Sustainable rebuilding of Ukrainian cities

Good practices from cities across Europe

About this publication

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About Eurocities: Eurocities represents the voice of more than 200 cities in 38 countries and over 130 million inhabitants, working together towards a good quality of life for people. Through joint work, knowledge-sharing and coordinated Europe-wide activity, the network ensures that cities and their people are heard in Europe (www.eurocities.eu).

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Introduction

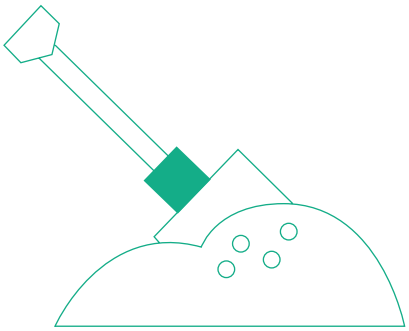
This publication is the result of a Eurocities-led pilot project that united 11 Ukrainian and 34 EU/EEA cities in a one-year-long initiative to assist cities in Ukraine to plan for a sustainable and inclusive reconstruction. Born from a strong display of subnational solidarity following Russia's full-scale invasion and existing twinning partnerships between Ukrainian and other European cities, the initiative mobilised peer learning and capacity building between cities, matching urban expertise with local needs in Ukraine. Running through 2023, participating cities came together in a series of online workshops and practical exercises to further a vision of sustainable urban development and identify relevant practices, tools, and methodologies to assist Ukrainian cities in their reconstruction planning.

Consolidating these insights, this toolkit publication serves as a guide for sustainable urban reconstruction, aligned with EU standards and principles, and emphasising a mid to long-term recovery perspective. It follows the approach of 'building back better', inspired by the objectives and policies of the European Green Deal, the values of the New European Bauhaus, and the guiding principles of the Ukraine Facility, gathering solutions that promote a decentralised, sustainable and climate-resilient reconstruction. Available in both English and Ukrainian languages, it presents Ukrainian cities with a range of practices that can inspire the development of comprehensive recovery and development strategies, rally funding opportunities, and further develop partnerships between cities and other stakeholders.

The publication is structured along five main entry points critical for sustainable rebuilding: integrated urban planning, clean energy and energy efficiency, disaster risk reduction and resilience building, circularity, and sustainable urban mobility. Each chapter collects key practices, tools, and methodologies in the respective areas, organised across several crucial enablers such as good governance, innovation and technology, digitalisation, incentives, and funding.

Part 1

Integrated **urban planning** for a **sustainable recovery**



- Framework and basic guidelines for sustainable urban development planning
- Good governance and organisational aspects
- Spatial management and land-use integration
- Data and digitalisation
- Incentives and funding

Integrated urban planning serves as the lifeblood for rebuilding and shaping sustainable cities, providing the necessary framework for addressing various urban challenges. At its core, governance serves as the backbone upon which sustainable policies and initiatives are built, guiding the planning process. This collaborative effort involves strategic decision-making, active stakeholder engagement, and the integration of diverse perspectives.

Moreover, sustainable urban planning acts as a catalyst for implementing a wide range of policies, including those related to energy transition, mobility, and circular economy, as well as guiding future strategic investment decisions.

By integrating sustainability principles into the planning process, cities can mitigate environmental impacts, enhance resilience to climate change, promote social inclusion, and foster sustainable economic development.

Framework and basic guidelines for sustainable urban development planning

The Sustainable Development Goals (SDGs) and the New Urban Agenda (NUA) are foundational pillars for the development of comprehensive urban planning frameworks. The SDGs, adopted by United Nations member states in 2015, provide a universal framework for global development, with Goal 11 specifically focusing on making cities and other human settlements inclusive, safe, resilient, and sustainable. This goal underscores the critical role of urban areas in achieving broader sustainable development objectives. It calls for improved urban planning for and with people, ensured access to basic services, affordable housing, sustainable transportation, and environmental protection.

The NUA, endorsed during the Habitat III conference in 2016, is a global action-oriented roadmap that emphasises the importance of well-planned and managed urbanisation. It provides a strategic framework for addressing various urban challenges, including housing, infrastructure, social inclusion, and environmental sustainability. The NUA highlights the need for inclusive, resilient, and sustainable cities and outlines key principles for urban development, such as integrated planning, participatory governance, and the promotion of safe and accessible public spaces. By aligning with the NUA, urban development planning can prioritise the creation of liveable and prosperous cities that benefit all residents, while minimising the negative impacts of rapid urbanisation.

The New Leipzig Charter 2020 – The transformative power of cities for the common good is a key policy framework document for sustainable urban development in Europe adopted at the Informal Ministerial Meeting on Urban Matters organised in November 2020 under the German Presidency of the Council of the EU. The Charter formulates five key principles of good urban governance, three concrete dimensions of action for urban development policy, and three spatial levels of urban policy.

Five key principles of good urban governance:

- common good orientation;
- integrated approach;
- participation and co-creation;
- multi-level governance;
- place-based approach.

Three dimensions for urban transformation:

- green city;
- just city;
- productive city.

The shaping of the digital transformation and land policy are also named as concrete fields of action.

Three spatial levels of urban policy:

- neighbourhood;
- city as a whole;
- functional (metropolitan) area.

The New Leipzig Charter 2020 emphasises the special role of multi-level governance for implementation of sustainable urban development and **encourages the local and regional authorities** to leverage their expertise and collaborate with relevant networks to assess EU legislation including for knowledge sharing and capacity building while fostering cooperation with diverse stakeholders to advance the EU's Urban Agenda objectives.

Useful tools for implementing the SDGs at local level

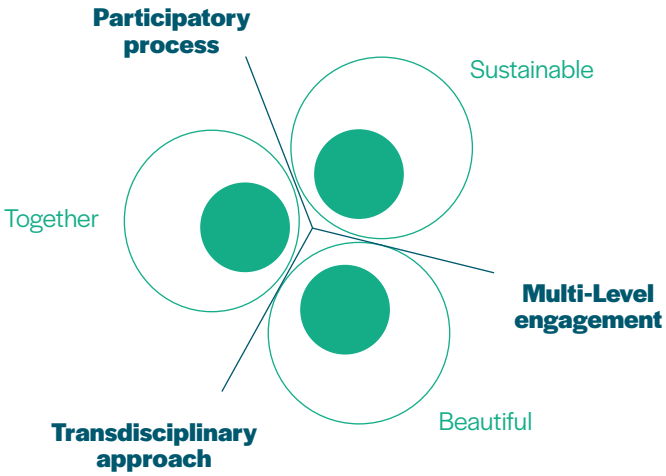
UN Global Guiding Elements for Voluntary Local Reviews (VLRs) provide a starting point and basic guidance for local and regional governments considering producing their local reviews.

UN-Habitat toolbox: from data analysis to citizen engagement when monitoring the SDGs (2022) has been created to support local governments that are interested in monitoring and reporting on the implementation of SDGs using VLRs, while contributing to local democracy. The toolbox is based on a detailed analysis of four Swedish municipalities that published their VLRs in 2021.

European Handbook for SDG Voluntary Local Reviews (2022) includes detailed and updated information on 72 indicators and related data sources, to assist cities in measuring their progress towards the 2030 Agenda for Sustainable Development. The set of indicators includes examples of both official and experimental indicators, coming from international and European institutions, but also regional and local governments and research institutes.

New European Bauhaus (NEB) is a creative and transdisciplinary movement connecting the European Green Deal to tangible projects based on three dimensions: sustainability (including circularity), quality of experience (including aesthetics), and inclusion (including affordability). The initiative has implemented a capacity building programme with Ukrainian partners in 2022/23. Ukrainian cities have been encouraged to participate in NEB initiatives, providing them access to resources and support for sustainable, inclusive, and aesthetically appealing projects. Additionally, the NEB Compass, a valuable tool within the New European Bauhaus framework, is integrated into the Ukrainian Digital Restoration EcoSystem for Accountable Management (DREAM) platform that monitors the country's reconstruction efforts. Its presence on the DREAM platform enhances its accessibility to Ukrainian municipalities and stakeholders involved in reconstruction and urban development efforts, offering practical guidance and evaluation support for sustainable and culturally enriched urban projects in Ukraine.

NEB Compass
Based on the EU infographics



Good governance and organisational aspects

Good practices related to urban development are often marked by a strategic approach to planning, where local priorities are identified and a shared vision for the city's future is constructed. It is crucial that this vision is based on the articulation between technical inputs from experts and inclusive and participatory processes, therefore legitimising the solutions proposed in the strategic plan. Connecting the strategic vision of a city with its other planning instruments, such as master plans, is central to ensure that the right tools are used in the right direction.

Urban planning documentation and its hierarchy from strategies to investment plans, from master- to neighbourhood detailed plans are the main carriers of knowledge enabling quality municipal management while ensuring prerequisites for transparent and accountable governance. The documentation is called upon to put everybody on the same page and make communication between all stakeholders result-oriented and smooth.

Since 2015, the international response to climate change, notably spearheaded by the Paris Agreement, has been a driving force in urging cities worldwide to revise and update their local development strategies and masterplans. This global commitment emphasises the need for cities to align their urban planning with the SDGs. Such alignment involves the re-evaluation of existing plans and the transformation of municipal organisational structures to encompass environmental aspects in all spheres of urban life. Furthermore, adherence to these global standards has become increasingly important for the attraction of investment and cities' positioning in the international arena.

Munich's urban development strategy stands as an example of good governance in city planning due to its comprehensive and forward-thinking approach. The city's overarching plan, known as STEP 2040, is a blueprint for a people-oriented, sustainable future. The fully digitalised plan integrates urban development aspects like open space design, mobility, settlement development, and climate change adaptation and mitigation solutions. Additionally, it articulates the local and regional challenges, developing constructive cooperation beyond the city's administrative borders. Integral to this comprehensive strategy is an investment plan that ensures funding is allocated appropriately, complementing and reinforcing the objectives outlined in STEP 2040.

Resources for Ukrainian cities

EU Academy Introduction to Capacity Building for Reconstruction (2023, in record).

TU Delft Tools for Post Conflict Recovery (2023, in record).

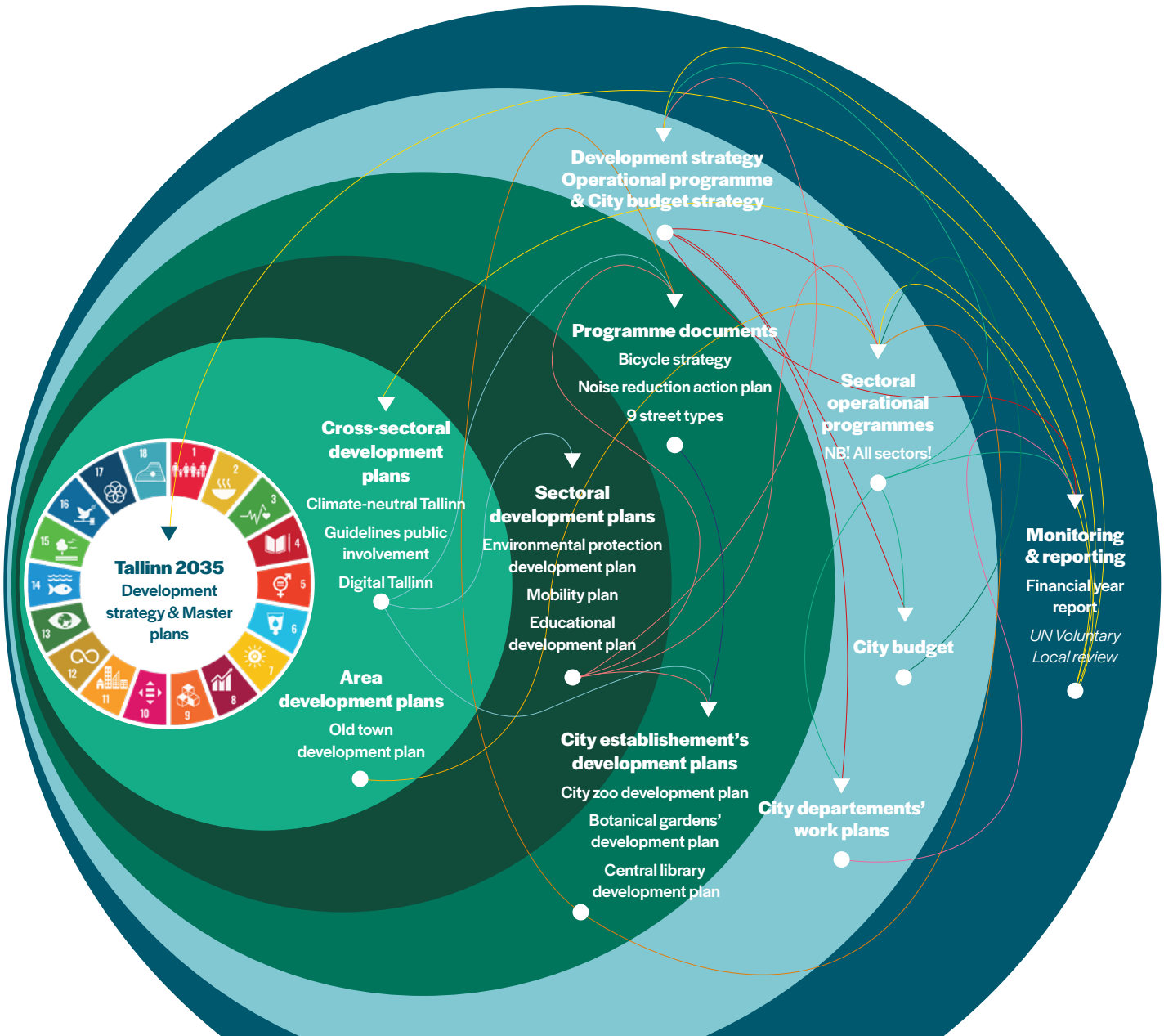
STEP 2040 includes six maps visualising the main fields of action:

1. Green and connected open spaces;
2. Efficient, reliable and climate-neutral mobility;
3. Strong residential districts and sustainable city development;
4. Climate-adapted landscape and settlement areas showing heat islands and groundwater nearby the surface to be considered for future projects;
5. Climate-neutral neighbourhoods and renewable energy;
6. Developing the city region in a spirit of partnership.

Awarded European Green Capital for 2023, **Tallinn** exemplifies an urban governance model that aligns strategic, spatial, and financial planning for balanced, future-oriented growth. The city's development strategy spans 15 years, with strategic goals typically reviewed and amended every 8-10 years, particularly after local government elections. The strategy aligns with district master plans, with adjustments made when necessary to ensure coherence. Implemented through a 4-5-year operational programme and budget strategy employing performance-based budgeting, the strategy encompasses cross-sectoral documents addressing innovative solutions, sustainable energy, climate adaptation, circular economy, and accessibility, adapting to evolving priorities. Area development plans further delineate strategy goals for defined city areas.

The URBACT programme is a EU initiative aimed at promoting sustainable urban development across cities in Europe. It targets local authorities, policymakers, practitioners, and other stakeholders involved in urban planning and development. URBACT networks bring together cities from different EU member states to exchange knowledge, share best practices, and collaborate on addressing common urban challenges. Starting in 2024, cities from Ukraine and Moldova will be able to apply, participate in URBACT events, and join URBACT networks.

System of Development Planning Documents in Tallinn
Based on the infographics of the city of Tallinn



While the urban planning documentation is the main carrier of local development knowledge, **good urban governance** determines common wellbeing orientation of this knowledge and its deployment. Front-running cities committed to reduce their environmental impacts, accelerate climate change adaptation and mitigation practices and develop urban resilience, conduct awareness raising campaigns and other events to engage people in co-creation of a living habitat. The core function of good urban governance is **quality coordination** that aims to understand all stakeholders' needs, concerns and challenges and then through knowledge transfer and evidence-based decisions to co-pave the way towards new daily habits and mindsets. While science conceptualises such activities in the helix innovation model, cities have been bringing this model to life in urban laboratories that became a wide-spread tool and space for multi-stakeholder participation and multidisciplinary experimentation for sustainable urban development planning.

Based on a quintuple helix model, **Guimaraes** 2030 Governance Ecosystem is an initiative that sought to bring together the public sector, universities, non-profit associations, citizens and media actors for shaping sustainable development projects in a local context. The premise under this governance arrangement is that citizens are the main actors in urban transformation, empowering a citizen–nature nexus that will remain a legacy for future generations.

The Landscape Laboratory established by the City Hall together with two local universities is a research centre that uses the context of Guimaraes to test innovative solutions, on areas such as nature and biodiversity, circular economy and urban development. It is also the municipal educational centre for environment education, being responsible for the municipal programme PEGADAS, that has the objective of educating young people towards sustainable behaviours and it is responsible for mobilising, engaging and raising awareness among residents on the importance of preserving local natural capital.

