Local ENergy Assistance)**: Technical assistance grants for investment preparation, especially for retrofitting and energy-efficiency in public buildings.
- **European Bank for Reconstruction and Development (EBRD)**:
    - **Green Cities Programme**: Co-financing and advisory support for urban resilience strategies and investments, including heat reduction actions.
- **Green Climate Fund (GCF)**: Available for non-EU countries, often through accredited entities or UN agencies.

8. Sustainability of Measures, Operation and Adaptive Management

Implementing a new measure (such as a park, fountain, or sensors) is only the first step—true resilience is achieved when the measure remains functional over time and adapts to changing conditions. That's why the strategic framework emphasizes sustainability planning and the adoption of adaptive management principles.

Recommendations for Ensuring Sustainability

Multi-year Operation and Maintenance (O&M) Planning:

Every implemented measure must include a plan for who will maintain it and how it will be funded in 5 or 10 years. For example, tree planting must include guaranteed watering for several years—otherwise, the trees will die. Therefore, it is advisable to establish a green maintenance fund or contractually bind companies to provide care for a certain period. The strategic framework recommends that cities institutionalize O&M responsibilities within internal regulations or as conditions in funding schemes.

Example: Chișinău introduced a requirement that every newly implemented green element must have a maintenance financing plan for at least five years.

Ongoing Monitoring and Evaluation of Effectiveness:

Monitoring data must be used to evaluate the benefits of implemented measures. It is recommended that each major measure be accompanied by performance metrics (KPIs).

For example, for a new park:

- temperature difference between the park and its surroundings,
- number of visitors on hot days.

For green roofs:

- building temperature reduction,
- volume of water retained.

These metrics should be tracked regularly (e.g., in an annual UHI report) and used to draw conclusions: which types of measures are most effective, where adjustments are needed. If targets are not being met, it is a signal to revise the strategy.

Adaptive Management – Strategy Review

Cities should create an adaptive management cycle: **Plan – Implement – Monitor – Evaluate – Update Plan.**

For example, Brno updates its climate action plan annually, incorporating new insights (including UHI data). The Danube Network could host evaluation workshops for cities to compare progress and jointly revise the framework. Flexibility is also key due to a changing climate—extremes may evolve over decades (e.g., longer droughts or more storms), so strategies must be continuously fine-tuned.

Institutionalization within City Structure

For long-term sustainability, UHI efforts must not depend solely on the enthusiasm of individuals or temporary projects. Cities should allocate permanent staff capacity and ideally establish a permanent working group or committee within the city council dedicated to this topic.

Community involvement also supports sustainability—when citizens feel ownership over new parks and trees, they will take care of them. Public support helps ensure that the topic won't be easily dismissed even after political leadership changes.

The framework therefore emphasizes a **learning culture**—a willingness to revise courses as needed, and to learn from the performance of implemented measures. That is the essence of **adaptive management**.

9. Differentiated Approaches for Different Types of Cities (Large vs. Small, EU vs. non-EU)

The Danube macro-region includes both major European metropolises and small municipalities, as well as countries inside and outside the EU. When applying this strategic framework, it is essential to consider the diverse starting conditions and allow for a degree of flexibility tailored to each city type. The framework is designed as a flexible and open document—not all recommendations will be equally feasible everywhere.

Large vs. small cities

Large cities (e.g., over 500,000 inhabitants) tend to have greater administrative and financial capacities, more complex structures (more departments, specialists), and more serious UHI issues due to extensive built-up areas. They can afford more comprehensive programs (e.g., detailed climate models, large park investments, issuing their own regulations).

Small cities and towns (e.g., under 10,000 inhabitants) often have limited budgets and personnel; however, they typically have more green spaces and lower density, so UHI may not be as extreme locally. Yet, their vulnerability may be higher due to fewer resources for adaptation.

The framework allows for **scaling of measures**: Small towns are encouraged to focus on **low-cost and tactical interventions**—a few trees in the town square, shading for playgrounds, volunteer-based watering of greenery—that can still significantly improve local conditions on a limited budget.

Large cities, by contrast, should **lead systemic change** (e.g., regulatory reform, major investments in green infrastructure) and support smaller ones through knowledge transfer.

Regional differences (climate and urban form):

The Danube region stretches from the Alps to the Black Sea, with varying climatic conditions (e.g., Vienna vs. Bucharest). While UHI strategies are relevant everywhere, the focus may differ - in southern areas with hot summers, emphasis will be on shading and water features, whereas northern cities may focus more on tree planting.

