D6.3. Handbook of best practices in noise

LIFE GreenMe5.

D6.3

Handbook of best practices in noise

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Executive summary

The LIFE GreenMe5 project involves the organization of thematic events, called Green Innovation Camps (GIC), in each of the partner cities and of each of the 5 pillars of the Green City Accord (biodiversity, air quality, waste management, water and noise). In those GIC, members of the partner cities (Transnational Expert Team) and local stakeholders, together with external experts in the specific thematic field, identify and exchange innovative actions to improve environmental management in the area to be addressed.

This report reflects on the discussions of the GIC held in Helsingborg on 6th May, focusing on noise, and presents some of the good practices exposed in the event.

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Introduction

1. Introduction

LIFE GreenMe5 and Green City Accord

The **Green City Accord (GCA)** is a **movement of European cities committed to environmental conservation.** The signatory city authorities agree to take action to make their cities greener, more resilient, and healthier.

The agreement includes five pillars related to the most important areas of urban environmental management: water, air quality, waste, noise and biodiversity. The initiative was launched by the European Commission in October 2020 and already involves more than 100 cities across Europe.

LIFE GreenMe5 aims to **facilitate the implementation of the GCA in five municipalities**. The philosophy of the project is based on the idea that the exchange of experiences and cooperation between the participating cities will serve to improve their capacities and find solutions to common challenges.

The project will **establish a multi-governance approach** to the implementation of the Agreement, integrating all municipal departments and stakeholders. For this purpose, **interdepartmental, supra-municipal and local working structures have been set up**. LIFE GreenMe5 will support the participating cities in the elaboration of the mandatory reports that are part of the political commitment.

This project, co-financed by LIFE funding, involves the Federation of Municipalities of the Region of Murcia, leader of the project, the municipalities of Murcia, Cieza (Spain), Arezzo (Italy), Vilnius (Lithuania) and Helsingborg (Sweden), and the company specialized in developing sustainability and environmental projects through European funding EuroVértice (Spain).

Under LIFE GreenMe5, **pilot actions** will be implemented to improve indicators in the five GCA areas - biodiversity, air quality, waste management, water and noise - with the aim of transferring them as good practice for implementation in other European cities.

These actions include measures in streets to reduce noise pollution and improve air quality, a manual to reduce food waste in schools, measures to improve green coverage or a door-to-door collection system for high-value and high-risk waste.

What are the Green Innovation Camps?

Along the LIFE GreenMe5 project, coinciding with the meeting of the Steering Committee, each partner country will organise **a Green Innovation Camp (GIC).** These **two-day thematic workshops** will focus on one of the five pillars of the Green City Accord: biodiversity, air quality, waste management, water and noise.

The GICs involve members of the **Transnational Expert Team** (municipal technicians of the partner cities, but not involved as staff in the project) and local stakeholders, together with external experts in the specific thematic field. The objective of each GIC is to identify and exchange innovative actions to improve environmental management in the area to be addressed in each of the cities. For municipal technicians, it is an opportunity to explore

other geographical contexts and share good practices and ideas to improve together the implementation of the Green City Accord.

Introduction to the series of handbooks of best practices produced by the LIFE GreenMe5 project

This is the third of a series of handbooks in which you can find in an agile way the best practices shared by the partners of the LIFE GreenMe5 project. The aim is to compile the learnings and experience of the Green Innovation Camps.

This third volume is the result of the meeting held in Helsingborg on 6th May 2025, focusing on noise.

Alexandre Svenssons – City of Helsingborg -- opened the event by describing the local context in Helsingborg and the city's ongoing efforts to address urban noise. He emphasized that cities alone cannot tackle environmental challenges such as noise pollution effectively. Instead, cooperation among municipalities, experts, and citizens is essential to generate impactful, sustainable solutions.

Then, **Rocío Méndez**, from the Federation of Municipalities of the Region of Murcia provided an introduction to the Green City Accord (GCA). She presented recent findings from the GCA monitoring reports, which track progress across five thematic areas: air, water, nature and biodiversity, circular economy and waste, and noise. Rocío explained that while cities are advancing in air and water quality, they are still falling short of targets in noise and waste management. She also introduced the LIFE GreenMe5 project, designed to support municipalities in achieving their GCA commitments through technical assistance, capacity-building, and peer learning.

After it, **Marta Reguilón** opened the thematic block on noise by setting the stage for why noise pollution is a critical and often underestimated issue in urban environments. Drawing from recent European Environment Agency data, she highlighted how exposure to excessive noise leads to a range of health issues including sleep disturbance, cardiovascular disease, and reduced cognitive development in children. She emphasized the value of interdisciplinary collaboration, citizen engagement, and integrated planning in effectively reducing urban noise levels.

Figure 1. From left to right: Alexandre Svenssons, Rocío Méndez and Marta Reguilón in the Green Innovation Camp on Noise. 6th May.

The event continued with interesting speakers that continued discussing about noise. The event was structured in three different blocks:

- Forest sounds vs city sounds. Presentation of Jonas Christensson, Delta Akustik.
- Noise challenges in cities. With the following presentations: An artistic approach to noise challenges in a new development area, Östra Ramlösa, Johanna Elgström and Isabell Dahlberg, City of Helsingborg; Vilnius' Approach to Air and Noise Pollution; Malmos' goals and action plan for a better environment, Mårten Spanne and Emelie Gustafsson, City of Malmö; Murcia's campaign regarding night leisure and the participatory council for noise, Manuel Vals, Municipality of Murcia.
- Effective noise prevention and protection that works. With presentations of Jens Forssén, researcher at Chalmers Technical University; and Manne Friman, noise consultant, Soniqa Akustik

The event was completed with a panel discussion on innovation and noise challenges.

Over the next year, two more GICs will take place in which the focus areas of the Green City Accord will be discussed:

- AREZZO (M26): waste management.

- CIEZA (M32): nature and biodiversity.

What will you find in this document?

In this document you will find an overview of noise aspects in Europe, including its current situation, the legal framework and commitments and indicators of the GCA for this pillar, as well as the best practices discussed of the Noise GIC that took place in May 2025.

The document follows the same structure as the one of the event. It starts by presenting the overall context of noise in Europe, including a summary of the data and legislation highlighted by EuroVértice in the event. Then, it continues exposing the information discussed by the different speakers.