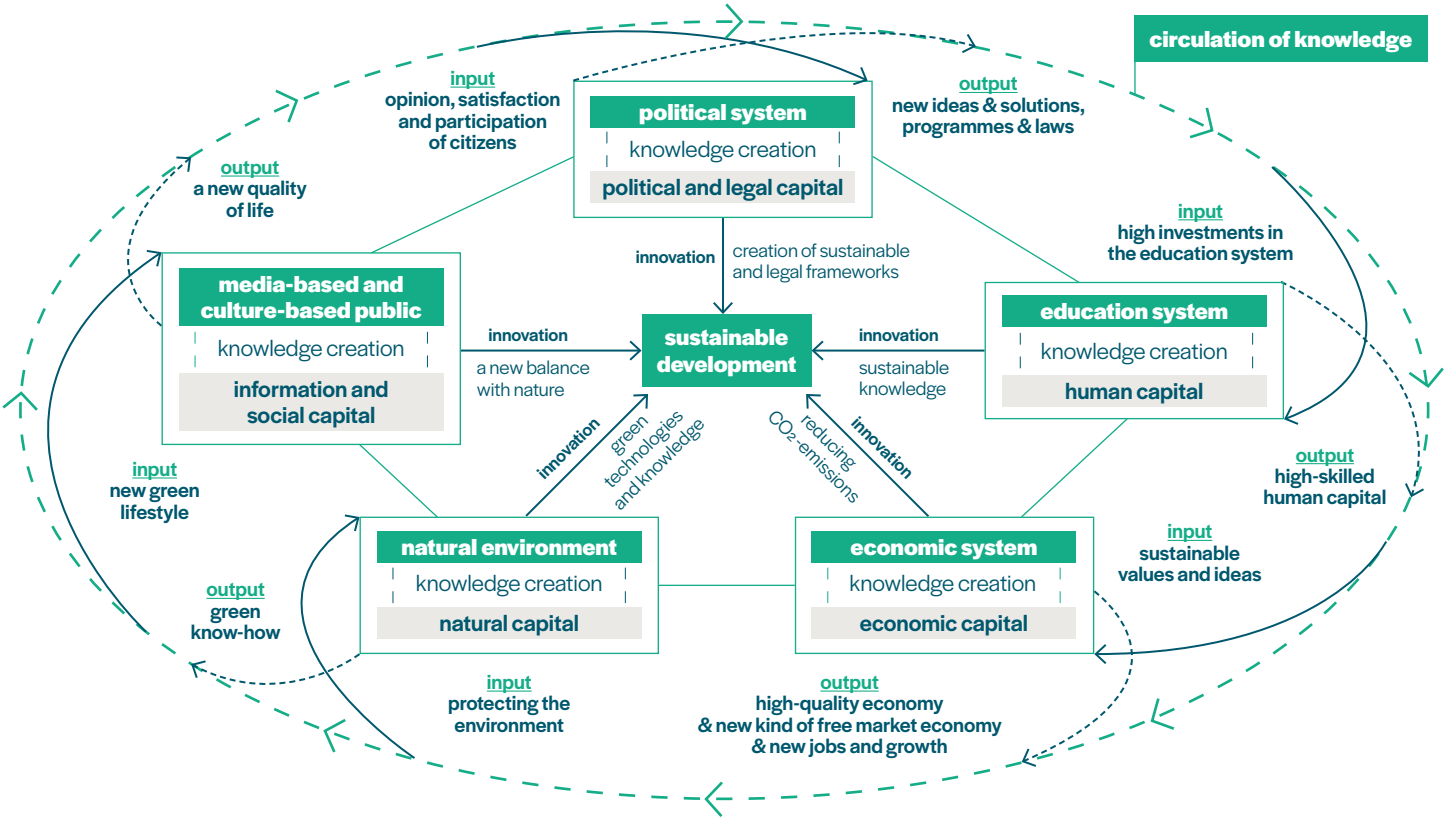
The study of the Guimaraes 2030 Governance Ecosystem outlines a three-step methodology for other cities aiming to adopt a five-helix model of governance:

1. Political commitment: sustainable urban development requires strong long-term commitment and a whole-of-society approach. Frameworks like the Paris Agreement and the New Urban Agenda can serve as a basis for advancing the transformation towards a sustainable city.

2. Diagnosis and baseline: conduct a comprehensive city sustainability diagnosis, covering environmental, social, and economic aspects. Define the territorial context, key indicators areas (such as the seven environmental indicators of the European Green Capital), and gather quantitative data from the last 5-10 years, considering historical, geographical, and socioeconomic factors.

3. Integration and participation:
- stimulate community involvement and educational efforts;
- explore the technical and scientific basis of the urban challenges;
-cultivate a sense of ownership among citizens and lay a robust foundation for their active participation in the city's sustainable development. If a baseline for each indicator area is already available, move to the next level of integration to allow for a full-fledged study of the main challenges. This step requires the formation of dedicated teams to work on these challenges, incorporating expertise in technology, science, education, and communication.

Effects of Investment in Education on Sustainable Development in Quintiple Helix
Based on the infographics of Elias G.Carayannis



Kosice mobile urban lab
Photo credit: the city of Kosice

Leveraging its achievement as the 2013 European Capital of Culture, Kosice launched the Kosice 2.0 project, aimed at revamping its cultural and civic landscape. This initiative was designed to address several challenges, such as talent retaining and transitioning from an industrial-focused city to one driven by digital and creative industries, boosting civic engagement, and enhancing public trust. A central element of this transformation was the establishment of the Citizens Experience and Well-Being Institute, which aims at empowering Kosice's innovation ecosystem.

Key components of Kosice 2.0 include realisation of the following initiatives:

1. Urban Innovation Sphere: offering innovation programmes to startups, NGOs, professionals, and residents.
2. Bravo-Hub: a co-working facility supporting startups.
3. Open Data Kosice: collecting and sharing city data online.
4. Mobile Urban Lab: collecting data and sparking public debates.
5. Public art installations: visualising urban data.
6. Educational programmes: targeting municipal employees, graduate students, and residents.
7. Design sprint workshops: collaboratively addressing urban challenges.

The project aimed to address identified challenges, promote innovation in the public sector, and engage stakeholders. Over a decade, Kosice transitioned from an industrial city with uncertain prospects to a vibrant hub for culture and technology, fostering spatial development and public sector innovation.

This innovation-driven approach can serve as a model for cities seeking to revitalise their cultural and creative ecosystems while embracing digital transformation.

Spatial management and land-use integration

Spatial management and land-use integration are crucial aspects of urban planning, emphasising the need for a holistic approach to urban development. In the modern urban landscape, the sufficiency of green and blue infrastructure plays a pivotal role in enhancing the quality of life for city residents. Green infrastructure, such as parks, forests, and urban green spaces, contributes to improved air quality, biodiversity, and recreational opportunities. Simultaneously, blue infrastructure, including rivers, lakes, and water bodies, supports water management, provides aesthetic value, and enhances ecological resilience. The proximity of basic services, such as healthcare, education, and transportation, is essential for creating liveable and sustainable urban environments.

Moreover, urban planning transcending administrative borders is imperative as cities are interconnected ecosystems that extend beyond municipal boundaries. Metropolitan area development and collaboration between neighbouring municipalities and regions is necessary to address shared challenges, promote efficient resource allocation, and develop integrated solutions for urban growth and sustainability. This comprehensive approach to spatial management and land-use integration fosters resilient, inclusive, and thriving cities that prioritise the wellbeing of their city-users while preserving the natural environment and cultural heritage.

Empowering the metropolitan area – the example of Riga

The Riga Planning Region (RPR) is a territory expanding from Riga across much of central Latvia. In 2020, RPR concluded an Action Plan for the Development of the Riga Metropolitan Area, aiming at achieving coherent development of the territory. It uses an integrated approach to reconcile the interests of the state, Riga City, surrounding municipalities and residents of the Riga Metropolitan Area. Furthermore, the plan serves as a foundational document for negotiations and dialogue between levels of government. It provides the main framework for EU Cohesion Policy funding and investment initiatives (2021-2027) in the Riga Metropolitan Area.

Key elements for Riga metropolitan development include building the understanding of the Riga Functional Space, developing a platform to convene municipalities and other stakeholders, analysing and modelling development scenarios based on data and digital technologies, and the provision of resources to municipal authorities in the context of projects and investments.

The Organisation for Economic Co-operation and Development (OECD), in collaboration with the European Commission, has developed an interactive web tool showing all urban centres and metropolitan areas in the world with at least 50,000 inhabitants. Data is represented at two scales: urban centres and functional urban areas (FUAs). FUAs approximate the boundaries of the whole metropolitan area around urban centres.

Eurostat Regions and Cities Illustrated - this interactive tool contains data on European regions, cities and other territorial typologies, grouped into different statistical domains. Using the interactive map, individual territories can quickly be selected while different visualisation options allow comparison and analysis in a user-friendly way.

Key steps for metropolitan development
Based on the infographics of the city of Riga

Set boundaries
Common understanding of definition of Metropolitan Area

Connect municipalities
Developing a platform to facilitate collaboration and connection between municipalities

Collect data and identify needs
Determine what requirements are necessary in order to fulfill the desired outcome

Provide resources
Ensuring access to resources to help cities to succeed

On December 1, 2023 Lviv oblast military administration approved strategy of Lviv agglomeration development, that is first of its kind in Ukraine.

Utrecht Barcode – healthy city standard

Being the fastest growing city in the Netherlands, **Utrecht** faces such challenges as the lack of affordable housing, public transport and traffic jams created not only by cars but also by bikes. To tackle these challenges, urban planning specialists of Utrecht city developed the Barcode – the 1-pager infographic guideline for better use of limited space for new residential district construction. For example, each 10,000 houses require a lot of different amenities: five schools, one high school, cultural spaces, healthcare, green, blue infrastructure, energy, etc.

The Barcode embodies the principles of proximity and mixed-use areas represented by the 10-minute walk/cycle city concept. This concept lies in the core of Utrecht Spatial Strategy 2040, aimed at polycentric city development preserving Utrecht's character while responding to the issues of quick growth inside territorial borders and climate change consequences. The Utrecht Spatial Strategy 2040 seeks to give solutions to uncertainties in five prioritised areas:

- How to ensure more greenery?
- How to ensure sufficient affordable housing for all Utrecht residents?
- How to provide more jobs and facilities for everyone?
- How to ensure good and sufficient public transport and sufficient space for cyclists and pedestrians?
- How to ensure that the city is ready for a different climate?

The ongoing refinement of Utrecht Barcode highlights the importance of optimising limited land use. This shift from quantity to quality involves reassessing land use functions, increasing density, enhancing environmental standards, and promoting multifunctional spaces. Additionally, it includes improving urban organisation and extending planning beyond city borders for regional sustainable development. The aim of the updated Intelligent Barcode is to efficiently manage resources, ensuring sustainable growth.

Revitalisation – bringing nature back to city

The development of the Utrecht Spatial Strategy 2040 commenced by re-evaluating and prioritising green and blue infrastructure as the cornerstone of urban planning. A notable project emerging from this new approach is the revitalisation of the Singel – an old canal and its banks, which were previously covered during the highway construction in the 1970s. In 2002 Utrecht municipality asked residents if they wanted the canal back. In 2015 construction began to revive the final part of the canal.

Bringing the canal back meant placing a huge, complicated construction site in the heart of the city, right next to the country's busiest train station. It also meant a new way of thinking in urban development with a focus on greenery and people, instead of roads and cars. After years of demolishing, breaking, digging and building, the canal was finally finished in 2020.

The project has boosted biodiversity, particularly for bees and butterflies and residents maintain the park themselves. Restoring the ecosystem helps compensate for the negative effects of climate change, for example with trees that help keep pedestrians cool in the summer. New paths were built with a buffer of lava rock, which improves water drainage after it rains. The revitalised canal and new greenery became the point of attraction for leisure of youth and elderly.

The Single canal before and after revitalisation
Photo credit: the city of Utrecht

Before


After

Necessary use of space for 10,000 liveable houses - Derived from 'Utrecht barcode' standard
Based on the infographics of the city of Utrecht

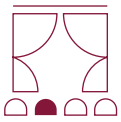
3.5 ha
Education

2000 m² child-care
5 primary schools
0.7 secondary schools

1.2 ha
Healthcare

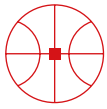
3 health centres
1 neighbourhood ambulance team location
10 community centre/day care centre
1500 m² other such provision

0.5 ha
Culture



4.2 cultural infrastructure on neighbourhood level
0.25 cultural infrastructure on city level

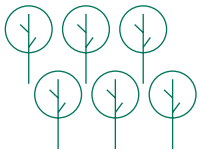
12 ha
Sports and games



70 000 m² sports park
10 000 m² sport in public
2.2 playground
1.3 sports hall
0.2 swimming pool

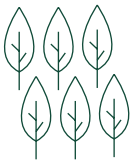
50 ha
Neighbourhood green

25 ha
Urban greenery



2.5 the main park in Utrecht (Wilhelmina Park)

42 ha
Green around the city

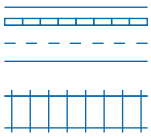


0.8 forest Amelisweerd & Rhijnauwen

5-10 ha
Water

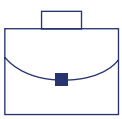
3.5 the main canal in Utrecht (Oude Gracht)

XX ha*
Mobility infrastructure

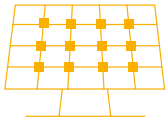


*Measure depends on spatial context and transport modes and cannot be easily standardised.

28 ha
Employment opportunities



max
49 ha
Energy



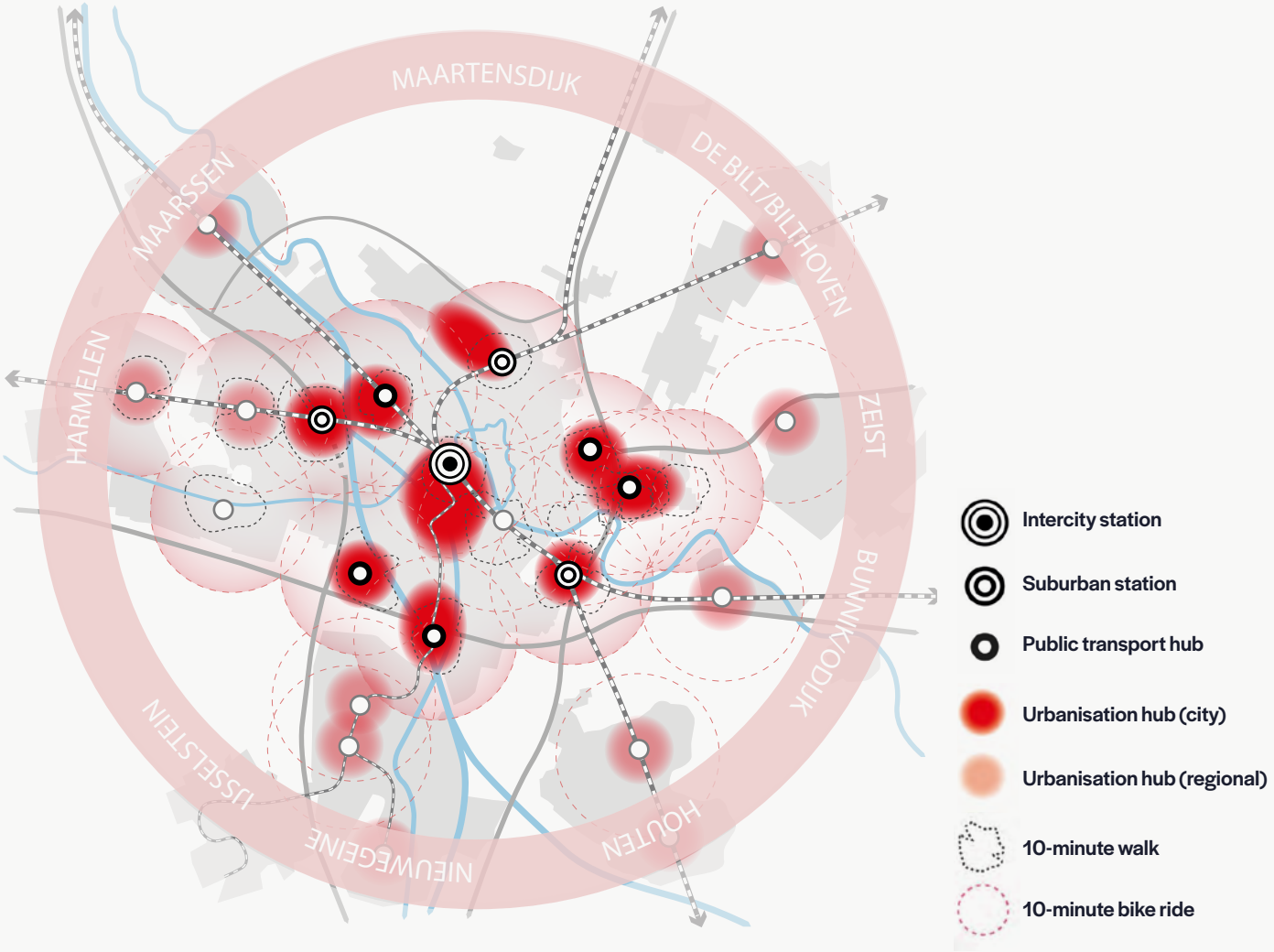
4.5 windmills
solar panels area equaling **72** soccer pitches

Polycentricity – urbanisation hubs for compact sustainable growth

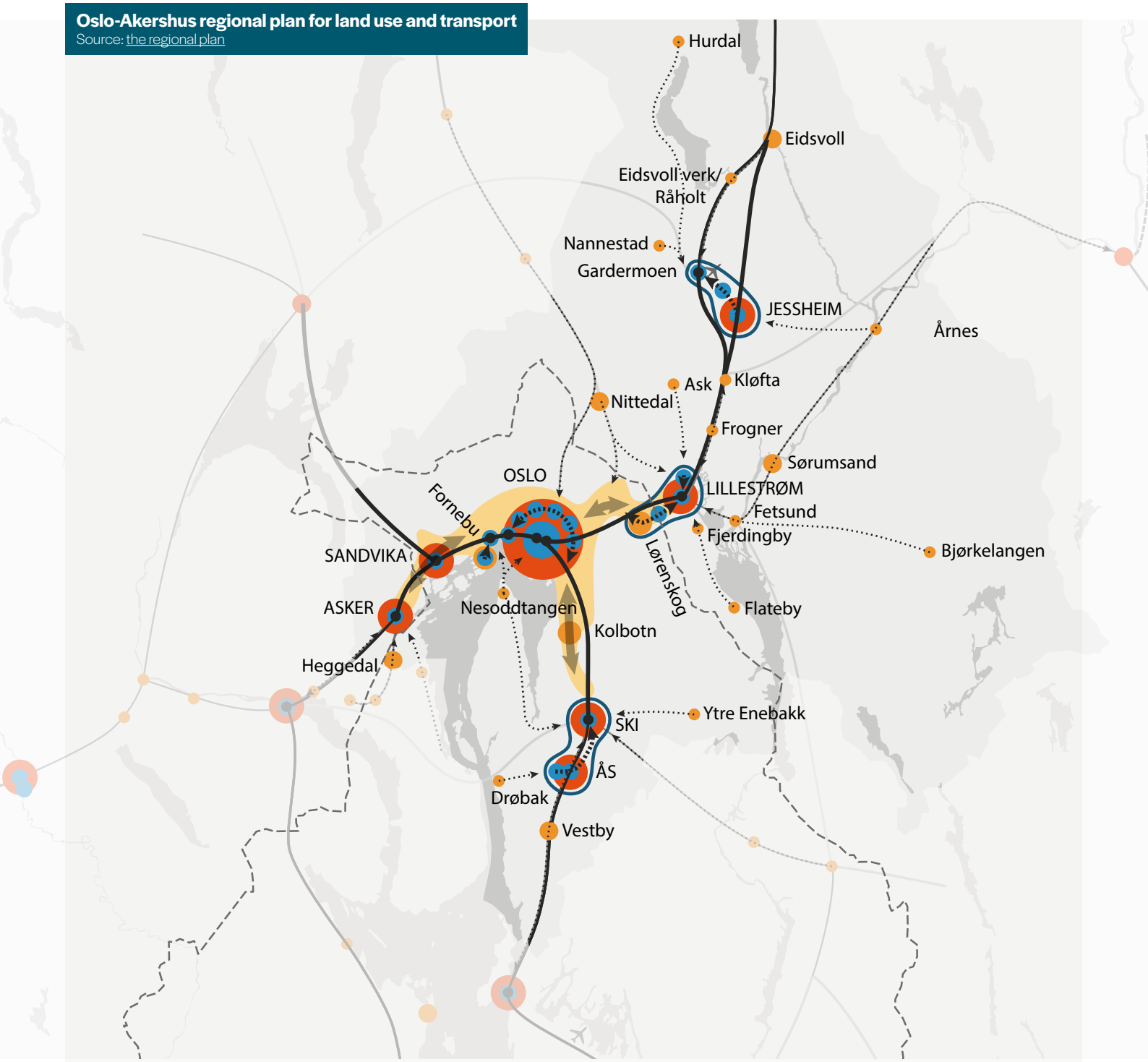
Sustainable urban development is not only a goal, but also a continuous process dependent on well-scrutinised and locally tailored approaches. Sustainable transformation induces change without dramatic interventions into city-users' daily routines. For this, **Utrecht** prioritises polycentric 10-minute city development around urban and regional hubs. A hub is a place where multiple roads and public transport connections intersect, as well as a place where more homes, amenities, offices and healthcare centres have been built. The plans for Utrecht urbanisation hubs lean on three pillars: high-rise buildings, high-density construction, and car-free spaces. Such a polycentric plan allows Utrecht to work in a fixed order. The city starts development of those hubs and once it's completed, they will build in other locations in the city and outskirts. At the same time, Utrecht's approach preserves and strengthens the landscape framework prioritising green and blue infrastructure as main factors of a healthy and high-quality city.