Similarly, historic cities with narrow streets may need to prioritize ventilation corridors, while newer developments might focus on greening housing estates. The framework is **not a one-size-fits-all**, but rather a **toolbox of measures** from which each city can select based on local needs and context.

Each city should begin with a **UHI vulnerability analysis** (as done in the pilot cities), which will highlight specific risks and help prioritize actions.

EU vs. non-EU cities:

EU cities benefit from access to structural funds, shared policies (e.g., adaptation plans as part of SECAP), and networks for mutual learning. Non-EU cities (e.g., in Serbia, Moldova) often face financial constraints and lack the pressure of EU regulations.

This strategic framework explicitly includes their participation:

- It recommends that **EUSDR and other donors create dedicated grant schemes** for these cities to implement pilot measures (e.g., small grants managed through regional programs).
- It also suggests making methodologies and outputs available in **multiple languages**, considering diverse legal contexts.

For instance, mandatory green roof legislation may not be feasible in some countries—alternative approaches like **voluntary developer commitments** may be needed.

Socioeconomic differences

Some cities (especially in the EU) have high public awareness of climate issues and greater willingness to participate, while in others, UHI may be a new or unpopular topic.

Communication strategies must be **tailored to the local audience**—advanced cities can move directly to implementation with public support, whereas others may first need **awareness campaigns** to explain the problem (e.g., why money is being spent on green spaces rather than other urgent issues).

In the end, **all cities—large or small, EU or non-EU—should work toward a shared vision** and use this framework as a **common guide**.

While the framework sets shared **minimum standards** for resilience (e.g., 20% shading, monitoring), the **path to achieving them may vary** depending on local conditions.

Solidarity and cooperation across the region will ensure that no city is left behind: larger and wealthier cities can support smaller and less-resourced ones, helping the entire Danube region become better prepared for UHI challenges.

10. Conclusion and Next Steps

Strengthening the resilience of cities and towns in the Danube region to the Urban Heat Island (UHI) effect is an urgent task requiring strategic leadership.

The framework provides a **long-term vision and shared recommendations** for the entire region, creating a **common foundation** - **a Danube-wide UHI resilience plan**.

Next steps

This **UHI Resilience Strategic Framework** serves as a **starting point for the systematic adaptation of cities to increasing heat**.

Implementing this strategic framework will exceed a single election cycle - thus, it is recommended that it be **formally approved at both city and regional levels** (e.g., city councils) to ensure legitimacy and long-term commitment.

It embodies the motto: *"No city left behind in the heat."*

Together, the cities of the Danube region can prepare for the challenges of climate change and make their streets greener, cooler, and healthier for all residents.

If the recommendations of this framework are implemented through local action plans and supported by **resource-sharing and mutual learning**, the Danube region can become a **model territory** where cooperation and innovation successfully tackle urban heat islands and improve quality of life - even on the hottest summer days.

Appendix I: Documents Reviewed

Entity / Subject	Strategy / Initiative	Direct URL
EU (European Union)	EU Strategy on Adaptation to Climate Change (EU Adaptation Strategy)	https://climate.ec.europa.eu/eu-action/adaptation-climate-change/eu-adaptation-strategy_en
EU (European Union)	EU Mission: Adaptation to Climate Change (EU Mission on Adaptation)	https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/adaptation-climate-change_en
Global Covenant of Mayors (initiative of cities)	Covenant of Mayors for Climate & Energy (integrating mitigation & adaptation)	https://eu-mayors.ec.europa.eu/
EU Danube Region (EUSDR – 14 countries)	EU Strategy for the Danube Region (EUSDR) – Action Plan (revised 2020)	https://danube-region.eu/wp-content/uploads/2020/04/EUSDR-ACTION-PLAN-SWD202059-final.pdf
Slovakia	National Adaptation Strategy to Adverse Climate Change Impacts (updated)	https://www.minzp.sk/files/sea/strategia-adaptacie-sr-nepriaznive-dosledky-zmeny-klimy-aktualizacia_2018/strategia-adaptacie-sr-nepriaznive-dosledky-zmeny-klimy-aktualizacia_2018.pdf
Czech Republic	Strategy for Adaptation to Climate Change in the Conditions of the Czech Republic (National	https://mzp.gov.cz/system/files/2025-03/OAZK_Narodni_adaptacni_strategie-

