NBS Best Practice 02

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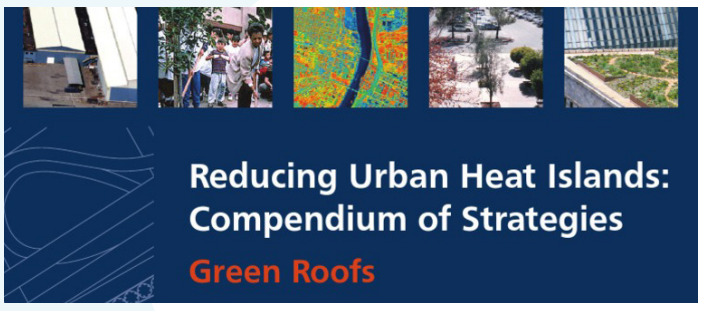
Green infrastructure to mitigate urban heat island

Since 2017, the **International Urban and Regional Cooperation** (IURC) program has been supporting Nature Based Solutions initiatives through knowledge exchange via study visits, networking events or online webinars, helping local governments integrate these ecosystem-based approaches into urban planning. The EU Green Deal and the EU Biodiversity Strategy for 2030 reinforce this approach through international collaboration to foster sustainable urban resilience, combat climate change and improve biodiversity in urban areas worldwide.

Context

The heat island phenomenon has been increasing steadily in cities around the world exacerbating the effects of **increased temperatures and heat waves.** Among known causes are the loss of vegetation and tree canopy, surfaces that capture solar energy and retain heat (e.g., pavement, dark roofs), densification of built space and increase in impermeable surfaces. It is not unusual to find significant variations in temperatures in the same city[1]. Urban heat islands (UHI) are of particular concern for public health, especially seniors, children and the most vulnerable neighbourhoods which often lack access to cooling spaces.

Green infrastructure to address UHI is often classified in one of three category of nature based solutions (NBS): conservation and restoration of ecosystems and biodiversity; sustainable management and climate-proofing of ecosystems, and; engineered ecosystem solutions (e.g. green roofs, facades, etc.)[2]. **There are a range of tools and modelling techniques at different scales that can help compare potential benefits of specific NBS measures** or combinations, to inform decision making [3]. There are many successful approaches from which to learn and improve the outcomes of green infrastructure investments.



Greening Hamburg's roofs: an early adopter is combining regulations, science, incentives and dialogue to maximize the benefits of green roofs in the city

Hamburg (pop. 1.8 million) was a green roof pioneer in the 1980's and later in 2015, the first city in Germany with a comprehensive green roof strategy. Housing requirements for a growing population, changes in rainfall patterns and increasing temperatures were exacerbating the impacts of extreme heat in the city.

Their comprehensive green roof plan[4] to promote green roofs and facades relies on a combination of policy, building requirements, financial incentives and public engagement to improve the city's rainwater retention capacity, reduce extreme temperature effects, provide additional green leisure areas and increase biodiversity. The implementation is not without its challenges as it competes with other city goals and must address reluctance to change by industry and public acceptance.

> Since 2014, 30Ha of green roofs have been implemented (35% on housing, 35% on industrial and business premises and 25% on other buildings). There are some 10 000 planning and building permissions for housing units processed yearly and most of those with green roofs are underway.

The city took a systemic approach and used NBS quality indicators and regulations on the surface and thickness of the green roofs instead of the more conventional water retention capacity. The installations came in many forms, from moss-based roofs on existing buildings to full landscapes with small ponds and groves on new ones.

Regulations are reviewed regularly in collaboration with stakeholders. **The initial investment of EUR 3,5 million was renewed in 2023 until 2026** where property owners can receive grants **covering 40-60% of costs for their installations**. The green roof plan is complemented by a commitment to implement a city-wide network of green spaces by 2030 linking the city's outer ring with its dynamic centre through a series of walking and cycling-friendly regenerated habitats[5]

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Montreal: Mobilizing community action and creating learning tools

Montreal has two decades of experience in working to mitigate heat island effects on its territory. The mobilization of community groups to delivered NBS is a stand-out element of their efforts. Financed by the Quebec Government's 2013-2020 Climate Change Adaptation Strategy, the CRE-Montréal, a non-profit organization, launched a 9-year program (ILEAU)[6] to improve the lives of residents of Montreal's eastern boroughs where there is a high proportion of low-income residents, a shorter-than-average life expectancy and a lack of green space. ILEAU partnered with public, private, and non-profit organizations to fund and implement practical UHI reduction projects using evidence-based criteria and maps developed by researchers at McGill University showing where to prioritize greening projects to create a network of green spaces that maximizes cooling benefits and biodiversity. ILEAU played a critical role in raising awareness in the community and developing tools to guide local efforts.