Public transport nodes have been at the core of urban and regional development in **Oslo** city and metropolitan area, enabling compact growth and thus preserving the Norwegian farmland and forests. This approach includes the development of housing, commercial, and public spaces in proximity to public transport facilities, thereby reducing car traffic growth and promoting more sustainable commuting patterns. The rationale of polycentric development is embodied in Oslo city and Akershus county land use and transport regional plan. Oslo metropolitan management goes back to the 1990s when the city's first agreement with neighbouring county council (Akershus) was concluded. This partnership established what is still the major financial mechanism, a 'toll-ring', meaning that every car driving into Oslo has to pay €5. The toll-ring brings the region €300 million every year to spend in line with the political choices. By mutual agreement, 60 % of all the toll-revenues are spent in Oslo, and 40 % in Akershus. The transport priorities are also closely aligned with the prioritised settlements for future growth. This has contributed to the fact that all transport growth is on public transport and not on the roads, despite a growin population and economy.

Utrecht urban nodes
Source: the city of Utrecht



Oslo-Akershus regional plan for land use and transport
Source: the regional plan



Priority growth areas:

- Oslo city
- Sub-regional hubs
- Sub-regional areas for workplace-intensive businesses
- Special focus areas for intensive urban and business development
- Morphological urban area
- Priority towns. The size indicates that some settlements are given higher priority

Principles for further development of public transport system:

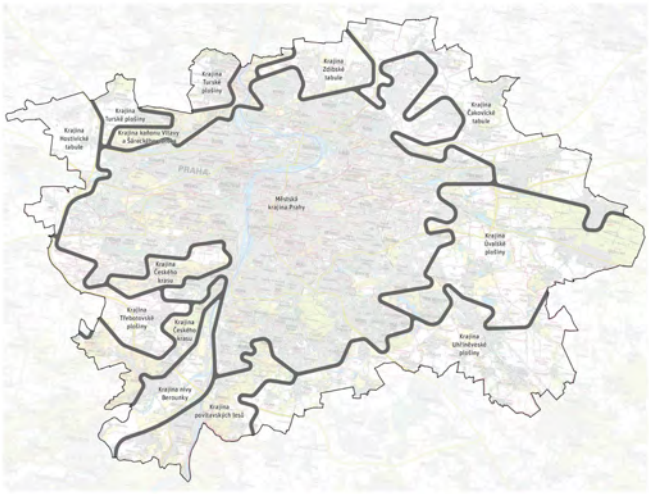
- Connecting Oslo and other regional towns
- Regional public transport hubs
- Link regional cities and workplace concentrations to regional public transport hubs
- Link priority towns to sub-regional hubs
- Public transport network in the city belt which offers many travel opportunities
- Airports
- Transport infrastructure
  - railway (existing and planned) and road
  - road only
- Planning area

Character-based units vs administrative divisions

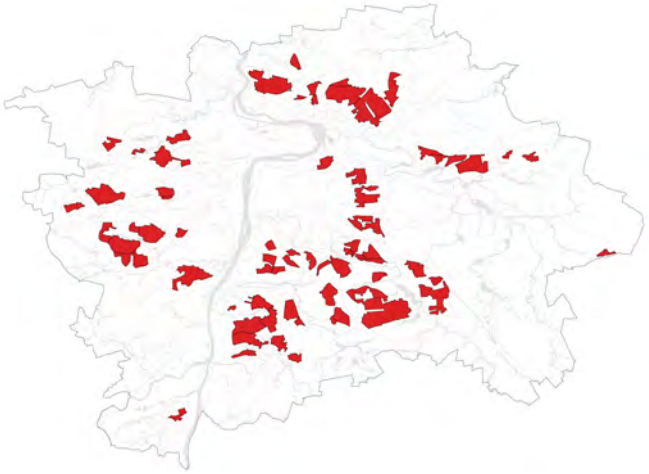
In response to the challenges of administrative fragmentation and slow, rigid governance hindering strategic decision-making in Czechia's cities, the **Prague** Institute of Planning and Development has developed innovative spatial management concepts and methods. These new approaches are tailored to the unique characteristics of territorial units and shared values of their inhabitants. A key aspect of this strategy is the integration of the European Landscape Convention's implementation guidelines, applying them to land-use decisions across municipal and regional borders, including the assessment of the metropolitan region area. On a regional scale, these units are identified as 'landscapes', while at the municipal level, they are referred to as 'localities'. In Prague alone, there are over 700 such localities, all of which are integral to the city's new land use plan, the Metropolitan Plan.

The principles and guidelines of the European Landscape Convention are also applicable to Ukraine.

Individual Landscape on Prague regional level
Source: IPR Prague



Individual Locality on Prague municipal level
Source: Metropolitan plan, IPR Prague



Data and digitalisation

Data and digitalisation are crucial for sustainable urban development, offering an unprecedented ability to gather, analyse, and use vast amounts of information to drive informed and thus feasible policy decisions. Digitalisation breaks down administrative silos by facilitating integrated, cross-sectoral approaches, enabling more cohesive and efficient governance for urban planning and development. Additionally, it empowers cities to accelerate implementation of climate-friendly strategies, optimise resource allocation, and engage communities more effectively, paving the way for a more sustainable and resilient urban future.

Tallinn's efficiency is determined not only by relatively innovative funding approaches (see page 8) but also by a full-range of digital solutions, resource saving and people-friendly public services. Tallinn is almost 100% paperless with about 60 information systems and a total of 130 e-services from 568 different public services provided by the city.

The Tallinn Strategic Management Office is currently developing a digital twin of Tallinn, a 3D digital model of the city that includes municipal data and processes. The main objectives and features of the digital twin of Tallinn are centred around enhancing urban planning, sustainability, and comprehensive data integration:

Enhancing urban planning and sustainability: the GreenTwins initiative focuses on developing a green model for the digital twin cities of Tallinn and Helsinki. This project emphasises the analysis of physical space models and digitising geographic information to optimise urban planning processes with a strong focus on environmental sustainability.

Revolutionising the construction sector: Estonia, including Tallinn, is pioneering the use of digital twins to revolutionise its construction sector. The aim is to create a digital twin for the entire country, which would be a groundbreaking step in digitising the construction industry. This would allow for more efficient and effective planning, development, and maintenance of urban infrastructure.

Comprehensive data exchange and simulation: the digital twin of Tallinn is designed to enable comprehensive data exchange and include models, simulations, and algorithms.

According to Tallinn Strategic Management Office's Enterprise Services 'Facts about Tallinn 2023' 150 kilometres of city streets have been mapped out as part of mobile data collection work and the goal is to map out all of Tallinn, which is approximately 1,200 kilometres of streets. The main goal of the digital twin of Tallinn is to make collection and management of the city's data more logical and to offer residents and service providers innovative digital solutions. In addition, the new technological solutions are meant to make Tallinn an attractive destination for both tourists and start-ups.

The fast-developing Slovakian city of **Kosice** created an urban research unit – the Citizens Experience and Well-Being Institute (CXI) – which plays a vital role by gathering urban data, analysing it, and disseminating the findings to the broader community through publications and articles. Additionally, it actively supports the local startup ecosystem to increase their competitiveness while providing practical solutions for the city's pressing issues. Moreover, the CXI offers valuable recommendations to the municipality, enabling evidence-based policy design and enhancing the overall performance and services provided by the city (see page 10).

Incentives and funding

There is no fit-for-all cities solution to make development sustainable in the short or even medium-term. Thus, incentives and funding play a pivotal role for municipalities to pave their unique way towards future-proof urbanisation. Awards and recognition programmes serve as powerful motivators, encouraging urban authorities to innovate and excel in sustainable practices. By recognising and celebrating the achievements of cities committed to sustainable urban development, these awards inspire other municipalities to follow suit and act as role models. Moreover, they promote healthy competition among cities, driving them to continuously improve their urban environments, reduce carbon emissions, enhance the quality of life for residents, and contribute to the overall wellbeing of communities. These accolades not only bring prestige but often come with financial benefits, enhancing a city's ability to invest in further sustainable initiatives. On the other hand, grants and co-financing, such as those provided by the EU programmes Horizon Europe and LIFE are essential for supporting innovative ideas and experiments in urban areas.

The designation of **Kosice** as the European Capital of Culture in 2013 significantly impacted the city's development, particularly in transforming its cultural and urban landscape. This prestigious title acted as a catalyst, shifting Kosice from its Soviet industrial heritage to become a modern, creative city in the 21st century. For Kosice, the award brought increased visibility and tourism, along with a renewed sense of self-confidence and ambition. The city capitalised on this momentum to further enhance residents' wellbeing and cultural engagement, as seen in the Kosice 2.0 project.

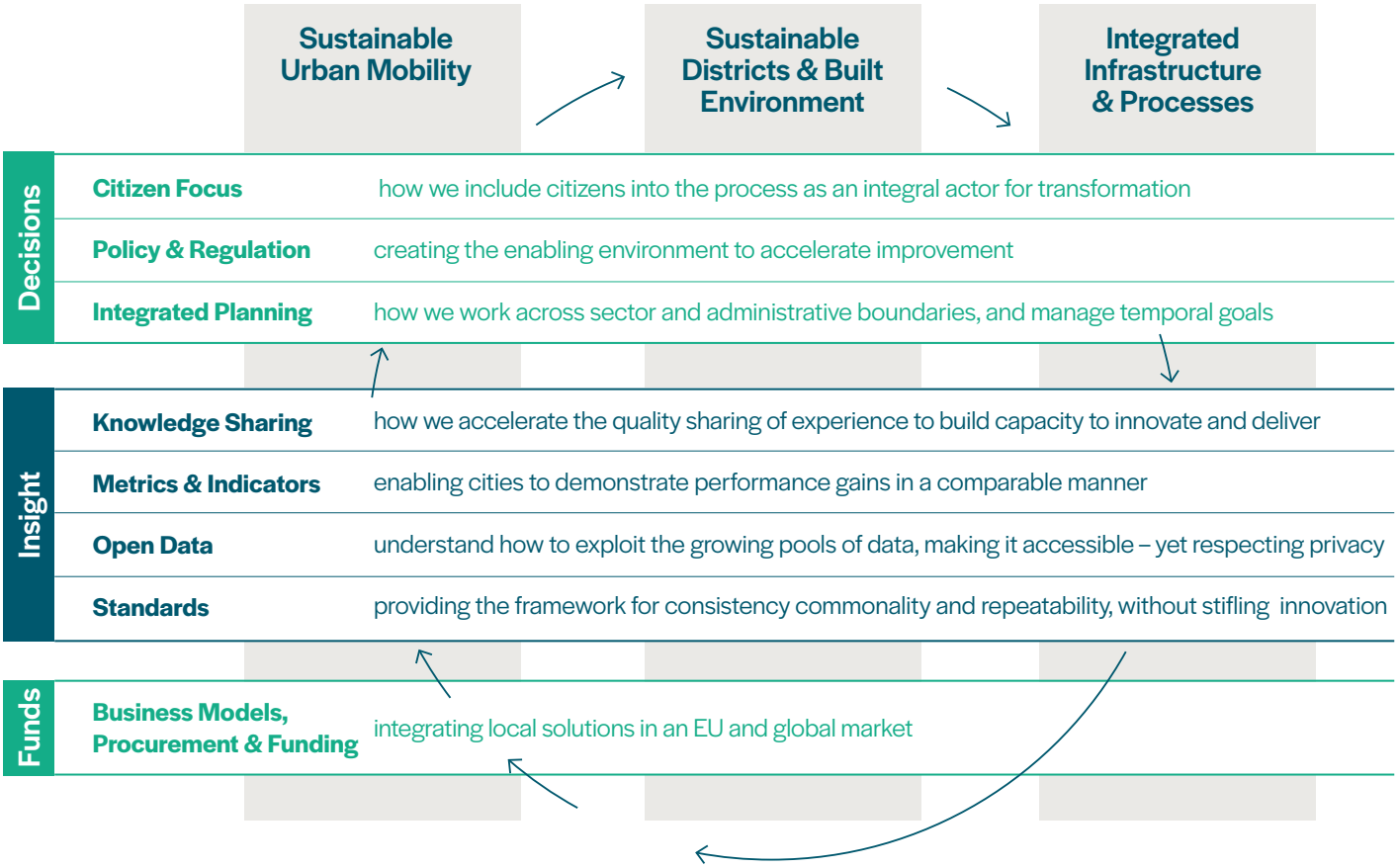
In December 2023, the European Commission set up three programmes to boost research and innovation in Ukraine:

- **New Horizon Europe Office in Kyiv based in the National Research Foundation of Ukraine;**
- **New European Innovation Council (EIC) action to support the Ukrainian deep tech community;**
- **New European Institute of Innovation and Technology (EIT) Community Hub.**

Approximately €70 million were invested in enhancing the city's cultural infrastructure, including the creation of new cultural spaces and organisations that are still active and offer cultural events today. A study conducted by the Technical University of Kosice found that the European Capital of Culture initiative had an impact coefficient of 1.65. This indicates that for every euro spent, the city's economy gained €1.65 in return.

In the case of **Munich**, the city employed an innovative 'fight against silos' working methodology during its participation in the EU Horizon 2020 funded programme, Smarter Together (2016 – 2021). This approach emphasised strong coordination and integration across traditionally separate areas of urban management. Munich's lighthouse initiative under this programme aimed at creating a new Freiham or retrofitting existing Neuaubing-Westkreuz urban districts, focused on merging technological innovation, citizen engagement, and energy efficiency.

Munich's model of cross-cutting enablers to integrate three main sectors of Smarter Together districts development
Based on the infographics of the city of Munich



In **Guimaraes**, a turning point towards sustainable development occurred in 2014. The newly elected mayor initiated this shift by requesting the University of Minho to conduct a comprehensive environmental diagnosis of the city. This assessment was based on 12 indicators aligned with the European Green Capital guidelines, covering a wide range of aspects such as climate change (adaptation and mitigation), waste management, nature and biodiversity, green areas, sustainable mobility, sustainable use of soil, water management, air quality, acoustic environment, eco-innovation and green growth, energy performance, and governance. This approach marked a decisive step in embedding sustainable development values into the city's urban planning practices. Finally, pursuit of the award led to formulation of Guimaraes 2030 Governance Ecosystem and of the Landscape Laboratory making Guimaraes a frontrunning city in achieving SDGs (see page 9).

Ongoing opportunities including for Ukrainian cities:

Find calls for LIFE and HORIZON proposals at Single Electronic Data Interchange Area (SEDIA).

LIFE Telegram Group of the Ministry of Environment of Ukraine (in Ukrainian only).

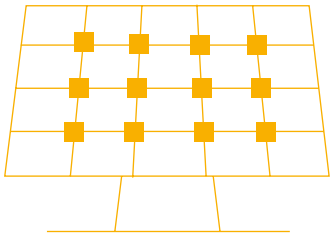
The European Territorial Cooperation Interreg Europe programme features cross-border and transnational programmes for selected regions of Ukraine.

URBACT capacity building programme.

Part 2

Clean energy and energy efficiency

- Good governance and organisational aspects
- Innovation and technology
- Data and digitalisation
- Incentives and funding



The energy sector is a major contributor to climate change, accounting for over two-thirds of global greenhouse gas emissions from fossil fuel combustion used for electricity, heat production, and transportation. These emissions are a major driver of global warming, leading to rising temperatures, changing precipitation patterns, and more frequent and severe weather events. The reliance on coal, oil, and natural gas not only exacerbates climate change but also degrades air quality, worsening health and reducing quality of life.

Energy is central to the European Green Deal and the European Union's (EU's) long-term strategy of achieving carbon neutrality by 2050, focusing on three key principles: ensuring a secure and affordable energy supply, developing an integrated and digitalised energy market, and prioritising energy efficiency while transitioning to renewable sources. Energy security, decarbonisation, and the deeper integration of Ukraine's energy infrastructure into the EU's are set to be crucial factors in Ukraine's journey towards EU accession and its alignment with the Paris Agreement on climate change. For example, Ukrainian energy infrastructure projects linked with other EU member states are already eligible to receive EU support in the field of energy and transport under the Connecting Europe Facility.