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Noise in Europe

2. Noise in Europe

Current situation

Urban noise has become one of the most **pervasive and underestimated environmental challenges in European cities.** While often treated as a secondary issue, noise pollution is deeply embedded in everyday urban life—shaping how we sleep, work, move, learn, and interact. From constant traffic to construction, nightlife, industrial activities, and crowd-related sounds, noise is a growing concern across the continent.

Recent studies estimate that approximately **100 million people in the European Union** are exposed to long-term environmental noise at harmful levels, primarily due to transport. When compared to the **World Health Organization (WHO)** recommended thresholds, this number increases to more than **144 million people**. Noise pollution is now considered the **second most damaging environmental factor for health**, following air pollution.

The health impacts are striking (Figure 1:

- **22 million people** experience chronic psychological stress.

- **6.5 million people** suffer from severe sleep disturbance.

- **12,000 premature deaths** annually are attributed to noise exposure.

- **12,500 children** face cognitive development impairments due to aircraft noise.

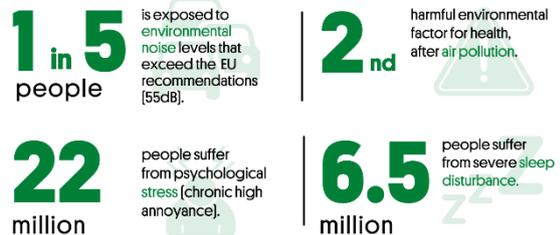- **48,000 people** are affected by coronary heart disease related to noise.

While **hearing loss and tinnitus are well-known effects**, noise also leads to non-auditory consequences: cardiovascular disease, metabolic disorders, sleep disorders, and reduced learning and attention in children (Figure 2). Moreover, noise has broader
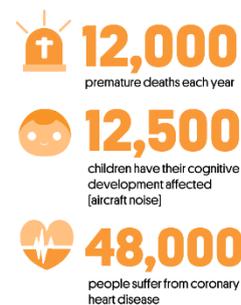
societal effects—reducing the quality of life, reinforcing social inequalities, and diminishing the attractiveness and livability of urban   spaces.
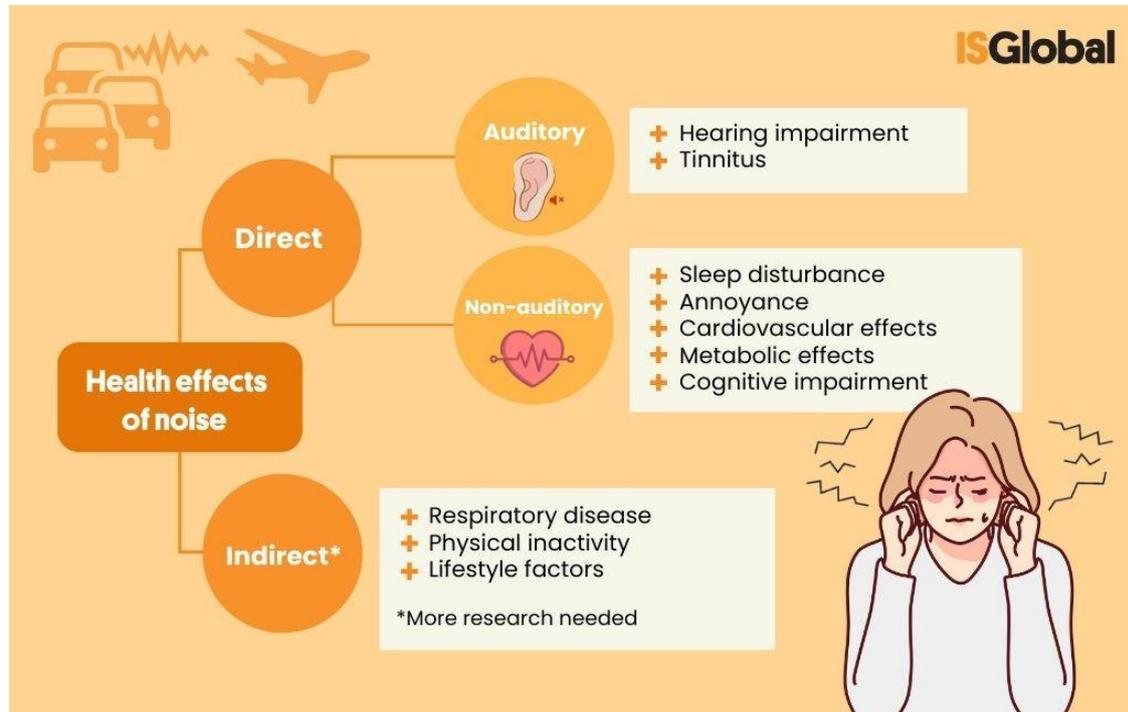
Figure 3. Direct and indirect health effects of noise. ISGlobal.

Urban noise is not a single-source issue. It stems from a wide range of overlapping sources—transport, construction, industry, and human activity—each varying in intensity, frequency, and time of occurrence, which makes it more difficult to tackle. The **densification of cities**, increased mobility, and proximity of housing to roads or railways have amplified exposure, making noise an inescapable part of urban life.

As visible from Figure 3, urban noise remains a significant challenge across Europe. The chart highlights the number of people exposed to long-term harmful noise levels from transport sources, split by both **urban** and **outside urban areas**, according to the **Environmental Noise Directive (END)** and the **World Health Organization (WHO)** thresholds.

- **According to the END thresholds**, **87 million people** are exposed to road traffic noise of **55 dB or higher** during the day-evening-night period, and **56 million people** are affected by night-time noise. These numbers are significantly higher in **urban areas** than in **outside urban areas**, reflecting the concentration of traffic and activities in city environments.