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	Adaptation Strategy)	aktualizace_20211026.pdf
Bulgaria	National Climate Change Adaptation Strategy and Action Plan (NCCASAP)	https://www.moew.government.bg/static/media/ups/categories/attachments/Strategy%20and%20Action%20Plan%20-%20Full%20Report%20-%20%20ENd3b215dfec16a8be016bfa529bcb6936.pdf
Romania	National Climate Change Adaptation Strategy (SNASC, 2024–2030, perspective 2050)	https://cdn.climatepolicyradar.org/navigator/ROU/2024/national-strategy-on-adaptation-to-climate-change-snasc-for-the-period-2024-2030-with-a-perspective-of-2050_b02fa72a464034a09d53789a392d5118.pdf
Austria	Austrian Strategy for Adaptation to Climate Change (+ Action Plan)	https://www4.unfccc.int/sites/NAPC/Documents%20NAP/The%20Austrian%20Strategy%20for%20Adaptation%20to%20Climate%20Change.pdf
Hungary	National Adaptation Strategy (Nemzeti Alkalmazkodási Stratégia, part of 2nd Climate Strategy)	https://nakfo.mbfsz.gov.hu/sites/default/files/files/N%C3%89S_Ogy%20%C3%A1ltal%20elfogadott.PDF
Serbia	National Adaptation Programme 2023–2030 (Program prilagođavanja... na 2023–2030)	https://www.ekologija.gov.rs/sites/default/files/2024-01/program-prilagodjavanja-na-izmenjene-klimatske-uslove-za-period-od-2023-do-2030-godine.pdf
Slovenia	Strategic Framework for	https://www.gov.si/assets/m

	Climate Change Adaptation (Strateški okvir za prilagajanje podnebnim spremembam)	inistrstva/MOPE/Okolje/Podnebne-spremembe/SOzP_ang.pdf
Bosnia & Herzegovina	National Adaptation Plan (NAP) (submitted to UNFCCC)	https://www.adaptation-undp.org/bosnia-and-herzegovina-finalize-countrys-first-climate-change-national-adaptation-plan
Germany	German Strategy for Adaptation to Climate Change (DAS)	https://research.fit.edu/media/site-specific/researchfitedu/coast-climate-adaptation-library/europe/germany-amp-poland/BMU.-2009.-The-German-Adaptation-Strategy.pdf
Zenica (BiH)	Green City Action Plan – Zenica (EBRD Green Cities Program)	https://ebrdgreencities.com/assets/Uploads/PDF/7018b505ef/Zenica-GCAP_Eng.pdf
Ratiboř (Czechia)	Local Climate Adaptation Strategy – Ratiboř Municipality	https://ratibor.cz/soubory/post/1894/files/12k7pi79.pdf
Chișinău (Moldova)	Green City Action Plan – Chișinău (EBRD Green Cities)	https://ebrdgreencities.com/assets/Uploads/PDF/dcd87699dc/GCAP_Chisinau-ENG.pdf
Kranj (Slovenia)	City SECAP (Sustainable Energy & Climate Action Plan) – Kranj	https://mycovenant.eumayors.eu/docs/seap/19995_1400158744.pdf

Under review documents

Niš (Serbia)	Sustainable Energy and Climate Action Plan (SECAP)	(Plan in preparation – no public document yet)

	– Niš (in development)	
Podgorica (Montenegro)	Green City Action Plan – Podgorica (EBRD Green Cities)	(GCAP document not publicly posted yet – information from city press and EBRD newsebrd.comebrd.com)
Hévíz (Hungary)	SECAP Hévíz (City Climate Action Plan) – in preparation	(No public SECAP yet – info from project reports)
Galați (Romania)	Sustainable Energy & Climate Action Plan – Galați (SECAP)	(City SECAP not publicly posted; info from city reports)
Sofia (Bulgaria)	Climate Change Adaptation Plan of Sofia Municipality (2019–2025)	(Plan available in Bulgarian; summary from Sofia Municipality and EBRD)

Appendix I: Summary of Interviews

As part of the project, 13 interviews were conducted, which included stakeholders from the following levels.