As the main engines of economic growth and population concentration, cities are responsible for more than 75% of energy consumption. As hubs where various challenges converge, cities play a crucial role in addressing the energy transition from a climate, economic, and social perspective. Mitigation in cities often focuses on reducing greenhouse gas emissions by integrating renewable energy sources like solar, wind, geothermal, and bioenergy into their energy profiles, improving energy efficiency in buildings and municipal infrastructure, and enhancing public transportation networks to reduce reliance on personal vehicles. Meanwhile, adaptation strategies aim to prepare cities for the impacts of climate change already underway. These include making infrastructure resilient to extreme weather, promoting decentralised place-based energy production and distribution, and public engagement to raise awareness and drive behaviour change.

Despite two years of full-scale Russian war against Ukraine, the country continues important energy sector reforms, including gradually phasing out fossil fuels and stimulating decentralised production from renewable sources. In line with the Law of Ukraine 'On Energy Efficiency', all municipalities must adopt local energy plans within three years of it coming into force in 2021. This provides Ukrainian cities with a key opportunity to accelerate the provision of decentralised and clean energy, and integrate these considerations into wider recovery planning at the local level, aligning with the prioritisation methodology for recovery projects developed by the Ukrainian Ministry of Restoration.

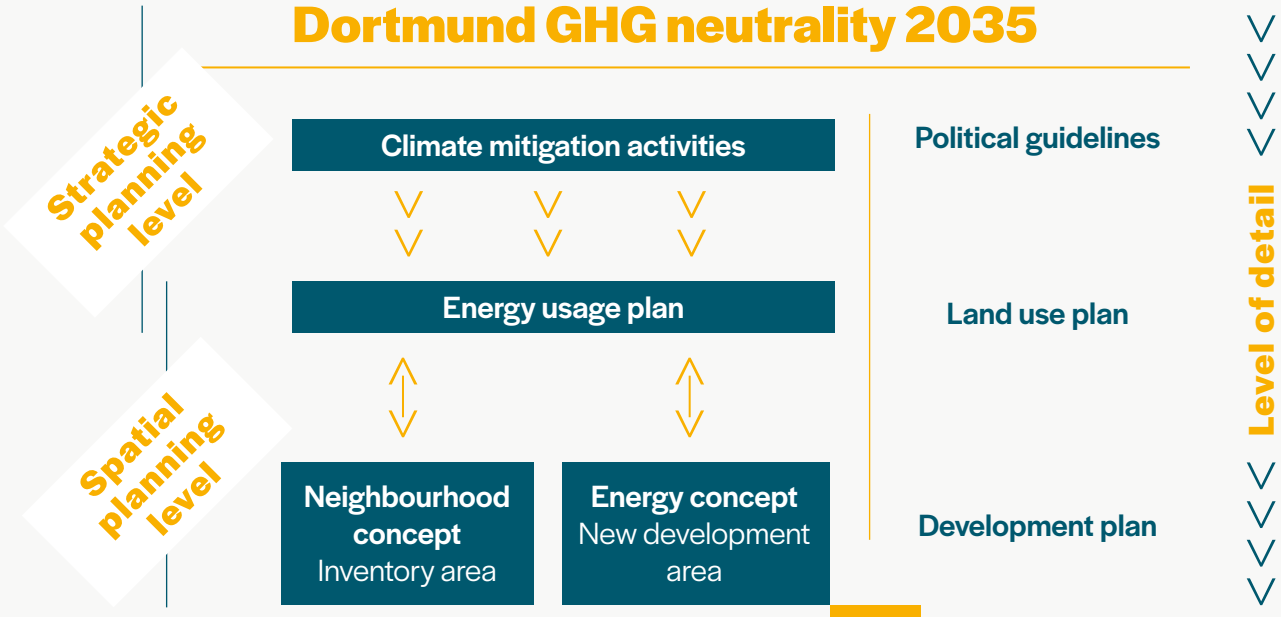
Good governance and organisational aspects

Recognising the interconnectedness between various urban sectors such as transportation, infrastructure, and housing, integrated energy planning can help cities to address interactions between these sectors, identifying synergies and optimising energy efficiency and sustainability. Tools such as Sustainable Energy and Climate Action Plans (SECAPs) provide a structured framework for local governments to integrate these elements into their energy planning efforts, enabling better coordination and resource allocation, and fostering community engagement in the clean energy transition.

Spatial energy planning

The city of **Dortmund** aligns its energy and land use plans with the overarching strategy to become greenhouse gas (GHG) neutral by 2035. The energy usage plan covers Dortmund's approach to redesigning the energy distribution in the city with specific actions translated into the spatial planning level. Thus, the energy concerns are explicitly taken into account in the land use policy and with more detail in the development plan, whether for existing or new urban spaces.

Urban development planning in Dortmund
Based on the infographics of the city of Dortmund



Identifying strengths and weaknesses

Over two decades ago, **Florence** embarked on a sustainability journey, aiming to enhance urban life and contribute to EU environmental goals. A comprehensive strategy outlined in its SECAP aims to improve the city's emissions profile while preserving Florence's unique landscape, historical heritage, and architecture which attracts over 10 million tourists a year. This energy and climate strategy guides city planning, including land use, digitalisation, mobility, waste and water management services, and post-pandemic recovery.

To ensure a holistic perspective in assessing the current situation and potential of the planned projects, Florence applies a well-known project management tool – **SWOT analysis.** Identifying strengths (S) and weaknesses (W) helps map internal factors of a territory or organisation, such as existing energy infrastructure, technological capabilities, and financial resources. Understanding these strengths and weaknesses aids in determining what resources are available and what areas need improvement for sustainable energy development. The analysis is also crucial for identifying external factors impacting energy and climate plans. Opportunities (O) might include potential funding sources, technological advancements, and supportive regulatory environments. Threats (T) could be anything from economic instability and environmental changes to political challenges. Recognising these helps in preparing robust plans that can adapt to changing circumstances. SWOT analysis is a simple yet powerful method to set realistic goals and devise strategies that leverage strengths, mitigate weaknesses, capitalise on opportunities, and guard against threats.

SWOT analysis of Florence's net zero target
Based on the infographics of the city of Florence

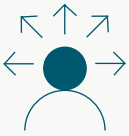
STRENGTHS

- Strong political commitment (vision)
- Working group formally created in 2010 (SEAP-SCP)
- Citizens' and stakeholders' long-lasting participation
- Wide experience in integrated planning
- Monitoring system (Key Performance Indicators)
- Cooperation with distribution system operator, service companies and third enterprises (SILFI, Publiacqua, ALIA, CASA spa, Toscana energia, e-distribuzione...)

WEAKNESSES

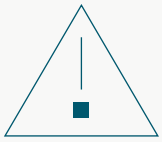
- Historical and landscape constraints
- Significant and variable impact of commuters and tourists
- Data collection

OPPORTUNITIES



- RECOVERY PLAN
- National incentives (110%)
- New EU targets (Green Deal) and new initiatives (Green cities accord, Climate neutral cities, Doughnut economics...)
- Plans under revision/update
- Metropolitan city extension/coordination as a multiplier
- Involvement in networks (regional, national, international)
- Innovation and new tools test (Replicate, CoME EAsy...)

RISKS



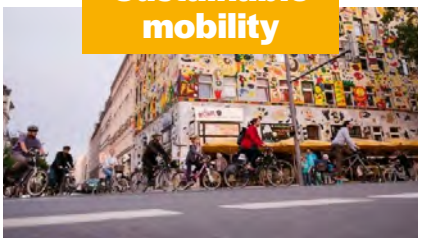
- Impacts of the pandemic/crisis
- Administrative tier and timing
- Private sector inertia

Turning targets into implementation

Guided by its Energy and Climate Protection Programme 2030 (ECPP), the city of **Leipzig** is on the way to becoming a climate-neutral city by 2040. Measures to reach 2030 milestones are focused on three key domains: mobility, heat, and electricity. The programme outlines 60 actions in seven fields, including sustainable transport transition, climate-friendly neighbourhood development, sustainable nutrition, agriculture, and climate and sustainability education. Increasing the share of renewable energy in public transport, district heating expansion, and energy renovation are further objectives of the energy and climate protection programme. The ECPP 2030 is further developed through an implementation plan every two years. The 2023/2024 implementation programme focuses on the transport transition, including localising the German nationwide initiative to introduce a 30 km/h limit on Leipzig's streets and expanding public transport and the bicycle network.

Priorities of action with selected measures of the Energy and Climate Protection Programme 2030 of the city of Leipzig
Based on the infographics of the city of Leipzig

Sustainable mobility



Mobility strategy 2030

- Expansion & promotion of **climate-friendly transport** as base for a **sustainable mobility change**
- Extension of districts with speed limit 30 km/h and biking-streets
- Concept of **'Leipzig as city for intelligent mobility'** with alternative driving technologies
- More public space for **pedestrians and cyclists** in public plannings
- **Modal split target 2030**
- 70 % environmental transport (actual 63 %)

~ - 400 000 t CO_2/a

Supply & disposal

Expansion of renewable energy

- **Municipal heat planning**
- RE-expansion with at least 400 MW by 2030 and supplementary storage capacities (power & heat)
- **Expansion of district heating**
- With establishment of virtual power plants for demand-responsive energy supply
- Promotion of private & commercial energy efficiency and renovation measures
- **Zero Waste Strategy**

~ - 455 000 t CO_2/a

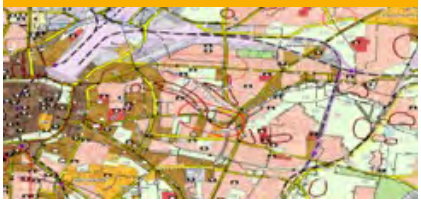
Public buildings & facilities

Schools & Kitas 2030

- **Sustainable building**
- with increased use of sustainable materials (recycling & grey energy)
- **Climate-neutral administration**
- Sustainable & innovative public procurement with better life-cycles for IT and municipal buildings
- **Energy-efficient refurbishment and usage**
- Automated consumption recording and evaluation with awareness-raising
- Energy-efficient refurbishment and energy saving lights with user-training (energy, water, waste)

~ - 25 000 t CO_2/a

Integrated planning & construction concepts



Land-use planning 2040

- **Integrated update of planning and climate protection guidelines** towards climate-neutrality
- **Identification of land-use potentials** in co-operation with the region for RE-expansion (400 MW PV & Windpower)
- **Consideration of energy and climate criteria** in urban development and planning processes
- **Climate-friendly mobility and low-traffic concept**s for new urban quarters

~ - 200 000 t CO_2/a

Communication & cooperation

Active public relations

- **Campaigns for climate-friendly action** and transparent monitoring (via climate reports)
- **Promotion of energy-efficient and ecological building standards** and energy consulting for private households
- **Roof-top register** for solar energy and green-roof potentials
- **GHG-footprint** of Leipzig`s inhabitants with awareness raising

N.N. t CO_2

Nutrition & agriculture

Regional value-chains

- **Strengthening sustainable value-chains** with the surrounding region
- **Procurement of sustainable food for canteens** and reorientation of preparation in catering facilities and municipal events
- **Reduction of food losses and waste avoidance** through the expansion of deposit and cooperative logistics

N.N. t CO_2

Cross-city collaboration

Multi-departmental and cross-sector involvement was crucial to Arezzo's SECAP development and implementation. The energy team, overseen by a strategic interventions councillor and managed by a director of environment, climate, and civil protection, comprises specialists from nine municipal departments: environment, climate and civil protection; strategic infrastructure and maintenance; territorial governance; mobility; public works design; sports, youth and third sector; the single centre procurement office; welfare, education and citizen services; and the governance, innovation and European policies service.

In 2021, **Dortmund** City Council set up a climate advisory board consisting of specialists from the science and economic departments as well as citizens. The board advises on municipal activities related to climate protection and adaptation. It also acts as a catalyst for implementing and accelerating climate protection programmes such as HP 2030 and MiKaDo and recommends further actions to achieve climate goals.

Workshop with Climate advisory board of Dortmund
Photo credit: S.Franke

Enabling renewable energy uptake

The development of locally produced renewable energy can simultaneously contribute to energy security, climate, and social inclusion goals. Energy communities – collective entities formed by individuals, households or local authorities – play a vital role in promoting the uptake of renewable, locally produced energy, such as solar, by fostering community ownership and engagement. At EU level, energy communities are recognised within the legal framework of the Clean Energy Package and directives like the Renewable Energy Directive (RED II) and the Electricity Market Directive, which provide guidelines and incentives for the establishment and operation of energy communities.

The Housing Cooperative Wroclaw South manages the **Wroclaw** Solar Power Plant, Poland's largest distributed photovoltaic installation. Operational since 2017, this community-led project features 2,771 solar panels on the roofs of 35 multi-storeyed residential buildings in the city centre. The Wroclaw South energy community produces 750 MWh, covering 100% of its electricity needs while reducing CO_2 emissions by 614 tonnes annually. Wroclaw continues to build up the prosumers' potential through the Horizon Europe 2020 Lightness Project.

In Ukraine, the only renewable energy community is Solar Town in **Slavutych**. Initiated in 2018 by a local activist, the cooperative installed photovoltaic systems on three rooftops rented by the municipality. The cost of the 200 kW project, including the design, equipment, construction works, and marketing, was €175,513. According to estimations, the project cut CO_2 emissions in Slavutych by 54 - 362 tonnes during its first year of operation.

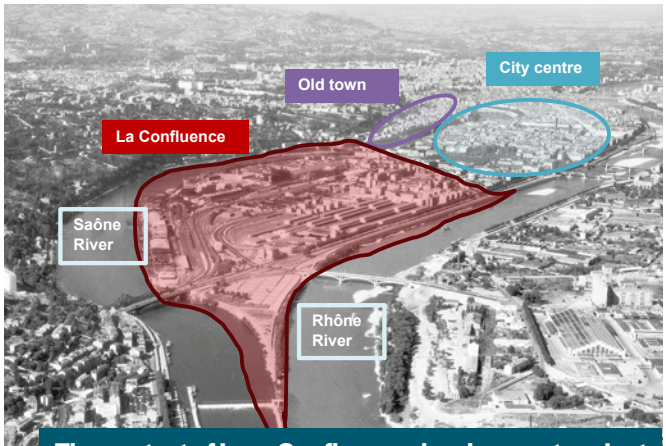
Mitigating financial risk

As part of the plan to double the size of **Lyon**'s city centre and connect new and historical neighbourhoods, the local authorities launched an initiative to revitalise a 150-hectare former industrial site located at the confluence of the Saône and Rhône rivers. This aligns with the overarching goal of becoming a carbon-neutral community by 2035.

A special purpose vehicle (SPV) dedicated to the project, SPL Lyon Confluence, was set up, with the shares owned by the Greater Lyon metropolis (98.25 %) and the City of Lyon (1.75%) authorities.

An SPV is a subsidiary created by a parent entity to fulfil a specific goal or temporary project and to isolate financial risk. Its legal status as a separate company makes the parent company safe even in bankruptcy. SPVs are often used for managing specific assets or investment absorptions, creating joint ventures or performing other financial transactions while protecting against financial failures.

Lyon's privately managed public company operates on the concession legal framework, which ensures that the decision-making is protected from politics while reflecting the public interest. Apart from the area development and management tasks, SPL Lyon Confluence serves as a key intermediary in fostering external partnerships for retrofitting the Confluence area into a Positive Energy District. SPL actively engages with stakeholders specialising in the railway, energy, river management, and pollution reduction industries, including with Japanese government and EU funds to drive the project's progress.



The context of Lyon Confluence development project
Photo credit: SPL Lyon Confluence, Baptiste Mougeot

Innovation and technology

Cities are leveraging a range of technological innovations towards clean energy production and energy efficiency through five main strands:

- **Building and infrastructure renovations;**
- **Environmentally friendly construction practices;**
- **Fossil fuel phase-out for heating-electrification and district heating;**
- **Local renewable energy production;**
- **Mobility sector emissions reduction.**

Reducing energy from lighting and buildings

Since 2020, the city of **Arezzo** has been improving the energy efficiency of public lighting by replacing traditional bulbs with LED lamps. The project, running until 2032 with a budget of around €5 million, is expected to result in 7.282 MWh/year of energy savings and 3,452 tonnes of CO_2/year of avoided emissions. Similarly, the city of **Florence** replaced old sodium and mercury vapour lighting fixtures in all public spaces with 30,000 LED lamps with high colour rendering. The renovation reduced electricity consumption and emissions by 40% and 3,000 tonnes of carbon dioxide equivalent per year respectively, while also cutting light pollution. The city also equipped the new system with Wi-Fi, traffic control sensors and video surveillance.

Four concrete measures are intended to set the course for more climate-friendly buildings in the city of **Dortmund**:

- 40% of flat and 30% of gable roofs of new buildings must be equipped with a photovoltaic system to generate electricity;
- all new residential and non-residential buildings must comply with efficiency standard 40 in accordance with German Federal Funding for Efficient Buildings guidelines;
- new building areas must always be connected to district heating. If no district heating is available nearby, the new neighbourhood will be supplied with its own local heating. Decentralised supply of individual buildings is only possible in exceptional cases;
- new quarters should be labelled under the state programme KlimaQuartier.NRW in recognition of the fact that climate protection goals can be achieved better at the district than at the building level. A KlimaQuartier.NRW is only allowed to emit around half of the greenhouse gas emissions generated by the 100 climate protection settlements – namely 5kg of CO_2 equivalents per square metre per year.

Recognising the importance of achieving energy self-sufficiency and aiming to phase out coal power production, the city of **Bydgoszcz** develops a local system of diversified renewable energy sources. Already in 2005, the first wastewater sludge-to-energy biogas plant was put into operation with the capacity to cogenerate 0.5 MW of heat and 2.5 GWh of electricity. As of 2023 the city deployed 66 solar panels on buildings, supplying 11 MW of electricity. In 2025, Bydgoszcz plans to inaugurate a new biogas plant designed to process up to 60,000 tonnes/year of municipal biowaste, separately collected in the communities within the Bydgoszcz metropolis association. This facility will have the capacity to cogenerate 4 MW of heat and 26 GWh of electricity, covering approximately 30% of the city's energy demand. Additionally, Bydgoszcz has designated 40 hectares of land, encompassing a closed landfill and post-industrial area, for the construction of 10 photovoltaic farms. These farms, with a combined capacity of 40 MW, will feature an energy storage facility and hydrogen production unit, aimed at supporting the city's public transportation system.