- When we consider the **WHO recommended levels**, the number of people exposed to harmful noise increases significantly. **144 million people** are exposed to transport-related noise at levels that can negatively impact health, with a notable difference between **urban areas** and **outside urban areas**. In urban areas, exposure is higher due to denser traffic and higher population concentrations.
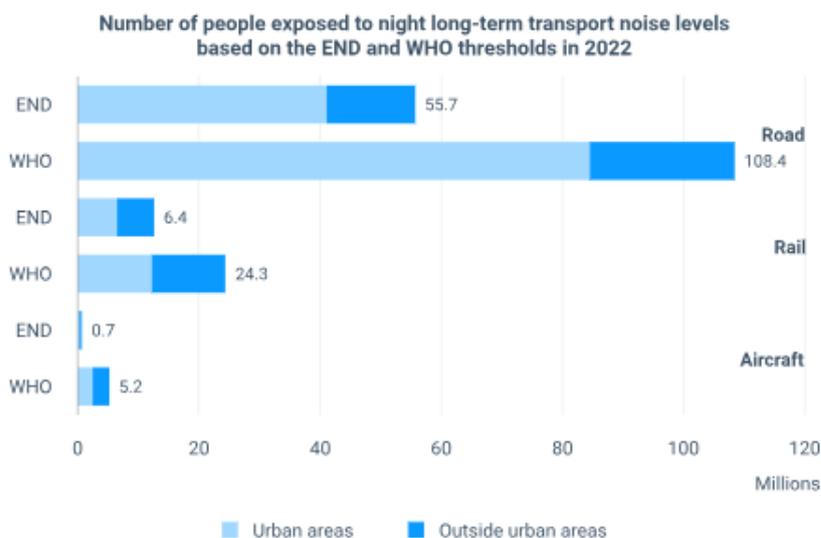
Number of people exposed to day-evening-night long-term transport noise levels based on the END and WHO thresholds in 2022

END	87.0 — Road
WHO	110.4 — Road
END	16.9 — Rail
WHO	19.0 — Rail
END	2.3 — Aircraft
WHO	14.3 — Aircraft

Millions (0 – 120)

Legend: Urban areas — Outside urban areas

Number of people exposed to night long-term transport noise levels based on the END and WHO thresholds in 2022

END	55.7 — Road
WHO	108.4 — Road
END	6.4 — Rail
WHO	24.3 — Rail
END	0.7 — Aircraft
WHO	5.2 — Aircraft

Millions (0 – 120)

Legend: Urban areas — Outside urban areas

Figure 4. Reported data on noise exposure covered by Directive 2002/49/EC, 2022, July 2024, European Environment Agency (EEA)

The chart also shows that while **road traffic** is the primary source of noise pollution across both urban and rural areas, other sources like **rail** and **aircraft** contribute less, though still significantly in certain locations. Notably, **aircraft noise** decreased during the pandemic, but as air traffic recovers, the numbers raised again. **Railway noise**, however, increased in urban areas, both during the day and at night.

These figures highlight the scale of the problem and demonstrate that efforts to reduce exposure to transport noise must consider both **urban and outside urban areas**, as the levels of exposure and sources of noise vary significantly across regions.

Despite data limitations (e.g. differences in how countries map roads), available evidence suggests that **30–60% of the urban population in many EU countries** is exposed to road noise above the END threshold—well above WHO recommendations.

Estimated percentage of inhabitants within urban areas exposed to unhealthy road traffic noise levels, based on Environmental Noise Directive thresholds, in 2022

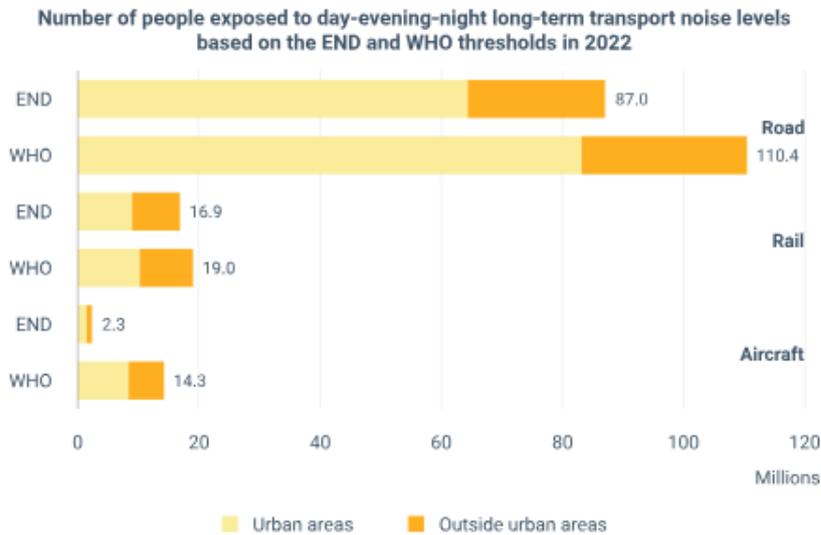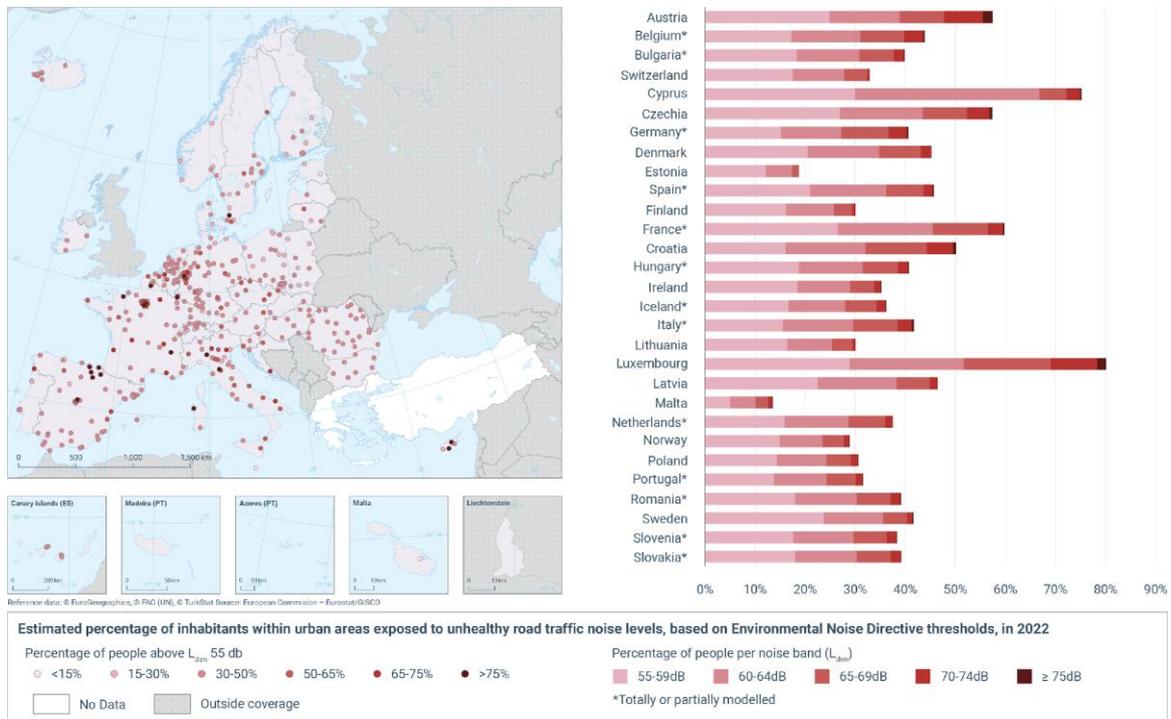*Figure 5. Reported data on noise exposure covered by Directive 2002/49/EC, 2022, July 2024, European Environment Agency (EEA)*