1. **Association Technopol of Galati (ATG)** – national level – *Advisor to the Secretary General, Ministry of Environment, Romania*
2. **Association Technopol of Galati (ATG)** – regional level – *Head of Service, Galati Regional Environment Directorate, Romania*
3. **Association Bureau for Integration and Social Innovations (BISI)** – national level – *Member of the parliamentary committee on regional development and local self-governance, Bulgaria*
4. **DEX Innovation Center** – national level – *Ministry of the Environment – Adaptation Department, Czech Republic*
5. **Chișinău Town Hall** – local level – *Chief Architect of Chisinau Municipality*
6. **Kisalföldi Vállalkozásfejlesztési Alapitvány (KVA)** – EU level – *EU Strategy for the Danube Region (EUSDR) Priority Area 5 Coordinator (Environmental Risks)*
7. **City of Nis** – expert level – *Urban Architect*
8. **City of Nis** – local level – *Representative of Municipal Office*
9. **City of Nis** – regional level – *Architect and project manager Regional Development Agency South (Serbia)*
10. **Capital City Podgorica** – expert level – *Landscape Architect*
11. **Capital City Podgorica** – national level – *Independent Advisor in the Directorate for Spatial Planning, Ministry of Spatial Planning, Urbanism and State Property, Montenegro*
12. **Sofia Development Association (SDA)** – regional level – *Head of Climate and Energy Department at Climate, Energy and Air Directorate Sofia Municipality*
13. **City of Zenica** – local level – *Deputy Mayor for Urbanism*

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Cross-cutting themes across countries

1. Prioritization and Integration of Blue-Green Infrastructure (BGI)
Among the interviewed experts, there is repeated agreement that green infrastructure and blue infrastructure measures have the strongest and most lasting impact and should be clearly prioritized.

- **Dominant cooling effect**: Expanding urban greenery and tree cover is considered key, as trees and parks provide shade and have the strongest overall and long-term impact. At the local level, planting trees along main streets and in public spaces is a priority.

"For Podgorica, priority combinations are tree-lined and shaded streets, permeable and cooler pavements, green-blue corridors along existing streams, and cool or green roofs on large buildings (malls, garages, public facilities)." (Landscape Architect, Podgorica)

- **Multi-benefit solutions**: Projects with an integrated approach are best suited for EU-level support and funding. Blue-green infrastructure serves multiple purposes at once, including cooling, water retention, biodiversity support, and flood prevention.

"From my experience, there is rarely a single, clearly defined "water management project" that deals only with one aspect such as Urban Heat Islands. These challenges are interconnected, part of the wider climate, hydrometeorological, and environmental system. For this reason, the most suitable projects are those that take an integrated perspective, linking heat mitigation, stormwater management, drought resilience, and public awareness." (Coordinator of EU Strategy for the Danube Region, Priority Area 5)

- **Combination of measures:** Although green infrastructure is the most important, experts emphasize that a combination of all three types of measures (green, blue, and white) works best. Reflective surfaces and cool roofs (white measures) are mentioned as effective for quick results, especially in hot locations.

2. The Need for Legislative Standardization and System Integration
Across all levels (national, regional, expert), there is clear agreement that to ensure long-term adaptation, UHI measures must become a mandatory part of urban development.

- **Introduction of standards**: It has been repeatedly confirmed that standards for urban heat mitigation (e.g., for green spaces, shading, reflective materials, and

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permeable surfaces) should be included in planning legislation and land-use planning.

"Urban heat mitigation standards should be integrated into planning legislation to ensure consistency and long-term impact. Setting minimum green space ratios, tree canopy targets, and reflective surface requirements in building and zoning codes would make cooling measures mandatory rather than optional, helping all Romanian cities adapt systematically to rising temperatures." (Head of Service, Galati Regional Environment Directorate)

- **Mandatory targets:** Setting minimum green space ratios, tree cover targets, and reflective surface requirements would ensure that cooling measures become mandatory rather than optional. This integration helps ensure that heat resilience becomes a fundamental part of long-term urban development.

"... [I]ntegrating minimum green coverage and surface material standards into urban planning is reasonable and effective. Provides cities with clear rules for new developments or reconstructions and promotes long-term sustainability." (Adaptation Department, Ministry of the Environment, Czech Republic)

- **Integration options**: UHI can be strongly integrated into national climate strategies, building codes (standards for insulation, ventilation, reflective materials), and financial programs that prioritize projects with UHI indicators.

"The development of the Rulebook on the Planning of Residential Settlements and Public Spaces is currently underway, and we work on including the integration of UHI requirements into this regulatory framework." (Independent Advisor in the Directorate for Spatial Planning, Ministry of Spatial Planning, Montenegro)

- **Lack of technical guidance:** Experts have repeatedly identified as problematic the lack of clear standards for the design and maintenance of nature-based solutions and the lack of technical guidance for permeable surfaces, which makes implementation difficult.