Sludge-to-energy biogas plant at the Bydgoszcz wastewater treatment plant
Photo credit: the city of Bydgoszcz

Presented by Solar Power Europe and city networks, the Solar Cities and Regions report outlines 21 key technical and regulatory solutions deployed in cities across Europe to increase the uptake of solar energy.

The city of **Wroclaw** is working to complement its 60.5 GWh system of photovoltaic installations with the largest thermal energy production from municipal sewage and rainwater in Poland. The project involves the construction of a 12.5 MW heat pump and corresponding networks powered by renewable sources. The energy obtained will cover 5% of the city's annual district heating demand while representing the first step in shifting from coal-burning infrastructure. The estimated emissions reduction totals 35,000 tonnes of CO_2, SO_2, NOx and dust annually.

Data and digitalisation

Baseline emission inventory and climate change risk and vulnerability assessment

Accurate and comprehensive data allows for the alignment of SECAP activities with the specific needs and capacities of a community. This ensures that the strategies adopted are not only effective but also tailored to the unique characteristics and challenges of a city. Baseline emission inventory (BEI) and climate change risk and vulnerability assessment (RVA) are the key components of SECAP. They can be carried out using data which local authorities usually have access to.

Within the baseline emission inventory, **Arezzo** collected and processed data from the building, lighting, and transport sectors. For example, the data on energy consumption was extracted from the bills or provided directly by electricity or gas providers, and the data on emissions was from the technical specifications of the vehicles, plants, and other equipment.

Urban sectors included in baseline emission inventory of the city of Arezzo
Based on the infographics of the city of Arezzo

MUNICIPAL BUILDINGS , EQUIPMENT/FACILITIES	All final energy consumption and related GHG emissions occurring in buildings and facilities public or owned by the local authority; e.g. government offices, schools, police stations, hospitals, etc.
TERTIARY BUILDINGS, EQUIPMENT/FACILITIES	All final energy consumption and related GHG emissions occurring in buildings and facilities of the tertiary sector (services); e.g. offices of private companies, banks, commercial and retail activities, private schools, hospitals, etc.
RESIDENTIAL BUILDINGS	All final energy consumption and related GHG emissions occurring in buildings that are primarily used as residential buildings for cooking, heating & cooling, lighting and appliances usage.
PUBLIC LIGHTING	Electricity usage in public lighting, owned or operated by the local authority (e.g. street lighting and traffic lights)
MUNICIPAL FLEET	All final energy consumption and related GHG emissions from fuel combustion and use of grid-supplied energy (e.g. electricity) for transportation occurring in urban street network under the competence of the local authority
PUBLIC TRANSPORT	All final energy consumption and related GHG emissions from fuel combustion and use of grid-supplied energy (e.g. electricity) for transportation occurring in the local transport (e.g. metro, tram and local trains)
PRIVATE AND COMMERCIAL TRANSPORT	All final energy consumption and related GHG emissions from fuel combustion and use of grid-supplied energy (e.g. electricity) occurring for transportation from long-distance trains, intercity trains, regional and cargo rail transportation

The data processing and interpretation outlined the priority areas for intervention in the city. As such, Arezzo implemented renewable energy projects, installing photovoltaic and thermal panels on public buildings, and reorganised the parking and limited traffic areas. The municipality established new cycle paths and bike-sharing within the city and started to develop electric mobility.

Moreover, baseline or 'as of now' data are crucial for monitoring and control activities to provide objective information on whether the project has been contributing to the SECAP target of 40% emissions reduction by 2030 compared to 2008. This management tool is essential to maximise the effectiveness of investments.

Dortmund uses an interactive Climate Barometer to share its climate plans and actions. The digital tool, built on the Climate OS platform, allows the city to simulate scenarios, monitor progress towards climate neutrality, and keep residents informed. As of January 2024, the Climate Barometer lists 124 climate measures from the city's Action Programme Climate-Air 2030, Mobility Masterplan 2030, and Germany's national climate goals.

Using data from 2018, including emissions from activities like driving and heating, and considering socio-economic factors, the tool calculates the impact of transitioning to lower-emissions options, like switching from petrol to electric cars. It also models how different actions interact and affect emissions reduction. Progress towards goals is tracked, allowing Dortmund to adjust strategies as needed.

The tool can be updated with new technologies and scientific findings, such as hydrogen or consumption-based emissions, to ensure it stays current. Additionally, periodic greenhouse gas balances provide an overview of the entire reduction pathway.

In 2020, **Bydgoszcz** took a significant step towards sustainable energy management by introducing an energy database. The database streamlined the management of 300 public buildings, gradually reducing their energy consumption and costs, which previously totalled €32 million annually.

By processing 40,000 energy, heat, and water invoices per year in a paperless manner, the work of 25 accounting department employees is now done by just one database manager.

The automation of tasks such as monitoring energy infrastructure, calculating CO_2 emissions, budget planning, and analysing energy consumption allowed Bydgoszcz to prioritise buildings for retrofitting. The city decreased heat consumption by 50% and electricity consumption by 40% over three years.

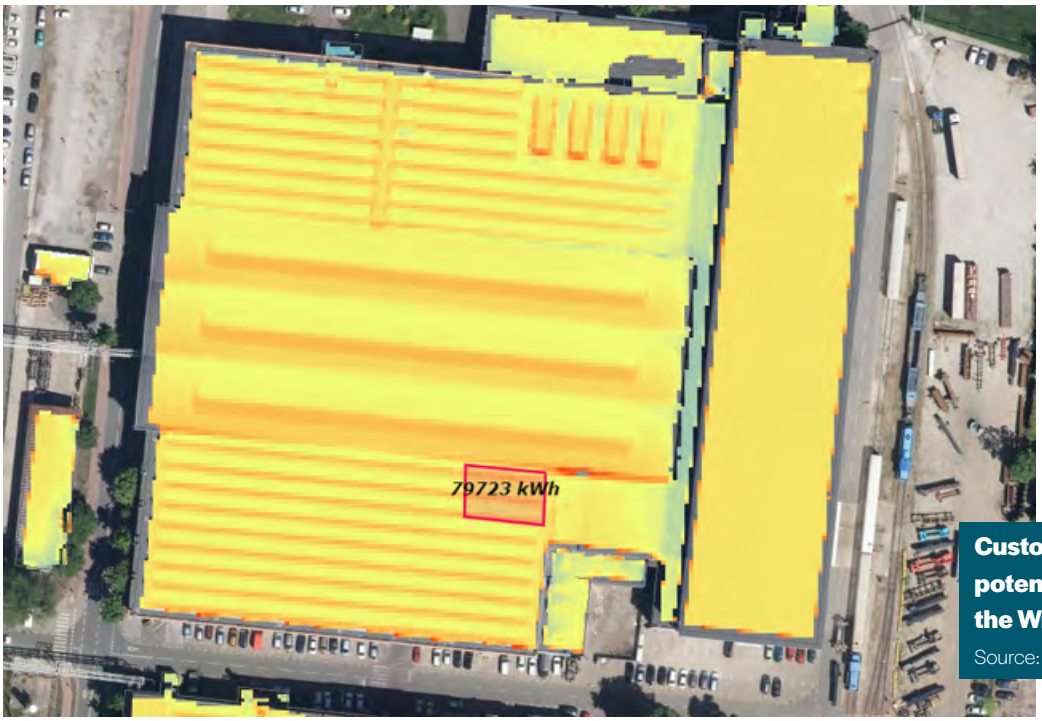
The system is being further developed to integrate data from 66 photovoltaic installations, with plans to increase to 110 by 2025. This provides updates for municipal managers on energy production and maintenance needs.

Wroclaw's solar potential map presents the amount of solar energy falling on the roofs of city buildings both annually and monthly. The data is broken down into solar radiation components:

- direct radiation (IDH),
- scattered radiation (ISH),
- total radiation, i.e. the sum of the above (ITH).

The map contains a tool that simulates a drawn area's solar potential but it doesn't take into account limitations resulting from photovoltaic technology, such as the efficiency of devices or the feasibility of installing them on a building.

The model used in Wroclaw is inspired by and essentially identical to the Solar Area Radiation model included in the ArcGIS software. This model was developed and adapted to local needs by the Wrocław Spatial Information System team.



Customised area for solar potential calculation on the Wroclaw online map
Source: the city of Wroclaw

IRENA SolarCity is a web-based simulator application helps cities, households, and businesses evaluate their prospects for generating electricity using rooftop-mounted solar photovoltaic (PV) systems.

Incentives and funding

The successful implementation of SECAPs requires sufficient financial resources. When considering the costs of envisioned actions, local authorities should also take into account their co-benefits. These regard not only health, quality of life, employment, and local attractiveness, but also economic aspects such as the return on investment. Apart from traditional forms of funding like budgetary subsidies, bank loans, grants, and equity allocation, cities are increasingly using innovative financing options. Conversely, local authorities are empowered to produce their own initiatives and financial incentives to promote and encourage local climate protection and adaptation practices.

New opportunity for Ukrainian cities

The European City Facility (EUCF) aims to support municipalities and local authorities in developing investment concepts related to the implementation of actions identified in their climate and energy action plans.

Alongside budget subsidies, there are many options for funding sustainable energy and climate actions. By focusing on empowering local authorities, the Horizon Europe 2020 PROSPECT+ capacity-building programme provides training on non-traditional ways to raise funds for green energy and climate investments. Generally, such innovative financing schemes imply either mixing different sources (own funds, public and private funds) or engaging various partners (e.g. citizens, private sector). Examples include:

- Citizen finance - crowdfunding and cooperatives;
- Energy performance contracting (ESCO);
- Internal contracting (intracting);
- Green bonds - local governments, or their agencies, can issue green bonds to fund their sustainable energy and climate actions;
- Guarantee funds - loan guarantees provided to lenders which serve as buffers against first losses of non-payment by the borrowers;
- Soft loans - loans below market rates and with longer payback periods derived from public funding to facilitate investments;
- Revolving funds - established to finance a continuing cycle of investments through initial amounts received from shareholders;
- Third party financing - debt financing where project financing comes from a third party, e.g. ESCO, which is not a user or customer.

PROSPECT+ replicable practices enable cities and regions to find inspiration and choose the proper funding mechanism for implementing clean energy and energy-efficient initiatives in public and private buildings, transport, public lighting, and cross-sectoral activities such as public engagement. The practices also provide a toolbox for decision-making on appropriate financing schemes.

In 2020, the city of **Wroclaw** launched a real estate tax exemption programme that facilitates the development of clean energy production by households and businesses. Buildings, or parts of buildings, located in Wroclaw and equipped with photovoltaics, solar collectors, heat pumps, ground heat exchangers, or recuperators are eligible for a five-year real estate tax exemption. The exemption also applies to cooperatives regarding space for residential purposes. The exemption is for up to a maximum of half of the investment costs incurred. Buildings or their parts related to large-scale commercial activities (with an area exceeding 400 m^2) are excluded from the exemption. Since the beginning of the programme, nearly 1,500 exemptions have been granted for a total amount of €6 million.

Solar panels on the roof of the bus depot in Wroclaw. The system covers half of the facility's annual demand

Photo credit: the city of Wroclaw

To accelerate greenhouse gas neutrality by 2035, the city of **Dortmund** deploys several funding programmes for citizen schemes: greening roofs and facades, unsealing of paved areas, installation of photovoltaic systems, geothermal energy equipment, soundproof windows, energy-efficient solutions, and renovations and vouchers for households to receive professional energy advice. The funding programmes are aligned with free educational events organised by Dortmund's service centre for energy efficiency and climate protection in cooperation with the Dortmund Adult Education Center.

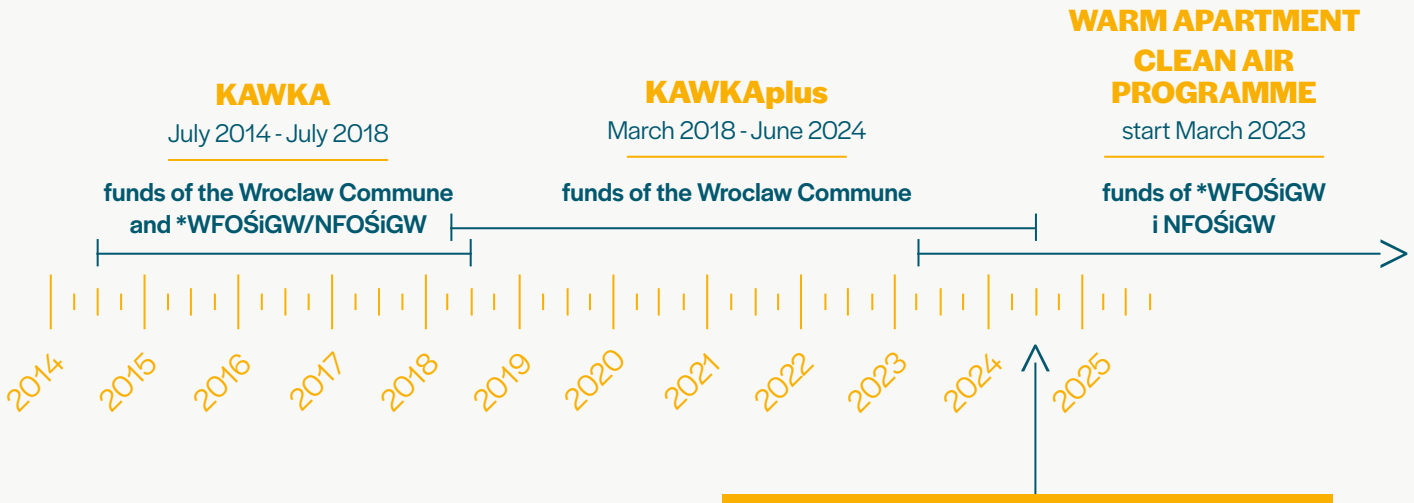
Since 2014, the city of **Wroclaw** has been implementing several subsidy programmes that support inhabitants in replacing solid fuel heating systems with low-emission ones and thermal modernisation of houses. By 2023, 14,461 solid fuel household furnaces and boilers were eliminated for €30 million while reducing air pollution by more than 10,000 tonnes of emissions annually. From 1 July 2024, according to the anti-smog resolution, a ban will be introduced on the most polluting class of solid fuel heating systems, with fines up to €1,150 imposed on non-compliant households.

128 solar panels with capacity of 48 kW were installed on Zhytomyr's hospital roof in summer 2023

Photo credit: the city of Zhytomyr

Subsidiary programmes for heating and energy-efficiency modernisation in Wroclaw

Based on the infographics of the city of Wroclaw



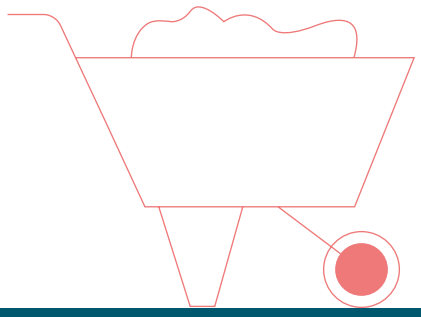
In addition, the Wroclaw Commune offers supplementary programmes:

- termoKAWKA,
- Local Shielding Programme,
- rent exemptions.

*WFOŚiGW/NFOŚiGW – Provincial/National Fund for Environmental Protection and Water Management

Part 3

Disaster risk reduction and resilience building



- Good governance and organisational aspects
- Innovation and technology

Disaster risk reduction (DRR) is a systematic approach to identifying, assessing and reducing the risks of disaster. At global level, the Sendai Framework for Disaster Risk Reduction guides DRR efforts, emphasising the importance of reducing disaster risk and losses. The Sendai Framework is explicitly linked to the Sustainable Development Goals (SDGs) through a specific target focusing on enhancing disaster risk reduction and resilience in urban areas, with particular emphasis on protecting people in vulnerable situations. Integrating disaster risk reduction and resilience into spatial planning becomes critical as urban areas grow and complexify, and infrastructure faces the risk of climate hazards and unforeseen challenges.

In the Ukrainian context, a comprehensive approach to DRR is crucial for effective crisis response and the establishment of long-term resilience. This is particularly critical due to the complex challenges posed by security risks, climate change, and the cascading impacts of disasters. A pertinent example is the destruction of the Khakhovka Dam, which underscores the far-reaching consequences on security, human and animal health, as well as the natural environment. Long-term planning becomes essential not only for mitigating immediate crises but also for anticipating, preparing for, and mitigating future risks associated with such multifaceted challenges. As cities represent the level of government closest to local communities, building their capacities remains vital for strengthening disaster response and creating more resilient infrastructures and inclusive societies.

Good governance and organisational aspects

The Urban Resilience Department in **Milan** plays a vital role in integrating resilience into the municipal authority's planning tools. Embedded within the Green and Environment Department, the directorate works in close coordination with municipal government units dedicated to climate and energy, water resources, waste management, and public green areas. The Urban Resilience Department's core functions encompass climate data collection and analysis aimed at providing new tools and information to face Milan's environmental and social challenges. Additionally, it provides scientific and technical support for municipal activities related to environmental issues, strategically monitors the municipality's goals and financial opportunities, and actively engages in knowledge exchange with international organisations, universities, and research institutions on resilience matters.

Revitalisation of Piazza Angilberto II in Milan
Photo credit: the city of Milan

Before

After

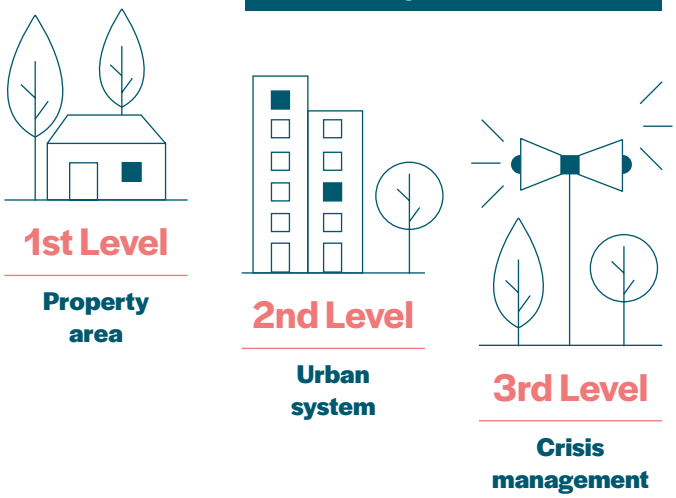
In November 2021, the United Nations Office for Disaster Risk Reduction (UNDRR) selected the city of Milan as a Resilience Hub in the Making Cities Resilient 2030 (MCR2030) campaign, which contributes to building a resilience-oriented vision of the city.