European legal and policy framework

To address this challenge, the EU has developed a range of legal instruments, the cornerstone being the **Environmental Noise Directive (END) 2002/49/EC**. This Directive obliges Member States to:

1. Assess exposure and health impacts.
2. Publish strategic noise maps.
3. Develop action plans every five years.
4. Ensure public access to noise information.
5. Preserve good acoustic environments in quiet areas.

However, the END does **not set binding noise limits**, leaving action largely to national and local governments. Evaluations of the Directive (most recently in 2023) show progress but call for stronger implementation to meet long-term goals.

In addition to the END, other EU legislation targets **noise at the source**, regulating emissions from:

- road vehicles and tyres;

- railway rolling stock;
- aircraft;
- and outdoor equipment (Directive 2000/14/EC).

Noise is also addressed through broader EU environmental and mobility policies, notably:

- The **Zero Pollution Action Plan** (2021), part of the Green Deal, which includes a specific target: **Reduce chronic transport noise exposure by 30% by 2030**, compared to 2017.
- The **Sustainable and Smart Mobility Strategy** (2020), promoting modal shift to quieter options: public transport, cycling, and electric vehicles.
- The **EU Urban Mobility Framework** and **Biodiversity Strategy**, linking noise mitigation to greener, healthier cities.

GCA commitments and indicators on Noise

The GCA includes three specific indicators on noise:

5.1 – % of population exposed to Lden > 55 dB (day-evening-night).

5.2 – % of population exposed to Lnight > 50 dB (night-time).

5.3 – % of population highly annoyed or sleep-disturbed due to noise.

The LIFE GreenMe5 project, under which the Green Innovation Camp is organized, supports signatory cities in advancing toward these targets. It offers methodologies, technical advice, capacity building, and peer exchange. Cities are encouraged to integrate noise into broader planning efforts: from quiet mobility and green infrastructure to participatory noise monitoring and sound-sensitive urban design.

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Best practices discussed in the Noise Green Innovation Camp – Helsingborg -May 2025

3. Best practices discussed in the Noise Green Innovation Camp – Helsingborg -May 2025

The event included different presentations that were structured according to the following sections:

- Forest sounds vs city sounds.
- Noise challenges in cities.
- Effective noise prevention and protection that works.

Forest sounds vs city sounds.

What was discussed?

The core of the event started with the presentation of Jonas Christensson, from Delta Akustik, who focused on the biological and psychological relationship between humans and sound. He demonstrated how sound behaves in different environments and illustrated this with frequency and reverberation charts. He explained that the human sense of hearing evolved to detect natural sounds—such as birdsong and flowing water—and is ill-adapted to artificial urban noise. He showed how hard, flat, parallel surfaces commonly found in cities create echoes and amplify unpleasant low-frequency sounds from traffic and ventilation systems.

Jonas stressed that this disconnects between our evolutionary hearing system and the modern sound environment contributes significantly to discomfort and health issues. He advocated for urban designs that minimize reverberation by using non-parallel surfaces and absorbent materials. His key message was clear: 'we shape our buildings, and afterwards, our buildings shape us'.

Understanding Soundscapes through Nature and Urban Contrast

Presented by: Jonas Christensson

Implemented in the framework of the project: N/A

Year: N/A

More info:

https://www.akustiker.se/

https://www.youtube.com/watch?v=Q-vjbKVy5rY

DESCRIPTION:

This practice centers on exploring the stark contrast between natural and urban soundscapes to inform healthier urban noise management. Humans' hearing system evolved to thrive in natural environments filled with varied, soft sounds like birdsong and flowing water. However, modern cities present a very different acoustic reality dominated by persistent, low-frequency noises from traffic, industry, and mechanical systems. These noises are often amplified by hard, flat, and parallel surfaces typical of urban architecture, which create problematic echoes and reverberations.

Detailed sound measurements and acoustic analysis demonstrate how sound behaves differently in forests compared to city environments. These findings emphasize the importance of incorporating acoustic considerations into urban planning and architecture from the earliest stages. By minimizing low-frequency noise sources and avoiding reflective surfaces through the use of absorbent and textured materials, urban design can better align with human auditory comfort.

By understanding the differences between natural and artificial soundscapes, municipalities can implement design strategies that reduce harmful noise exposure and create urban environments that better align with human auditory comfort and health. The practice promotes creating soundscapes that not only reduce noise pollution but also enhance the sensory experience of public spaces, contributing to wellbeing and social cohesion. Success relies on interdisciplinary collaboration, educating urban planners and architects about sound, and treating acoustic quality as a fundamental element of urban design—on par with visual and spatial planning.

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Noise challenges in cities

What was discussed?

Urban noise pollution is a multifaceted challenge that requires innovative, integrated solutions to balance growth, wellbeing, and environmental quality. The Green Innovation Camp showcased diverse approaches from European cities, illustrating how noise management can be woven into the fabric of urban life with creativity, data-driven strategies, and community engagement.

In Helsingborg, the Östra Ramlösa residential development exemplifies how traditional noise mitigation can evolve into a collaborative artistic process. Faced with the task of softening road traffic noise near natural areas, city planners invited artists early into the design phase to rethink noise barriers as multifunctional, poetic urban elements. This approach not only addresses acoustic challenges but enriches public spaces, creating environments that resonate emotionally with residents and visitors alike.