3. Critical Gaps in Data, Monitoring, and Capacity

It has been repeatedly emphasized that the main barriers to implementation are problems with basic data and insufficient technical capacity of local governments.

"Certainly, such a joint framework should develop a joint vision, common definitions and indicators, joint data and monitoring tools. It should also provide guidelines for policies and capacity building and refer to funding opportunities." (Member of Parliament, Bulgaria)

- **Lack of localized data:** Cities often rely on national hydrometeorological services, but this creates gaps in localized real-time metrics such as shading levels or green cover percentages, which are key for GIS planning.

"Some institutions are obligated to collect and measure data, but it is essential to consolidate all this information into a single platform for easier monitoring and decision-making. A more systematic and continuous approach to collecting and sharing data would greatly benefit urban planning and adaptation efforts." (Representative of Municipal Office, City of Nis)

"The City Administration of Zenica does not directly collect systematic urban heat data. Weather and microclimate data are primarily handled by national meteorological institutions, which creates gaps in localized indicators such as shading levels, surface temperatures, or green cover dynamics that are essential for planning." (Deputy Mayor for Urbanism, City of Zenica)

- **Recommended methodology:** The most effective approach to mapping UHI is a combination of satellite data (e.g., Land Surface Temperature maps) with local knowledge and GIS analysis. It is essential to strengthen data and early warning systems.

"The best approach is to combine satellite data with local knowledge. Satellite maps show which parts of the city are the hottest, but local experience - such as where people feel the most heat, voice heat-related problems, or places with no shade - helps confirm and better understand these hotspots. Using both together gives the most accurate results." (Urban Architect, City of Nis)

- **Need for data standardization:** A transnational framework should ensure common monitoring tools, data sharing, and common definitions for comparable results across the region. Data should be consolidated into a single platform for easier decision-making.

"Another key resource is Sofia's digital twin, which we actively use for analyzing and managing urban heat island dynamics across the city. It allows us to visualize data in 3D and better understand the interactions between urban form, vegetation, and microclimate." (Head of Climate and Energy Department at Climate, Energy and Air Directorate Sofia Municipality)

- **Need for technical support**: It is crucial to provide training, technical guidance, and model projects for local governments and experts.

"Technical guidance from experts, including capacity-building workshops with organizations like the World Bank or UN-Habitat, would be invaluable for adopting best practices, such as GIS modeling for site selection and monitoring protocols." (Chief Architect of Chisinau Municipality)

4. Need for multi-level and cross-sectoral coordination

Respondents at all levels pointed out that current activities are fragmented and often end when project funding ends.

- **Formal coordination structures:** Formal cooperation frameworks such as joint working groups, regional resilience coordination centers, or multi-level working groups are necessary to ensure effective implementation and long-term continuity.

"Another very effective approach is through knowledge exchange and peer learning. The EUSDR already provides a strong platform for this, and under PA5 we try to connect local governments, universities, and civil protection bodies so that experience from EU Member States can be shared more systematically with neighbouring countries." (Coordinator of EU Strategy for the Danube Region, Priority Area 5)

- **Cross-sectoral integration:** It is repeatedly emphasized that UHI must be linked to public health, biodiversity, air quality, water management, and energy efficiency.

"By connecting experts across countries, it also strengthens peer learning, advocacy, and interdisciplinary collaboration, ensuring that urban heat adaptation becomes a recognized and well-supported professional priority." (Advisor to the Secretary General, Ministry of Environment, Romania)

- **Support for inclusion and vulnerable groups:** The transnational framework should prioritize support for vulnerable communities and municipalities with low capacity.

"Prioritize support for vulnerable communities and low-capacity municipalities, ensuring fair access to funding, data, and technical support. Integrate UHI adaptation with goals in public health, biodiversity, air quality, water management, and energy efficiency." (Member of Parliament, Bulgaria)

- **Financial facilitation:** Access to funding is often limited by bureaucratic barriers and competition. Simplified application procedures and targeted assistance with grant writing would help.

"The most useful support would include dedicated budget allocation for environmental protection…Financial support is absolutely crucial, and education should start from the earliest stages — with workshops for children, active participation of high school students and university students, and public awareness campaigns for adults on topics like climate change, urban heat islands, and nature-based solutions." (Representative of Municipal Office, City of Nis)

In summary, the most frequently repeated message is that the Danube region must move from isolated projects to systemic adaptation, guided by binding standards for blue-green infrastructure and supported by shared data and cross-sector coordination.

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