Three levels of rainwater management in Gdansk

In its strategy to adapt to climate change and bolster resilience against extreme weather events like flash floods, **Gdansk** has revised its urban rainwater management. This involved strategically relieving the rainwater drainage system, employing measures to stop or delay the flow, focusing on retaining water close to its source, using rainwater for greenery watering, and integrating nature-based solutions to treat rainwater.

At the basis of this approach, the city formulated three levels of rainwater management.

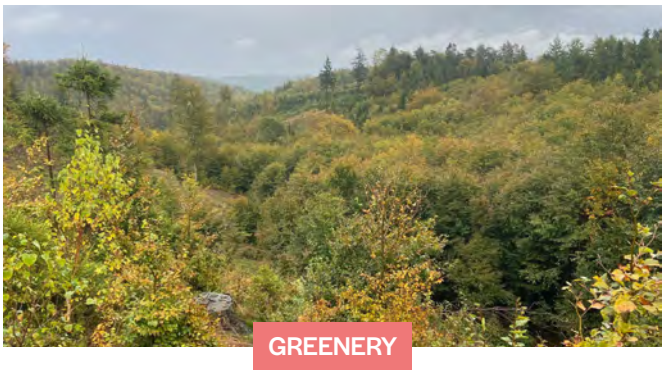
Based on the infographics of the city of Gdansk

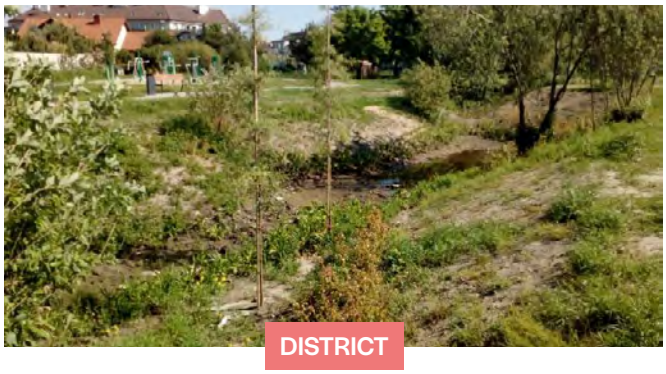


1st level:

This level involves demands that property owners catch the rain at the property via nature based and green solutions such as rain gardens, bioswales, and retention parks.

Multi level urban retention
Photo credit: the city of Gdansk





2nd level:

At this level, excess water from the first level and stormwater from roads and public spaces (that is not stopped by the greenery) is drained and stored in urban water reservoirs. The city has 53 retention reservoirs with 800,000 m^3 of volume. The reservoirs are designed to look like natural ponds or lakes and blend into the city's landscape.

One of 53 retention reservoirs in Gdansk
Photo credit: Gdanskie Wody

3rd level:

This level activates the city's crisis management system and mobilises municipal services to pump excess water, protect buildings and reservoirs, and unblock grates and inlets. Municipal workers such as firefighters receive regular preparedness trainings and conduct exercises for different flood scenarios.

Protection of buildings against flooding in Gdansk
Photo credit: Grzegorz Mehring

Pumping water from flooded places in Gdansk
Photo credit: Grzegorz Mehring

Athens – Civil protection framework and fire prevention

In Greece, civil protection operates as a coordinated resource system, bringing together national, regional, and local authorities in collaboration with various public institutions and services. It encompasses prevention, intervention, and restoration measures.

In the field of fire prevention, Athens has developed 'IOLAOS' – a plan that addresses the city's responsibilities in forest fires. Every year fire danger is categorised within the municipality's jurisdiction from low to very high (5-rank scale) and a plan is made on what each division of the municipality should do in case any of the five categories occur. Notably, the period from 1 May to 31 October is critical due to the arid summer conditions. The municipality takes proactive steps during this period, including coordinating local bodies for cooperation, cutting dry and flammable flora in public and private green spaces, and conducting daily checks on the Ministry of Civil Protection's fire risk prediction map. In response to elevated risks (level four on the scale), 24-hour patrols are initiated in green spaces, and municipal water transport vehicles and equipment are strategically positioned for firefighting support in collaboration with the Fire Service.

Water tank vehicle of Athens
Photo credit: Division of Green Areas and Urban Fauna, the city of Athens

Innovation and technology

MCR2030 and Disaster Resilience Scorecard for cities

Making Cities Resilient 2030 is a United Nations led cross-stakeholder partnership for improving local resilience. It empowers cities through a three-stage roadmap, offering knowledge, and tools for monitoring and action. A central element in the initiative is the Disaster Resilience Scorecard, an instrument that raises awareness of risks and helps local governments to develop their local DRR strategies, monitor and review progress. It provides a set of tools that allow local governments to assess their disaster resilience, structuring around UNDRR's Ten Essentials for Making Cities Resilient. The initiative also helps to monitor and review progress and challenges in the implementation of the Sendai Framework.

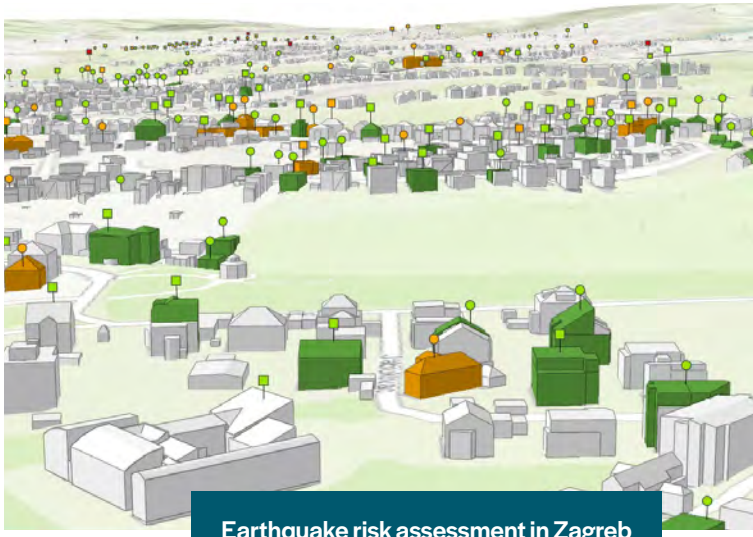
The preliminary assessment tools are available for download in Ukrainian language in Excel and pdf formats. Additionally, the assessment can be enhanced by incorporating specific scorecard addenda that address themes such as public health, food systems resilience, cultural heritage, and the inclusion of people with disabilities.

IMPACT Initiatives is a leading Geneva-based organisation that shapes humanitarian practices, influences policies and impacts the lives of humanitarian aid beneficiaries through information, partnerships and capacity-building programmes. In the field of DRR, IMPACT informs the community on natural and technological hazards and supports them with disaster preparedness planning. Multi-hazard assessments have been conducted in Chernihiv, Dnipro, Kharkiv, and Kryvyi Rih, among others. Local and regional area-based assessments in Ukraine can be accessed via IMPACT's resource center.

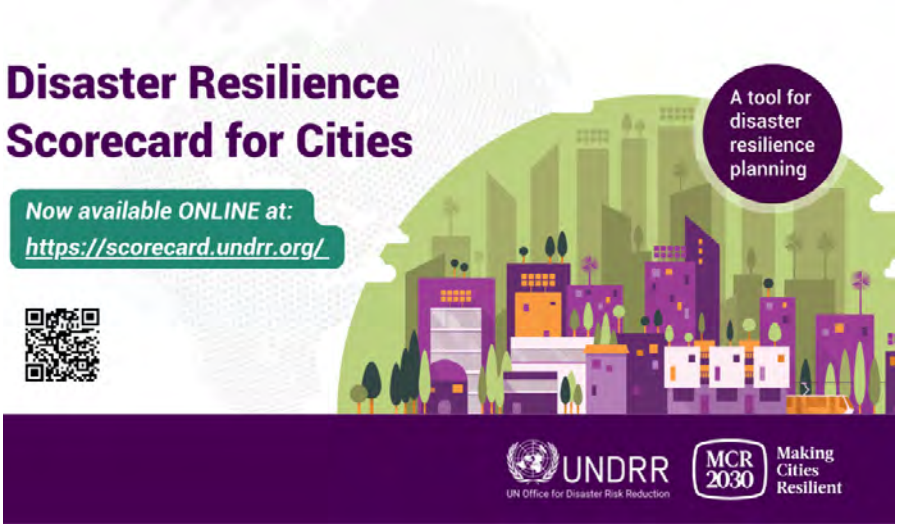
Zagreb's earthquake risk assessment: database of buildings and population

The 'Potresni rizik Grada Zagreba' project provides an assessment of earthquake risks in **Zagreb**, involving the creation of a comprehensive database covering 320,000 buildings on the ArcGis online platform. Each building is characterised by approximately 200 attributes, including details such as the year of construction, purpose of the building, number of floors above and below ground, roof shape, floor plan shape, construction material, etc.

This extensive data collection serves several technical objectives: providing crucial information on damaged buildings and infrastructure, establishing the economic basis for renovating existing structures and constructing new safe buildings, and preparing measures for the rapid recovery of earthquake-affected communities. Furthermore, the database supports various dashboard visualisations, enhancing accessibility and utility.



Earthquake risk assessment in Zagreb
Source: the city of Zagreb



Flood control in the city of Prague

Prague's flood control system combines grey infrastructure like walls, fixed and mobile barriers with green measures and nature-based solutions, such as restoration of wetland, watercourses and reservoirs. Green infrastructure enhances resilience by improving natural drainage and reducing water runoff.

This dual approach not only fortifies against floods but also yields climate adaptation benefits and contributes to human wellbeing, showcasing Prague's commitment to a sustainable and resilient urban environment.

Testing flood protection measures at the Lichtenstein Palace in Prague
Photo credit: the city of Prague

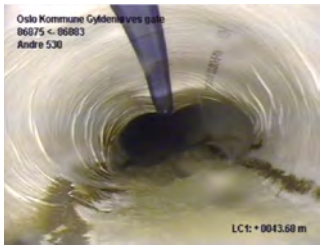
Multidisciplinary teams, comprising urbanists, water management specialists, landscape architects, sociologists, and emergency/rescue teams, are vital for comprehensive flood protection and resilience planning. Each discipline contributes unique insights, ensuring a holistic approach that addresses the complex challenges associated with flood protection.

'No Dig' technology in Oslo

Trenchless technology is an environmentally friendly approach to infrastructure repairs that eliminates the need for extensive excavation. It is commonly used in various infrastructure sectors such as water and sewer systems. Additionally, trenchless repair technology typically requires less heavy machinery and equipment, resulting in lower energy consumption and emissions.

The city of Oslo is using such method for wastewater and stormwater pipelines.

Trenchless sewerage maintenance in Oslo
Photo credit: the city of Oslo

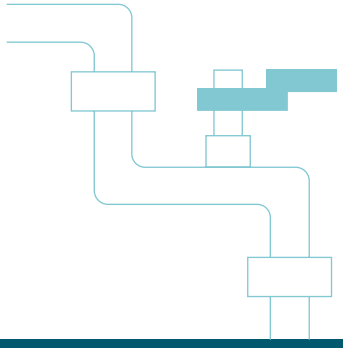


Environmental and cost benefits of trenchless pipe repair

- Environmental friendliness: the 'no dig' approach minimises surface disturbance and soil erosion, while helping to preserve vegetation.
- Cost-effective: trenchless methods offer financial savings by reducing labour, equipment, and restoration costs compared to traditional digging approaches.
- Quick implementation: the technology allows for efficient and rapid repairs, minimising downtime and inconvenience to residents and businesses.
- Adaptability to urban constraints: trenchless technology is invaluable in urban environments like where digging may be impractical due to existing buildings, infrastructure, or challenging ground conditions.

Part 4

Waste and **water** management, circular **(re-)construction**



- Good governance and organisational aspects
- Innovation and technology
- Data and digitalisation
- Incentives and funding

The main aim of the circular economy, a key part of global sustainable development, is to manage resources without waste. This section explains the current management practices and technologies for handling city waste and water, showcasing how we can shift from traditional, linear ways of production to more sustainable, 'closed loop' methods. This is something cities and local authorities can really speed up.

In the building sector, the circular economy isn't just about handling construction and demolition waste better. It's about thinking of resource use in every stage of a building's life, from its design to its eventual demolition. This holistic approach is central to the New European Bauhaus initiative touched upon in the first chapter.

With more than 90% of municipal waste being landfilled, a lack of basic infrastructure and incentives for separate collection and recycling, and low awareness among the population regarding the environmental impacts of improper waste management, Ukraine faces a challenging journey towards adopting circular practices. The full-scale Russian invasion has added a new dimension to the challenge, particularly in managing the debris from destroyed buildings. However, ongoing developments in the sector present Ukrainian cities with an opportunity to leapfrog to more sustainable methods and benefit from the experience of other European cities. By leveraging available technologies, expertise, and funding opportunities, Ukrainian cities can swiftly transition towards sustainable urban waste management, attracting investments, grants, and other forms of financial support.

Good governance and organisational aspects

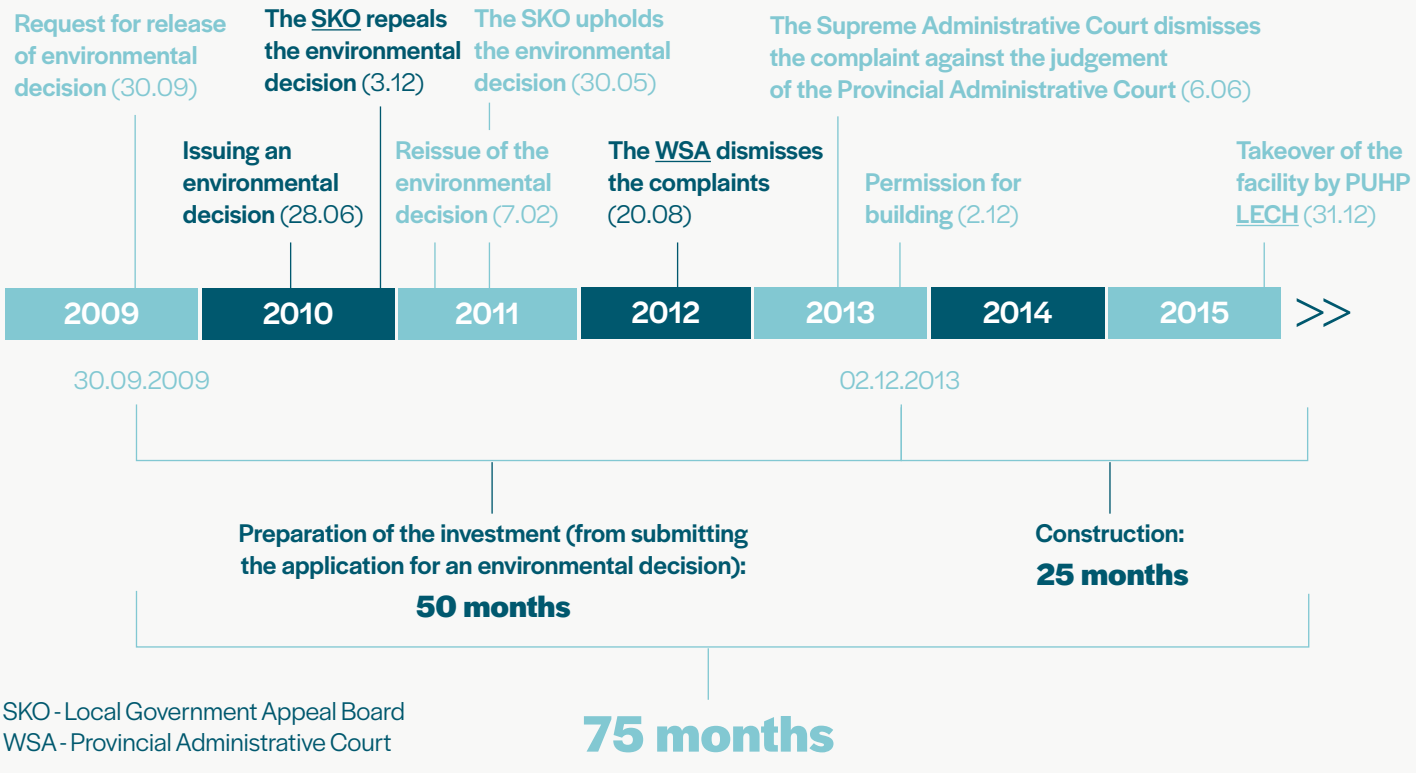
Due to their extensive powers to organise and coordinate communal economic activities local authorities have been the main actors responsible for municipal waste and water management, maintaining clean and healthy living spaces and providing basic utility services to inhabitants. Good urban practices in the sphere feature long-term planning of comprehensive integrated systems built within EU legislative frameworks: Waste Framework Directive and Directive on Urban Waste Water Treatment. Another distinguishing characteristic of good urban governance is partnership building when neighbouring communities strive to join forces and capacities for enabling implementation of large infrastructural projects.

Since 2021 European financial institutions have been increasingly favouring less carbon-intensive, higher waste hierarchy alternatives, moving away from including Waste-To-Energy incineration in their sustainability plans

Plan ahead

Since 2009, **Bialystok** has significantly advanced comprehensive municipal waste management in Poland that allows the authorities to sustain low prices for households while fulfilling EU environmental standards by using the best available techniques. Municipal solid waste from ten municipalities of Bialystok agglomeration is treated at two different sites with installations such as a municipal waste sorting facility, a composting plant for green and biowaste, waste storage fields, and a waste-to-energy incineration plant processing 120,000 tonnes of solid waste per year with cogeneration of heat (350,000 GJ) and electric power (up to 50,000 MWh). The amount of electricity produced can supply power to approximately 16,000 households, while the amount of heat generated can heat approximately 900 single-family houses in winter. It took almost seven years for Bialystok to develop and construct the thermal power plant. A major part of that time went for receiving environmental permissions and community consent.