Moving to Vilnius, noise management is integrated within a broader environmental strategy addressing air pollution and sustainable mobility. The city's recent strategic noise mapping revealed tens of thousands of residents exposed to harmful noise levels, primarily from traffic. In response, Vilnius implemented a comprehensive Noise Prevention Action Plan focused on establishing quiet zones, incentivizing electric vehicle adoption, and expanding green infrastructure. Transparency and public participation are key, supported by the innovative "City Lungs" platform that provides real-time noise and air quality data to citizens and policymakers.

Malmö's approach underscores the critical role of strategic policy integration and targeted interventions. With its flat landscape and proximity to intense traffic sources, the city has set ambitious noise reduction targets for 2030 and 2050, prioritizing homes, schools, and recreational areas. While progress depends on political commitment and policy coherence, Malmö's use of detailed noise mapping and green infrastructure expansion illustrates how evidence-based planning can guide meaningful change.

Murcia highlighted a less commonly addressed source of urban noise: nightlife and leisure activities. The city's pioneering Leisure Noise Map identified conflict zones where terrace and street noise exceeded legal limits, impacting residents' wellbeing. Murcia's solution combines strict licensing, participatory councils involving businesses and citizens, and cutting-edge real-time noise monitoring via Limiters-Controllers-Recorders (LCRs). This data-driven, inclusive governance model balances vibrant urban life with acoustic comfort, offering a replicable framework for cities with dynamic social scenes.

Together, these examples reveal that tackling urban noise demands not only technical solutions but also creative design, strategic policy, and democratic participation. Cities are moving beyond simple noise reduction towards fostering healthier, more liveable, and socially vibrant urban environments.

Best practices presented

Artistic Noise Mitigation through Collaborative Urban Design

Presented by: Johanna Elgström, Landscape Architect & Isabell Dahlberg, Public Art Developer, City of Helsingborg

Implemented in the framework of the project: N/A

Year: N/A

More info:

https://involvering.helsingborg.se/sv-SE/projects/ostraramlosa

DESCRIPTION:

Östra Ramlösa is a planned new district located five kilometers from Helsingborg's city center, designed to become one of Sweden's best neighborhoods for families. Covering 84 hectares, this green and family-friendly area will eventually accommodate around 3,000 homes. The district is characterized by its unique natural heritage, including centuries-old oak trees, extensive pedestrian, cycling and bridle paths, as well as essential facilities like schools, preschools, a sports hall, and a large activity park along the Lussebäcken stream. It is well connected to the city center and nearby transport hubs, including a planned hospital.

Facing the **challenge of mitigating road traffic noise from an adjacent four-lane road, the city chose an innovative approach to noise reduction beyond traditional barriers**. Conventional noise embankments typically rely on large volumes of earth and vegetation to reduce sound but often neglect the experiential and social quality of the environment. The project excavated approximately 80,000 cubic meters of material, constructing noise barriers about 1,500 meters long and 4 to 6 meters high.

Recognizing the complexity of noise as an environmental and social issue, Helsingborg's urban planning team **invited artists into the early planning stages to collaboratively rethink the noise mitigation strategy.** This marked a novel process where artists were not only contributors of isolated artworks but active partners throughout, engaging in ongoing dialogue with city planners and architects. The city developed a **new funding and collaboration model: while artists received fees and consultancy payments**, the physical transformation of landscape materials was financed by the urban development project itself.

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This interdisciplinary process aimed to generate **new perspectives on landscape, noise, and urban living by creatively using existing site elements to produce more than just functional noise barriers.** Artistic proposals were encouraged to explore functions beyond noise attenuation, such as spaces for cultivating plants, social gathering, or quiet contemplation—essentially redefining "function" to include poetic and unexpected qualities that enrich residents' and visitors' experiences.

Inspired by works like Maya Lin's *Storm King Wavefield* (2009), this approach embraced **courage and faith in experimentation, acknowledging that outcomes could be surprising and beneficial for future urban projects.** The integration of artistic competence was valued equally alongside technical and planning expertise, promoting a culture of learning and collaboration.

By combining art, ecology, and urban design, Östra Ramlösa's noise mitigation strategy seeks to create a **better living environment** that supports wellbeing, social cohesion, and biodiversity. It demonstrates how cities can engage new partners to meet environmental challenges innovatively, resulting in multifunctional urban spaces that resonate emotionally and practically with their users.

Integrated Noise and Air Pollution Management through Strategic Monitoring and Sustainable Mobility

Presented by: Aušra Sičūnienė, City of Vilnius

Implemented in the framework of the project:
N/A

Year: N/A

More info:

https://greenme5.fmrm.es/2024/01/22/lorem-ipsum-dolor-sit-amet-consectetuer-adipiscing-elit/

DESCRIPTION:

Vilnius, the largest and fastest-growing city in Lithuania, faces escalating challenges related to both noise and air pollution due to rapid **population growth** (approximately 6% increase over the past three years) and intensifying urban activities. Recognizing the intertwined nature of air quality and noise impacts on public health, the city has adopted a comprehensive and integrated approach to environmental management.

A key pillar of Vilnius's strategy is the **Strategic Noise Mapping** conducted every five years to assess exposure levels across the metropolitan area. The latest mapping revealed that nearly **30,000 residents** are exposed to noise levels exceeding 65 dB(A), primarily from road traffic, which remains the largest contributor to urban noise pollution. This data-driven assessment guides targeted interventions and informs the city's **Noise Prevention Action Plan (2024–2028)**, which outlines 36 concrete measures aimed at reducing population exposure to harmful noise by at least 2.5% over five years.

Vilnius **complements noise management with robust air quality monitoring** through an interconnected network of four automatic stations strategically located in diverse urban settings—from background pollution areas to high-traffic intersections and residential zones. The city makes this data publicly accessible via its innovative **"City Lungs" digital platform**, offering real-time insights into noise and air pollution, empowering citizens and authorities to make informed decisions.

The city has also pioneered the establishment of **quiet agglomeration and nature zones** to protect sensitive areas and promote urban biodiversity. These zones are coupled with aggressive policies promoting sustainable mobility, including generous subsidies for electric vehicles—up to €5,000 for purchases—which contributed to a surge in electric vehicle adoption.