Montreal is also well supported by university researchers. The Heat Island Research Group of the Université du Québec developed a thermal picture of Montreal and maintains the data on an open portal. Recently, Montreal installed temperature and humidity measurement stations to collect data over 10 years and, in partnership with McGill University, assess the effectiveness of NBS and the distribution of UHI in the city.[7]

ILEAU's collaborations delivered :

1. Planting of 31 840 trees, shrubs and perennials.
2. Removal of 3058 m2 of pavement.
3. 02 green installations.
4. 400 meetings with local stakeholders.
5. Hundreds of citizens mobilized through workshops, consultations and participative projects.

Tempe, Arizona: urban heat resilience in through urban forestry and networks of plans

Mid-size cities such as **Tempe, Arizona**, also recognise the importance of mitigating the impacts of UHI and extreme heat. Because of its location in the Sonoran Desert, **shade does not come naturally to many of the city's neighbourhoods**. With an average daily maximum temperature of 30.9 C and average of 111.4 days over 37.8C, the effectiveness of their actions is paramount to reducing the population's vulnerability to heat. The successive Climate Action Plans[8] and a comprehensive Urban Forestry Master Plan (UFMP) have guided the efforts to manage and expand the city's mostly man-made urban forest. Developing and maintaining a healthy urban forest provides many benefits including the reduction of energy use and utility costs, mitigation of the effects of the urban heat island, expansion of habitat for wildlife and reduction in stormwater runoff.

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Specific goals and targets of UFMP:

1. Empower residents, businesses, organizations and city staff to collaboratively create and care for an urban forest that provides a 25% tree canopy by 2040.
2. Improve mobility through the equitable distribution of shade trees to create a walkable, 20-minute city that benefits public well-being and economic development.
3. Increase park, open space and public space use and care for a healthy biodiverse urban forest canopy.
4. Increase tree canopy, replace missing/diseased trees and update sparse landscape in rights-of-way, parks and city properties.

Since 2017, Tempe has relied on a range of incentives and programs to engage citizens and the business community. The Community Tree Stewards program is a newly launched collaboration from all levels of government aiming to promote community wealth-building and expand equitable urban cooling and resilience to extreme heat.

Conclusions and lessons

The scientific evidence that nature-based solutions (NBS) can mitigate the effects of UHI and address other societal challenges is expanding. While there remain gaps in measuring their effectiveness in various contexts, experiences show that successful approaches include plans supported by data, cross-sectoral collaboration, innovative designs, financial incentives and community engagement.

The use of NBS continues to evolve and we can draw useful lessons from these best practices and others from communities of all sizes such as Toronto (Green Roofs – City of Toronto), Boston, Massachusetts (Heat Resilience Solutions for Boston | Boston.gov). Madrid Barcelona (https://interlace-hub.com/green-infrastructure-and-biodiversity-plan-madrid) and many others.

here are active networks sharing experiences and results that can inform local decision-makers and useful searchable databases such as the US Environmental Protection Agency that can connect you to relevant local initiatives. All are useful resources that offer insights on the state of the science, available data sources, technology guidelines, and community education tools.

Resources:

European Environment Agency. Nature-based solutions in Europe: Policy, knowledge and practice for climate change adaptation and disaster risk reduction. EEA Report No1/2021

1. Government of Canada: https://www.canada.ca/en/services/health/publications/healthy-living/reducing-urban-heat-islands-protect-health-canada.html
2. Design guide for urban heat island mitigation measures https://publications.gc.ca/site/eng/9.857881/publication.html
3. US Environmental Agency: https://www.epa.gov/heatislands/community-heat-island-effortshttps://www.epa.gov/heatislands/guide-reducing-heat-islands
4. https://www.epa.gov/heatislands/guide-reducing-heat-islands

1.CMHC. 2014. Urban Heat Island Mitigation and Measures and Regulations in Montreal and Toronto. Research Highlight. Technical Series 14-1000
2.Nature-based Solutions in Europe. EEA Report 2021. pp98
3.Analysis of Heat Waves and Urban Heat Island Effects in Central European Cities and Implications for Urban Planning ; Urban Adaptation to Climate Change in Europe report (EEA 2012).
4.https://www.greenroofs.com/2015/01/20/watch-relaunch-hamburgs-new-green-roof-strategy-by-wolfgang-ansel-from-our-virtual-summit-2013/; GREEN-ROOF-STRATEGY-OF-HAMBURG.pdf
5.http://www.hamburg.de/gruenes-netz/3939882/aufgruenen-wegen-artikel/
6.https://www.inspq.qc.ca/sites/default/files/publications/3327-urban-heat-island-mitigation.pdf
7.Îlots de chaleur : des stations pour mesurer les températures estivales | Ville de Montréal
8.Meerow et al (2023) Plan Evaluation for Heat Resilience - City of Tempe.pdf

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For more information **info-na@iurc.eu**