Preparation and implementation of the investment to the waste-to-energy incineration plant in Bialystok
Based on the infographics of the city of Bialystok



SKO - Local Government Appeal Board
WSA - Provincial Administrative Court

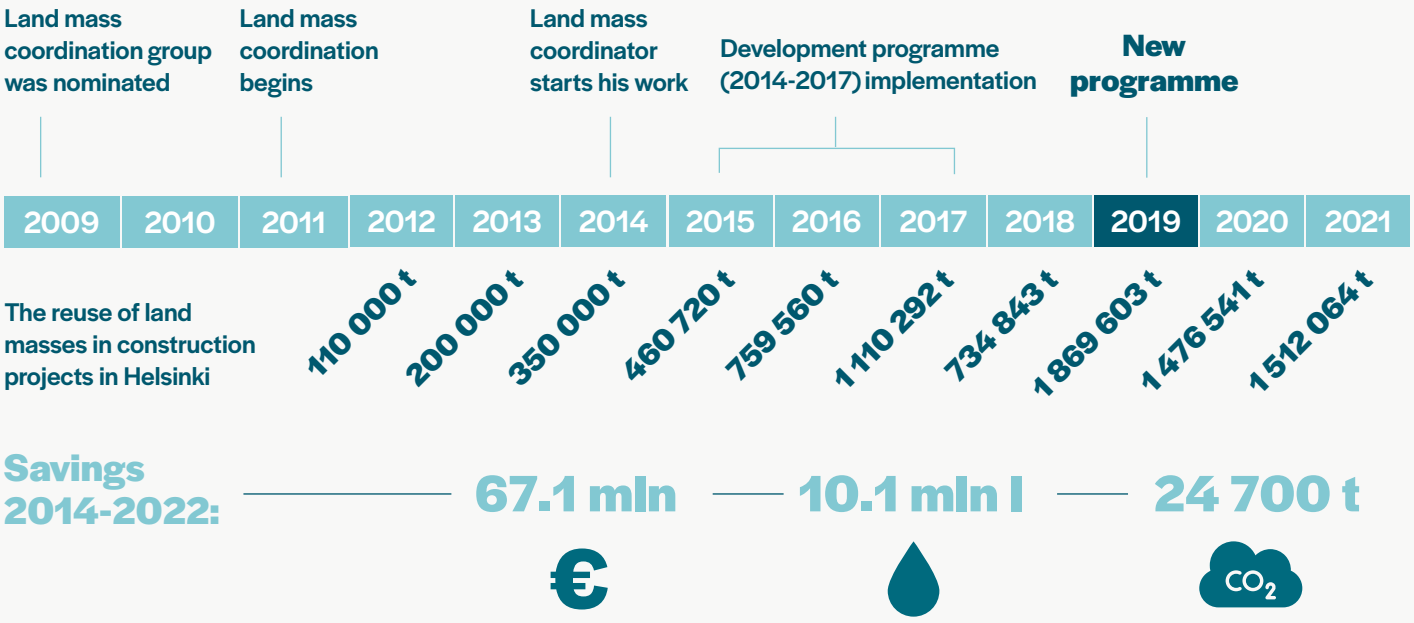
Development programme for excavated soil management

In 2009, **Helsinki** faced a unique challenge with the disposal of surplus soil from its construction sites. To address this, the Mayor of Helsinki established a working group within the Urban Environment Division. This group, composed of technology and environmental experts, engineers, and landscape architects, was tasked with developing a sustainable solution for managing the excavated soil.

The result was an innovative programme focused on repurposing the soil locally, thereby reducing the need for long-distance transportation. This approach was not only environmentally prudent but also economically beneficial. The city achieved significant cost savings and reduced its environmental footprint. While specific figures like fuel saved and CO_2 emissions reduced were notable, the broader impact of the initiative was its role in promoting sustainable urban development.

The initiative also had a wider influence, encouraging other regions to consider similar strategies for soil reuse. It highlighted the importance of a multidisciplinary approach in solving urban environmental challenges and served as a catalyst for new business models in sustainable practices. Helsinki's experience showcases the potential of urban areas to turn environmental challenges into opportunities for innovation and sustainability.

Outcomes of development programme for land mass coordination in Helsinki
Based on the infographics of the city of Helsinki



Prioritising local hazards management

In 2008, the city of **Lublin**, located in one of the two Polish regions with the most asbestos-containing materials, initiated the 'Asbestos Removal Programme'. Updated in 2023, this programme mandates property owners to inspect buildings with asbestos and report their findings by 31 January each year. As of 2023, Lublin has successfully removed 2,685 tonnes of asbestos from 1,673 properties, tackling about 40% of the city's estimated 463,000 m^2 of asbestos-containing products.

Poland prohibited asbestos production and use in 1997, and in 2002, it launched its first national asbestos abatement programme, leading to more robust local actions like Lublin's initiative. These efforts align with the EU Waste Framework Directive, which requires proper disposal of substances like asbestos, known for high cancer risks and once commonly used in construction, such as house roofing. Asbestos materials, categorised under Construction and Demolition Waste, require specialised handling due to their hazardous nature.

An employee of a licensed company, dressed in a white tight suit with an oxygen mask, sits on the roof and removes concrete-asbestos tiles
Photo credit: the city of Lublin

Innovation and technology

Dismantling vs demolishing

Haarlem has used an innovative and environmentally conscious approach dismantling buildings which contain asbestos. This 'LEGO block' method focuses on disassembling the building in segments. This approach aligned with Haarlem's goal of climate neutrality and minimised environmental impact. This practice was trialled on a government building constructed with asbestos in 1967, with the city employing a demolition company known for its circular economy practices.

Key features of this approach included:

1. **Preservation of materials:** The dismantling process was designed to salvage and repurpose as many materials as possible. Doors, window frames, kitchen fittings, and even specific items like the building's professional kitchen and restrooms were carefully removed for reuse in other projects.
2. **Innovative waste management:** The removal of materials was conducted using an aerial lift, which lowered a recycling container to the site. This method not only protected the materials from damage but also enhanced safety and reduced noise pollution.
3. **Hazardous material handling:** Special care was taken to remove environmentally hazardous components, such as fluorescent tubes containing heavy metals, and the toxic substance Chromium 6. These were safely extracted and disposed of, or immediately reused when possible.
4. **Recycling of debris:** Concrete debris from the demolition was repurposed for road construction.

The Haarlem government's approach to this demolition project represents a model of environmental responsibility, showcasing how demolition can be conducted in a way that prioritises material preservation, safety, and sustainability.

Special disposal of asbestos containing materials

Since the launch of the programme on asbestos removal from the territory of **Lublin**, the only accessible and legally permitted method of neutralising asbestos waste (i.e. weakening or eliminating the harmful effects of asbestos) is its storage in hazardous waste landfills, or in separate parts of landfills for non-hazardous and/or inert waste. The city of Lublin transports its asbestos-containing waste 50 km to neighbouring Krasnik city where it's deposited in the special landfill dug into the ground (so-called cells). Technological and organisational aspects of transporting and disposal of asbestos-containing waste include:

- after removal and before loading onto the truck, asbestos waste must be wrapped with polyethylene foil;
- materials containing asbestos are transported to the landfill by an authorised (licensed) company;
- carrier delivering the material presents to the landfill dispatcher or manager a transport document and an asbestos transfer card, which must be confirmed;
- unloading from the means of transport takes place using a forklift on the unloading plate located at the bottom of the landfill pit basin;
- unloading process must be carried out carefully so as not to damage the insulating membranes of the waste wrap;
- packed asbestos is placed in layers, each layer is covered with a 25 cm thick technological fill.

Asbestos-containing waste logistics and depositing at EkoAzbest landfill in the city of Krasnik

Photo credit: EkoAzbest

When asbestos is mixed with cement in products like some older building materials, it's less likely to be harmful. However, when these materials get damaged or broken, especially during building work or repairs, they can become dangerous. Lublin follows EU waste guidelines in dealing with such products.

Total building destruction resulting from natural disasters or other emergencies impedes careful demolishing and construction waste sorting at source. In such cases, Lublin municipality may reach the specialised local company which is capable of providing both rescue and construction and demolition waste management services immediately. The solution consists of bulk collection of the debris and transporting it to the municipality's own site where the materials are sorted and then taken to storage. After collecting enough volume, the recyclable materials are fed to grinding machines to prepare them for use in different applications such as road construction or insulation products.

Preparedness for multi-faceted risks at Turku Region Waste Water Treatment Plant

Green Public Procurement

The EU's Circular Economy Action Plan highlights Green Public Procurement Criteria that reduce the environmental impact of purchased goods and services. Through identification and testing of novel sustainable practices and products, cities can incorporate such criteria into their procurement procedures.

Haarlem's Sustainable Public Procurement policy and strategy focus on using its €250 million budget towards green, fair, and circular procurement. The city's strategy is comprehensive, encompassing climate-friendly, circular, and socially responsible procurement. Haarlem has also committed to the 'Green Deal' from the Dutch Ministry of Infrastructure and Water Management, integrating sustainability into roadworks and infrastructure. Among the main circular economy criteria in Haarlem public service tenders are gas-free energy supply, energy-saving indicators, climate-neutral transport and alignment of all civil engineering works with 'Green Deal Sustainable Civil Engineering'. Haarlem municipality also applies Social Return on Investment for evaluating all procurement bids exceeding €200,000. This approach includes a mandatory clause in contracts, assigning a specific portion (5%) of the contract's total value for the contractor to allocate towards aiding individuals who are distanced from the job market in gaining more stable employment. Contractors are required to demonstrate this commitment in a verifiable manner. With the aim of becoming 100% circular in 2030, 100% gas free in 2040 and 100% climate neutral in 2050, Haarlem embeds its ambitions in multiple state-of-the-art projects expanding the potential of innovation procurement while facilitating local market development.

Annually, the city of **Helsinki** engages in procurement activities exceeding €2 billion, which represents approximately 40% of its total expenditures, presenting significant potential for reducing its carbon footprint. The city is actively involved in numerous initiatives and research projects aimed at integrating circular economy criteria into all of its procurements by 2025. To achieve this goal, Helsinki collaborates with businesses, academia, and NGOs to develop and refine criteria that facilitate the procurement of innovative construction materials, such as cement-free concrete or concrete based on alkali-activated geopolymer. Examples also include procuring demolition or construction services from companies committed to reusing building components.

Furthermore, Helsinki, in collaboration with other cities, extends its efforts beyond public procurement by exploring circular criteria for land allocation. This may involve establishing mandatory criteria for companies bidding on projects, such as the recycling of soil, or awarding points in competitive land sales for initiatives like the reuse of building components. Additionally, the city's own projects may incentivise circular economy measures by awarding quality points to bidders, with each point potentially valued at €700,000.

Useful resources

Urban Agenda online course on Innovative and Responsible Public Procurement

URBACT's Strategic Public Procurement

Cityloops circular construction handbook for local and regional governments

CNCA and Laudes Foundation recommendations for cities to dramatically reduce embodied carbon in built environment

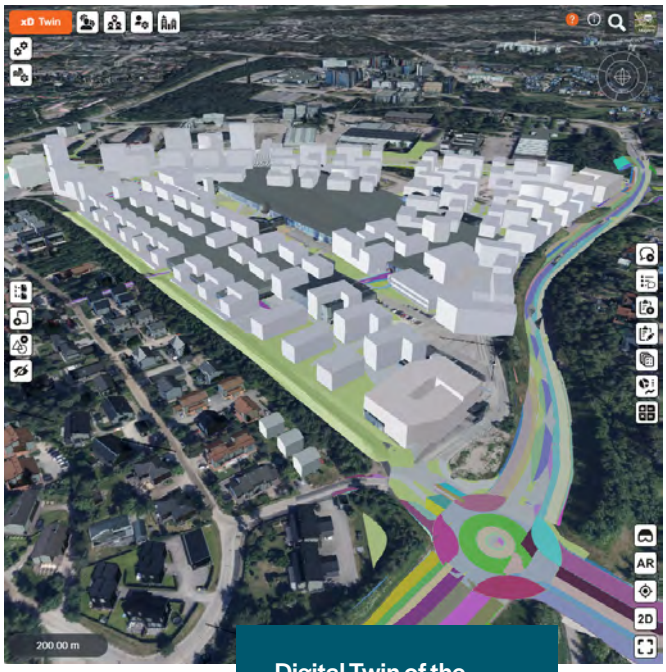
Big Buyers: ICLEI and Eurocities public procurement of zero-emission construction sites

Data and digitalisation

Urban modelling and monitoring

The city of **Espoo** employs several digital technologies to enhance and speed up circular economy development as part of its broader goal to become carbon-neutral by 2030. These technologies include:

- 6D Information Model: Espoo uses a 6D digital twin for area development projects, which integrates 3D designs over time (4D) with cost (5D) and a dimension on carbon footprint (6D);
- Drones, laser scanners and sensors collect data, enabling science-driven decisions;
- A Service Map featuring more than 370 circular and sharing economy services in Espoo and other cities of Helsinki Metropolitan Area;
- Materiaalitori, a circular economy digital marketplace owned by the Finnish Ministry of Environment and intended for the professional exchange of waste and production by-products, waste management and other circular economy service listings;
- Espoo Climate Watch: this tool compiles the city's climate actions, including those related to land use, construction and demolition, and resource management, to monitor progress and evaluate the impact on achieving carbon neutrality.



Digital Twin of the Kera district in Espoo

Photo credit: Jarkko Sireeni, XD Visuals

Information and communications technology (ICT) architecture for communal water management

Budapest Waterworks is the biggest water management company in Central Europe, almost fully owned by the city of **Budapest** and 1% by nearby cities. Each day, the company provides 2.4 million inhabitants with healthy potable water, operates two drinking water and seven sewage treatment plants and maintains a 7,200 km water and 840 km sewer network. High-level automation allows the company to sustain quality services and efficient management of this large infrastructure and 1,500 employees. Practically every process is measured and led by integrated ICT modules including corporate management systems (SAP), geographic information systems (GIS), vehicle tracking systems and supervisory control and data acquisition systems (SCADA) that allow monitoring and control of technological parameters and limits for various scenarios including pipework, water production, water safety and disaster risk reduction. Key aspects include multi-limit control with audio signalling for critical parameters like chlorine levels. Local and automatic protection functions are linked to a central dispatcher service. Staff members receive annual training to manage different scenarios, and qualified personnel regularly check and test signalling and protection equipment. This enables early handling of incidents and remote management of emergencies like flooding or energy supply interruptions.

Central dispatcher service of Budapest Waterworks

Photo credit: Budapest Waterworks

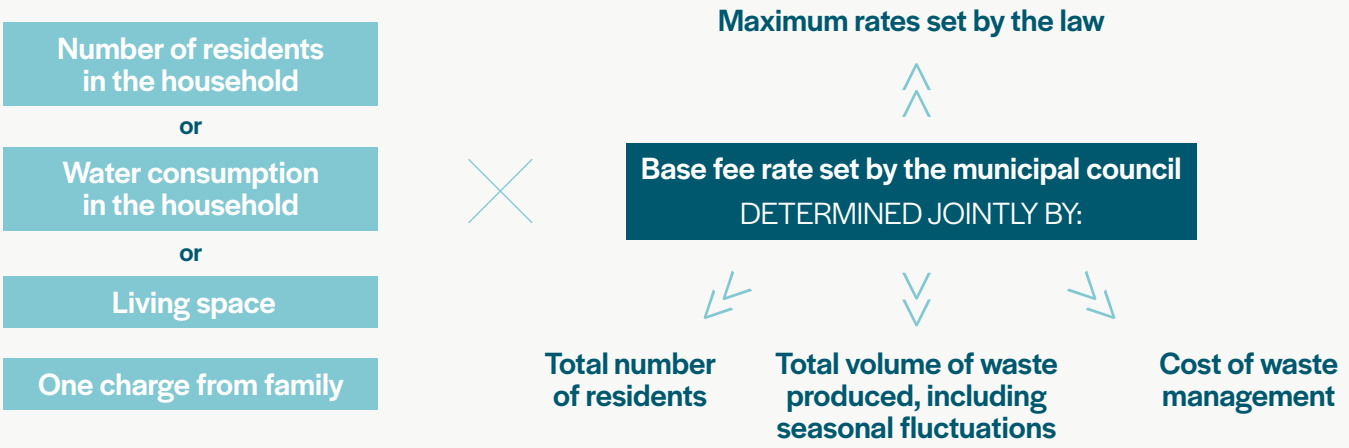
Incentives and funding

‘Polluter pays principle’ in municipal waste management

Under the EU Waste Framework Directive, the polluter-pays principle mandates that waste management costs, including for the infrastructure and operation, shall be covered by the original waste producers or by the current or previous waste holders. In **Bialystok**, this is implemented through a local waste tax, a major funding source for the city’s waste system. The tax calculation follows the Act on maintaining cleanliness and order in the commune, with the base rate set by Bialystok’s municipal council. Methods of the tax calculation can be combined. Bialystok municipality defines its tax based on household living space.

However, Bialystok faces challenges due to increasing municipal waste, especially packaging waste, and limited power to influence market economies and consumer behaviour. To address this, the city plans to introduce an extended producer responsibility (EPR) scheme for packaging, once it is enacted on the national level. This scheme, already common in the EU, allocates only financial or financial and operational responsibility for waste management to the producers. It requires them to meet targets for collection and recycling of the waste generated by their products consumption, establish user-friendly waste management systems, and conduct public awareness campaigns. The long-term goal of EPR scheme is to encourage businesses to design products and processes that generate no waste, impacting the entire value chain.

Options for municipal waste tax calculation in Poland
Based on the infographics of the city of Bialystok



Encouraging waste prevention and quality sorting

The waste hierarchy is one of the main principles of the EU environmental policy, which prioritises no-waste production and pollution prevention. For the waste hierarchy implementation the 2018 amendments to the Waste Framework Directive introduced modern economic tools like 'pay-as-you-throw' (PAYT) schemes and updated provisions for extended producer responsibility (EPR) schemes. EPR primarily addresses packaging, electronics, batteries, vehicles, and tyres.