In alignment with national and EU directives, Vilnius is preparing a new **Air Quality Plan (2026–2030)** and has committed to prohibiting the burning of coal and peat starting in 2025, further tackling pollutant sources. Public transport modernization, expanded

green infrastructure, and low-emission zones form integral parts of the broader environmental agenda.
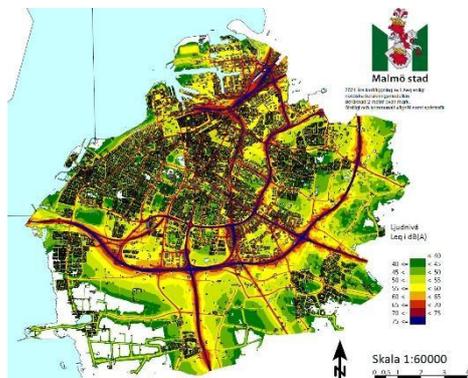
Strategic Urban Noise Reduction through Policy Integration and Targeted Interventions

Presented by: Mårten Spanne & Emelie Gustafsson, City of Malmö	
Implemented in the framework of the project: N/A	
Year: N/A	
More info:	

DESCRIPTION:

Malmö faces **distinct urban noise challenges shaped by its flat topography, proximity to heavy road and sea traffic, and rapid population growth**. The city's strategic approach to noise management focuses on developing an **evidence-based action plan** aligned with Sweden's national implementation of the Environmental Noise Directive (END) and the European Green Deal.

Central to Malmö's efforts is **a clear set of ambitious noise reduction goals** targeting residential exposure, educational environments, and recreational spaces. By 2030, the city aims to reduce the percentage of residents exposed to noise levels exceeding 65 dBA by 30%. Additionally, Malmö seeks to increase the proportion of schoolyards with noise levels below 50 dBA to 60% by 2030, improving learning environments for children. Recreational areas are also a priority, with goals to expand quiet zones to enhance community wellbeing.

Developing this action plan required **careful policy integration and stakeholder engagement**. Malmö highlighted challenges in aligning new noise strategies with existing urban policies, balancing legal frameworks, political priorities, and financial constraints. The complexity of policy coherence and political buy-in means that progress can be incremental and requires sustained advocacy.

The city uses **strategic noise mapping and monitoring to guide targeted interventions**, including traffic calming, speed limit adjustments, green infrastructure expansion, and zoning reforms. Public consultation processes have been employed to incorporate community feedback and improve plan acceptance.

Although still evolving, Malmö's noise action plan represents a comprehensive, measurable, and transparent framework. It sets clear benchmarks and monitoring processes for tracking exposure reductions. Early measures have already contributed to localized improvements in noise levels, especially around schools and parks. The plan's focus on vulnerable populations, such as children, highlights Malmö's commitment to environmental justice and inclusive urban health.

Murcia's campaign regarding night leisure and the participatory council for noise

Presented by: Manuel Valls	
Implemented in the framework of the project: N/A	
Year: N/A	
More info:	

DESCRIPTION:

Murcia faces a unique noise challenge often overlooked in traditional environmental noise policies: **noise generated by leisure activities**, particularly in bustling city centers where outdoor terraces, bars, and nightlife create significant acoustic impacts. Recognizing that the **Environmental Noise Directive (END)** does not comprehensively cover leisure noise, Murcia developed a dedicated **Leisure Noise Map (LNM)** in 2017 to identify and manage these sources.

The methodology combined continuous and short-term sound level monitoring near terraces and busy streets to characterize noise emissions. This enabled the city to delineate **"conflict areas"** where authorized noise limits were regularly exceeded, impacting significant portions of the population during evening and night periods. The map informed the designation of **Special Acoustic Protection Areas (SAPAs)**, which receive focused regulatory attention.

Murcia implemented an innovative governance framework to address these issues, characterized by:

- **Strong citizen participation** involving residents, business owners, academic institutions, and local authorities.
- Creation of a **dedicated Leisure Police force** tasked with monitoring and enforcing noise regulations.
- Licensing restrictions limiting the density and operating hours of terraces and street vendors in sensitive zones.
- Deployment of **Limiters-Controllers-Recorders (LCRs)**—tamper-proof sound monitoring devices with real-time data transmission—to ensure compliance with noise emission limits.

This participatory and technology-enabled approach balances the economic vitality of nightlife with residents' right to peace and quiet. Murcia's multi-stakeholder engagement fosters social cohesion and compliance, while data-driven enforcement ensures accountability.

The **Leisure Noise Map** and associated governance measures have led to improved noise management in critical urban areas, reducing the number of complaints and enhancing

the quality of life for affected residents. Real-time monitoring and enforcement have increased transparency and trust between businesses and the community. This approach is **one of the few in Europe that explicitly addresses leisure noise,** providing a pioneering example for cities worldwide grappling with similar challenges.

Effective noise prevention and protection that works

What was discussed?

The technical session on effective noise prevention illuminated the **evolving landscape of noise mitigation,** emphasizing that solutions must address both measurable noise levels and human perception to create truly healthier urban environments.

Jens Forssén from Chalmers University of Technology opened the discussion by presenting evidence-based research highlighting the challenges posed by increasing urban densification. As cities grow denser, residents find themselves living closer to traffic and other noise sources, making thoughtful urban planning critical. Jens underscored the concept of designing for **'quiet sides'**—orienting residential buildings and outdoor spaces so inhabitants have access to areas shielded from the loudest noises. His studies revealed that even when the noise levels measured at a building's façade remain the same, having a quiet side dramatically reduces annoyance and sleep disturbance.

Advancing noise mapping techniques, Jens introduced the **QSIDE model**, which integrates indirect sound pathways such as reflections and diffractions into traditional noise maps, offering a more accurate picture of urban noise exposure. He also advocated for combining multiple small-scale design interventions—like green roofs, vegetated facades, closed courtyards, soft ground surfaces, and green buffers—to collectively reduce noise and improve urban soundscapes.

Building on this scientific foundation, Manne Friman from Soniqa shared practical, real-world examples where innovative noise mitigation measures have been successfully implemented. These include **soundwalls with irregular surfaces** that diffuse sound waves, **landscaped berms** replacing conventional noise barriers to create inviting green spaces, **guardrails with noise-absorbing materials**, and **low-noise thin-layer road surfaces** that minimize tyre-road noise over long periods. Notably, Manne presented the **Jungle Soundscape Playground**, a novel public space where natural and artificial sounds are orchestrated to mask urban noise and enrich children's sensory experiences. The park was visited with the participants after the talks finalized.

Manne highlighted that noise mitigation must also focus on **perception management**. Strategies such as environmental zoning to restrict noisy activities, campaigns promoting quiet tires and electric vehicles, and night-time bans on heavy vehicles are vital. He also discussed emerging enforcement technologies like noise-monitoring cameras—akin to speed cameras—that help ensure compliance with noise regulations.

Together, these presentations underscore a holistic approach to urban noise: combining cutting-edge research, thoughtful design, ecological integration, community wellbeing, and robust governance. This dual focus on reducing actual noise and improving perceived sound quality is crucial for cities striving to create sustainable, liveable environments.

Best practices presented

Advanced Noise Prediction and Mapping Techniques for Urban Environments

Presented by: Jens Forssén, Applied Acoustics, Chalmers University of Technology

**Implemented in the framework of the project:** N/A

Year: N/A

More info:

Wei et al., "Urban Background Noise Mapping: The General Model." Acta Acust united with Acust. 100(6):1098–111, 2014

Estévez Mauriz et al., "Incorporation of the quiet side in noise maps", in TECNIACUSTICA 2014., 2014, pp. 123–130.

Forssén et al., "Prediction of quiet side levels in noise map calculations – an initial suggestion of methodology", ICA, 2019

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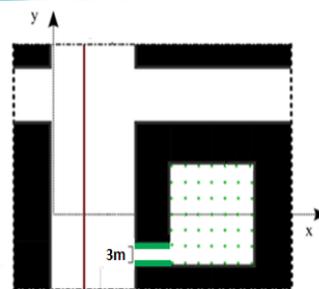
DESCRIPTION:

Traditional noise mapping methods often underestimate noise levels in complex urban environments, particularly in inner courtyards and areas affected by multiple reflections and diffractions. Jens Forssén highlighted the limitations of standard engineering models, which typically focus on direct sound paths but neglect indirect effects such as higher-order reflections, scattering from distant sources, and diffraction around obstacles.

Forssén introduced the **QSIDE model**, an advanced approach integrating reflection, diffraction, and turbulence scattering effects to better predict noise distribution. This model enhances the accuracy of urban noise maps by incorporating the "quiet side" phenomenon—where parts of a building or neighborhood receive significantly lower noise exposure than the façade facing a noisy street.

He demonstrated through case studies how including indirect noise pathways in calculations can reveal noise level differences of up to 10 dB in inner yards compared to traditional maps. This improved mapping enables more precise identification of high-exposure zones, better informing urban planning and mitigation efforts.

The application of advanced noise mapping techniques allows municipalities to design more effective interventions, target resources efficiently, and improve public health outcomes. Accurate noise data underpin transparent policymaking and increase public trust in mitigation strategies.

Holistic Urban Planning for Noise Mitigation and Improved Soundscapes

Presented by: Jens Forssén, Chalmers University of Technology	
Implemented in the framework of the project:	
Year: N/A	
More info:	

DESCRIPTION:

Jens Forssén emphasized a comprehensive planning approach that addresses noise at its source, propagation, and receiver levels. The practice involves a toolbox of strategies, including:

- **Traffic redistribution:** Concentrating traffic to designated streets or tunnels to reduce overall noise exposure.

- **Temporal management:** Banning heavy and noisy vehicles during night hours.

- **Traffic calming:** Speed reductions, limiting acceleration, and promoting quieter driving behaviors.

- **Urban design:** Positioning buildings to act as barriers, designing courtyards and balconies to face quieter areas, and employing absorbing materials on facades and roofs.

- **Green infrastructure:** Using vegetated walls, roofs, and ground surfaces to absorb and diffuse sound.

Forssén highlighted the importance of including acoustic considerations early in the planning process to optimize the combined effect of multiple measures, thereby improving both noise levels and perceived sound quality. He presented evidence that access to quiet sides and green spaces significantly reduces annoyance, even where façade noise levels remain constant.

Cities implementing these principles can achieve substantial reductions in population noise exposure and related health impacts. Additionally, improved soundscapes enhance residents' wellbeing and satisfaction with urban environments.

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Urban Morphology and Greening Strategies to Improve Noise and Air Quality
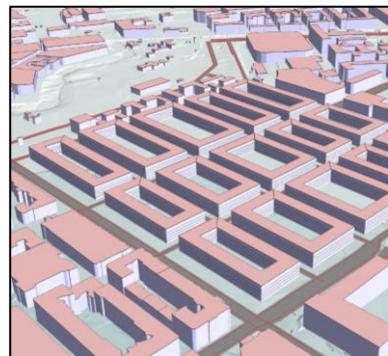
Presented by: Jens Forssén, Chalmers University of Technology

Implemented in the framework of the project: MaGNA Project / Chalmers University of Technology

Year: N/A

More info:

https://research.chalmers.se/publication/530938/file/530938_Fulltext.pdf

DESCRIPTION:

This practice derives from the Morphology and Greening for Noise and Air quality (MaGNA) project, which studied how different urban layouts and vegetation influence environmental noise and air pollution. Jens Forssén presented findings showing that urban form and green infrastructure play critical roles in shaping noise exposure and air quality at the building façade level.

The study compared various typologies:

- Closed blocks with small openings generally reduce noise but may worsen air quality.

- Blocks with larger openings improve air flow but may increase noise exposure.

- Vegetated roofs, facades, and ground surfaces contribute to noise attenuation.

- Concentrating traffic to fewer streets can reduce overall noise burden, though local hotspots may intensify.

The research provides a nuanced understanding of trade-offs between noise and air quality, highlighting the need for balanced design solutions that optimize both.

By applying MaGNA findings, urban planners can optimize building forms and green spaces to reduce noise annoyance and improve air quality simultaneously, benefiting public health and livability. Examples include using vegetated roofs to reduce noise by approximately 3 dB and employing dense green barriers to block sound propagation.

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Multifunctional Urban Noise Barriers and Soundscape Design

Presented by: Manne Friman, Soniqa Acoustic Consultancy

Implemented in the framework of the project:

Year: N/A

More info:

https://miljobarometern.stockholm.se/content/docs/tema/buller/Grona-losningar-for-en-battre-ljudmiljo.pdf

DESCRIPTION:

Innovative noise mitigation solutions implemented across Helsingborg combine technical engineering with ecological and aesthetic design. Central to this approach is the transformation of traditional noise barriers into multifunctional urban elements that not only reduce noise but also enrich public spaces.

Key interventions include:

- **Soundwalls with irregular surfaces** that scatter sound waves to reduce reflections.
- **Landscaped berms** serving as green noise buffers that double as recreational spaces.
- **Guardrails paired with absorptive noise barriers** near parks, enhancing acoustic comfort.
- **Low-noise thin-layer road surfaces** that reduce tyre noise and maintain long-term effectiveness.

This practice exemplifies how integrating sound mitigation with urban greening and community-focused design enhances both noise reduction and user experience.

These solutions have yielded measurable noise level reductions and created inviting, vibrant urban spaces. Resident feedback highlights improved perceived sound quality and greater appreciation of outdoor environments.

Immersive Soundscape Design for Urban Playgrounds – Djungellekan Jungle Playground

Presented by: Manne Friman and Eric Hildestål, Soniqa Acoustic Consultancy

Implemented in the framework of the project:

Year: N/A

More info:

https://efterklang.org/projects/djungellekan-playground-helsingborg/

DESCRIPTION:

The City of Helsingborg envisioned **transforming its old harbor and industrial zone**, Oceanhamnen, into a vibrant, sustainable district emphasizing greenery and play. Central to this vision was the creation of Djungellekan, a unique jungle-themed playground inaugurated in 2022, inspired by the imaginative voices of the city's youngest residents.

Located next to busy ferry boarding lanes and adjacent traffic, the **playground posed significant acoustic challenges.** To create an inviting and immersive sound environment, the design team developed a multi-faceted acoustic strategy. A noise barrier shaped like historic shipping containers was installed to mitigate traffic noise while honoring the area's maritime heritage.

Soundscape design played a pivotal role: employing a sophisticated 12-channel speaker system, the playground simulates a dynamic jungle environment with sounds emanating from multiple directions and scales, replicating the natural variability of a jungle soundscape. Interactive installations, such as animal fact recordings accessible by placing an ear against a giraffe sculpture and a button-activated gorilla sound feature, engage children's curiosity and enhance play experiences.

This innovative blend of noise control and creative sound design **transformed a noisy urban setting into a green oasis** filled with rich auditory adventures, significantly enhancing the quality of the playground experience.

Djungellekan is the first playground of its kind in Sweden, widely praised for its pioneering approach to sound design in urban play environments. The project has garnered multiple prestigious awards, including the **Ljudmiljöpriset 2022**, **Landmärket 2022**, **Red Dot Design Award 2024 (Best of the Best)**, and three categories at the **International Sound Awards 2024**—Soundscapes & Ambient Sound, Universal Design, and Social & Culture.

Beyond aesthetic and acoustic innovation, the playground serves as a model for integrating soundscape design with urban noise mitigation, fostering sensory-rich, inclusive spaces that contribute to children's wellbeing and community engagement.

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Noise Governance, Perception Management and Enforcement Technologies

Presented by: Manne Friman, Soniqa Acoustic Consultancy	
Implemented in the framework of the project:	
Year: N/A	
More info:	

Road
→ Lower noise limits for motor vehicles
→ More vehicles are electric
→ Increased use of low noise asphalt
→ More noise barriers on major roads
→ Quiet tires
→ Lowered speed limits on some major roads

Rail
→ Increase in urban rail infrastructure
→ Silent brake policies
→ Maintenance and rail grinding
→ Increase in electrification
→ Increase in speed and high-speed lines

Aircraft
→ Quieter aircrafts
→ Improved landing/take off procedures
→ Night curfews

DESCRIPTION:

Effective noise management requires attention not only to physical noise reduction but also to the **perception of sound**. Strategies include creating "quiet sides" for dwellings, ensuring access to quiet gardens, and designing neighborhoods to minimize visual and auditory intrusion from busy roads.

Besides governance innovations should be emphasized, such as:

- **Environmental zoning** to regulate noise-producing activities.
- Campaigns promoting **quiet tires and electric vehicles** to reduce traffic noise.
- **Night-time bans on heavy vehicles** to reduce disturbance during sensitive hours.
- Deployment of **noise monitoring cameras**, akin to speed cameras, enabling enforcement against noise offenders.

These measures address behavioural and regulatory dimensions of noise, recognizing that community acceptance and compliance are vital for lasting improvements.

Combining technical controls with governance and perception strategies has enhanced Helsingborg's noise management, reducing annoyance and fostering greater community satisfaction.

Highly applicable in urban contexts seeking comprehensive noise control. This holistic approach needs integrated policies and investment in enforcement technologies alongside urban design.

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4

Conclusions

4. Conclusions

The Green Innovation Camp on noise, held in Helsingborg within the framework of the LIFE GreenMe5 project, highlighted the complexity of urban noise as an environmental, health, and urban planning challenge for European cities. Throughout the different sessions and best practice presentations, several common key elements emerged.

Effective noise management requires an interdisciplinary and integrated approach, combining technical expertise, urban design, regulatory measures, governance frameworks, and community perception management. The experiences shared demonstrated how addressing noise pollution goes beyond purely technical solutions, emphasizing the importance of including noise considerations early in urban planning processes to optimize both physical noise reduction and perceived sound quality.

Moreover, the exchange of knowledge between cities underscored the value of combining data-driven strategies with participatory processes, ensuring that both authorities and citizens are actively involved in defining and implementing solutions. The role of innovative monitoring technologies, such as advanced noise mapping tools, real-time monitoring systems, and enforcement technologies like noise cameras, also proved essential for enhancing transparency, compliance, and policy effectiveness.

Finally, the examples presented during the camp showcased the growing trend towards multifunctional and creative interventions that integrate noise mitigation with broader urban objectives, including public space enhancement, biodiversity, sustainable mobility, and social cohesion. The outcomes of this Green Innovation Camp offer valuable insights for cities striving to build healthier, more liveable, and resilient urban environments in line with the Green City Accord objectives.