In **Ljubljana**, the local EPR schemes are enhanced with the PAYT method for sustainable management of residual and biowaste. Ljubljana's public company, serving the city and 10 adjacent municipalities, implements PAYT principle for both door-to-door and underground container collection systems. Door-to-door collection charges are based on container volume (80, 120, and 240 liters) for residual waste and the frequency of collection, with biowaste collection costing approximately five times less than non-recyclable waste. For underground containers, charges are based on the actual number of disposals, with a minimum billing for both waste types. The entries are activated by a special access card.

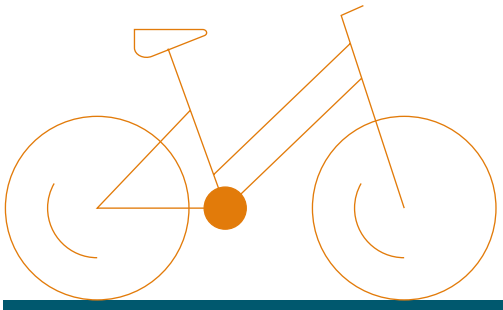
The pricing also considers the number of people in household or multi-apartment buildings, where bills are usually managed by the building's manager. An average household bill is €12.71 per month. This tailored approach, combined with an extensive awareness campaign, has positioned Ljubljana as a leader in EU municipal waste recycling. Since 2004, when all waste went to landfill, the city has achieved more than a threefold reduction in residual municipal waste production.

There are 80 underground collection points in Ljubljana
Photo credit: M.Štefančič

Part 5

Sustainable urban mobility

- Good governance and organisational aspects
- Innovation and technology
- Data and digitalisation



Urban mobility impacts both the environment and society at large. Ensuring sustainable development of the sector is crucial to address air pollution, traffic congestion, and the efficient use of public space, contributing to the improvement of residents' quality of life. Promoting a modal shift towards public transport, active mobility (i.e. cycling and walking), and shared mobility contributes to reducing greenhouse gas emissions and dependence on fossil fuels.

Furthermore, sustainable urban mobility ensures equitable access to transportation, making cities more inclusive for all residents, regardless of age, income, or ability. It enhances economic efficiency by reducing travel times and congestion, and by decreasing the cost of moving goods and people, fostering economic growth and productivity. Innovative low-carbon transport and smart mobility solutions further enhance urban resilience, preparing cities to adapt to future challenges. The main instrument to integrate these multiple aspects and enablers into the local context is a sustainable urban mobility plan (SUMP) prepared for and with people.

Mobility planning in European cities has a long history. However, SUMPs started to become a standard practice in municipalities in the EU a decade ago, when the EU presented its first concept in 2013. In this concept, SUMPs differ from more traditional mobility planning approaches by applying some key principles. In SUMPs, the plan is designed for the 'functional urban area' (i.e. the commuting area) and is not limited to the boundaries of the city. All modes of transport are addressed in an integrated manner, avoiding a siloed approach or the dominance of planning for motorised transport. Additionally, a SUMP is the result of a participatory approach, both with institutional partners and people. SUMPs should also set objectives for the future and include detailed action plans. Monitoring and evaluation are also strong components of SUMPs. This allows mobility performance to be assessed and ensures a high level of quality.

In Ukrainian cities, transport systems contribute to a high rate of pedestrian and cyclist fatalities (40% of all traffic collisions), 90-95% of air-polluting emissions, and significant noise levels. In 2018, the government adopted the National Transport Strategy 2030, which outlines the main challenges, areas of action, and targets. These include the reduction of greenhouse gases and pollutants emitted from mobile sources by 60% compared to 1990 and 70% compared to 2015. Although the strategy highlights the importance of "strategic planning for the provisions of transport services in cities and territories adjacent to cities as a component of their strategic development planning", the local authorities undertake the relevant actions and SUMP development on a voluntary basis. This adds crucial value to international and capacity-building projects – including European Mobility Week – which support Ukrainian cities to take the lead towards a sustainable, efficient and safe mobility system.

Good governance and organisational aspects

Intermunicipal cooperation for integrated mobility development

While decentralisation enables cities to better address local needs and challenges, intermunicipal cooperation and agglomeration development allow for high quality and innovative public services, including sustainable transportation and delivery of goods at affordable prices. Furthermore, mobility governance beyond administrative borders, at the level of functional urban areas, lays the foundation for integrated short- and long-distance travel while enhancing the reliability of the infrastructure and preventing traffic jams in the city and its commuting area.

Nantes Metropole, representing 24 municipalities, is responsible for 11 sectors, including urban planning, mobility services, public spaces, and road maintenance. In the field of transport and mobility, Nantes Metropole oversees public transport, parking management, mobility services, active mobility, and accessibility. Facing multiple challenges such as population increase, environmental pollution, and financial constraints, Nantes Metropole aims to substantially reduce the number of single-occupancy vehicle trips in favour of cycling, walking, public transport, and car-pooling. The transition incorporates actions under four strategic priorities of Nantes Metropole's SUMP, including local mobility and traffic calming, enhanced mobility services, easy access and connected metropole, and a greater use of cleaner and shared cars. Nantes Metropole highlights the significance of the SUMP, which is used as a reference document to share mobility-related issues and objectives with stakeholders and to ensure citizens, municipalities, public transport operators, mobility solution providers, and large employers are committed to the action plan and goals.

To have a complete vision of the critical issues related to achieving sustainability, the authorities of **Bologna** metropolitan area manage urban mobility through the prism of the spatial development of all 55 municipalities. In 2016, to put everyone on the same page, the metropolitan city of Bologna and the municipality of Bologna adopted the guidelines for SUMP development and three years later the SUMP itself. It integrates four planning tools for sustainable mobility: urban logistics, cycling mobility, urban traffic, and urban development at the city level. By 2030, the actions are forecast to result in 440,000 journeys redirected from private cars to public transport and cycling, a 50% reduction in road collisions compared to 2010, and a 40% reduction in traffic emissions compared to 1990, contributing to climate protection and better liveability.

As the primary source of carbon emissions in Lyon, the transport sector is a particular focus of the local authorities there.

The metropolitan city of Lyon, representing 58 municipalities, delegates urban mobility management to the local public entity SYTRAL Mobilites. By the end of 2024, it will deliver a new SUMP covering the Lyon metropolitan area and 11 neighbouring municipalities that are collaborating through a public establishment for intermunicipal cooperation (EPCI). The EPCI has powers related to economic development, planning, and more.

The SUMP addresses four main aspects: space, time, multimodality, and implementation. It suggests actions for putting metropolitan mobility on a net zero trajectory through three strategic levers for changing user behaviour:

1. spatial development and land use policies aiming at a decline in travel demand;
2. expanding public and shared mobility offers to encourage modal shift towards low-carbon options;
3. introduction of technological innovation for climate-friendly and comfortable vehicles.

The overarching aim of SYTRAL Mobilites' efforts is in line with the national strategy to reduce transport greenhouse gas emissions by 64% by 2040 from 2015 levels.

Useful online tools

Guidelines for developing and implementing a SUMP (2nd edition)

Guide on SUM planning in metropolitan regions

EU urban mobility observatory

CIVITAS network of cities

Mobilise your city partnership

Mobility Academy

Urban Mobility Courses | Tools to Move Europe Forward is a European e-learning platform to help professionals develop their sustainable mobility planning skills

Rationale of the metropolitan city of Lyon mobility plan
Based on the infographics of SYTRAL Mobilites

Prospective dimension

- A **2030** horizon to follow up on the projects undertaken
- A **2040** horizon to provide a coherent overall framework for future projects
- Reflect on current practices but also anticipate and support the **evolution of behaviours**

Territorial dimension

- The Mobility Plan is a common project and not only a **juxtaposition of each territory's strategy**
- It should **induce local arbitrations** intended to guarantee overall consistency

Multimodal dimension

- Set changes in modal shares as an objective to be achieved by the mobility system
- Agree on the relevant offers to meet future demand and change behaviours

Programmatic dimension

- Integrate into the Plan actions/projects on which stakeholders (State, Region, Sytral Mobilités, Department, Metropolis, EPCI) **have confirmed their will to implement and finance**
- Make the link with the 2030 and 2040 horizons

Inter-disciplinary approach and stakeholder engagement

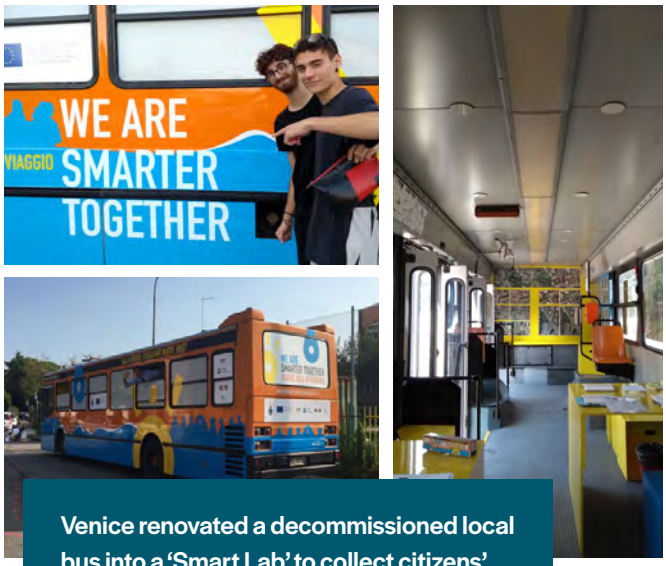
In the city of **Madrid**, a team of around 10 specialists is designated to guide urban mobility, including:

- team lead or project manager;
- technical staff such as engineers, architects, and environmentalists with at least five years of experience in the mobility field and technical skills in GIS, AutoCAD, and simulation software.

For data collection, including surveys, capacity control, and intensity counts, the core team receives support from the assisting staff. The urban mobility unit integrates the work with three other municipal departments responsible for environment and greenery, engineering and construction, and urban planning and zoning. The unit also collaborates with other institutional stakeholders like the public transport consortium, municipal police department and parking control, and regional authorities. Madrid's mobility unit underlines the crucial role of public engagement to reflect real needs, discuss challenges, and co-create solutions for improving public transport services. The main targeted groups are all inhabitants, vulnerable groups with particular mobility requirements (such as children, elderly people, and citizens with disabilities and/or reduced mobility), associations representing various mobility users (such as cyclists, micromobility users, and commuters), companies and associations in the urban freight distribution sector, and associations from other beneficiary sectors like tourism, commerce, environment, energy, and health.

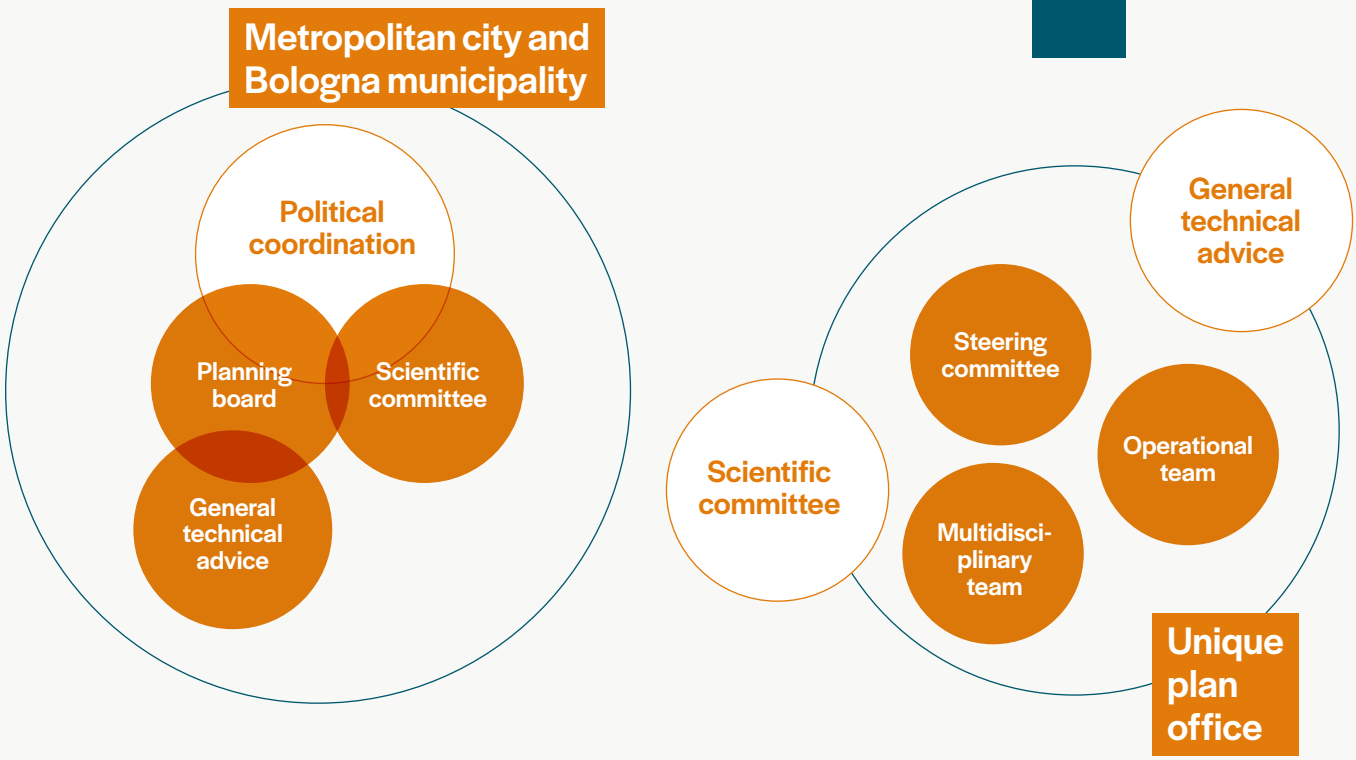
Since 2019, the city of **Hamburg** has coordinated the SUMP development with relevant authorities and inhabitants. The process involved ongoing participation from various stakeholders, including political representatives, and administration expert committees, public transport companies, environmental associations, NGOs, and research institutions. This approach enabled the urban mobility team to address potential conflicts at the early stage of planning while ensuring the coherent implementation of complex projects.

The metropolitan city of Bologna formed a scientific committee to oversee and guide the SUMP process. This independent committee consisted of five experts in fields such as mobility, environment, urban planning, and socioeconomics, offering a diverse range of insights. Their main role was to provide advice and maintain oversight of the SUMP, without directly drafting it. The committee's efforts significantly contributed to the SUMP's ambitious objectives, enhancing political involvement and adding scientific authority to the initiatives.



Venice renovated a decommissioned local bus into a 'Smart Lab' to collect citizens' input on sustainable urban mobility
Photo credit: the city of Venice

SUMP development coordination in the metropolitan city of Bologna
Based on the infographics of the metropolitan city of Bologna



Innovation and technology

Although cities tailor sustainable urban mobility plans and programmes to address their unique needs and climate challenges, the projects usually revolve around the following key areas of action:

1. Integrated urban and transport planning: public transport nodes, mobility hubs, polycentricity, intermodality, remodelling of dangerous junctions, 30 km/h speed limit, low-emissions zones, 10/15-minute city, public shared space, and park and ride facilities;
2. More and better public transport: replacing fossil-fuel vehicles with a low-carbon transport fleet, 5-minute frequency and on-demand services, and autonomous ride-pooling;
3. More space for active mobility: pedestrianisation of districts, improvement and expansion of cycling routes and bicycle parking, prioritisation of public transport at traffic lights, low-emissions zones, and high-speed bicycle lanes;
4. Intermunicipal, regional and (inter-)national accessibility: TEN-T policy implementation, improvement and expansion of railway nodes, ring road, expansion of charging infrastructure, and single ticket system;
5. Optimised delivery of goods: urban consolidation centre and use of smaller and cleaner delivery vehicles such as cargo bikes and zero-emission vans (last mile logistics);
6. Digitalisation of mobility: Mobility as a Service (i.e. MaaS, where all mobility solutions are available on a single platform for ticketing, payment, and route options), Cooperative – Intelligent Transport Systems (i.e. C-ITS data exchange between vehicles, road infrastructure, and road users), and automation.

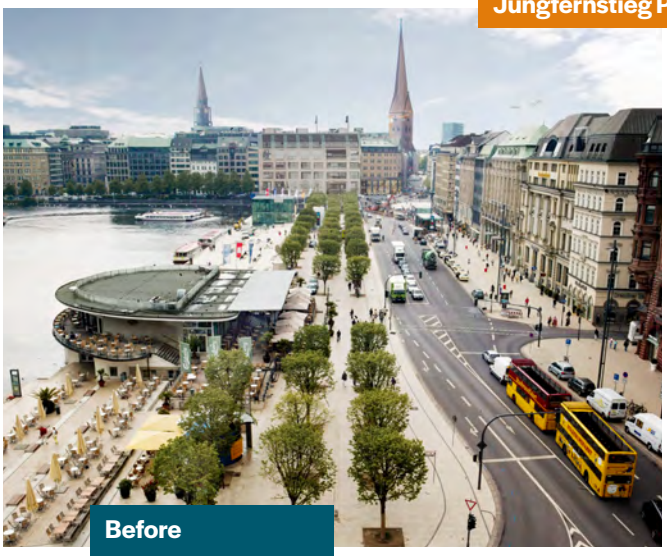
More space for active mobility

Ferretto Square in Mestre of Venice

Before
Photo credit: srotiAmestre

After
Photo credit: the city of Venice

Jungfernstieg Promenade in Hamburg



Before
Photo credit: moka-studio

After (under construction)
Visualisation: moka-studio

Puerta del Sol Square in Madrid

Before
Photo credit: Telemadrid

After
Visualisation: Imago Reliquiae

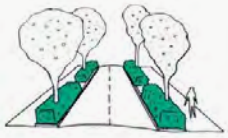
Design standard for better streets

Aiming to integrate sustainable mobility infrastructure and urban development, the city of **Vilnius** performs all works related to the street changes only after the 12 design principles have been fulfilled. With these standards, the city reasserts the view that the street is the main public space, where not only movement, but also life takes place. Vilnius' street standard considers everything that is between the facades of buildings: pedestrian and bicycle paths or lanes, green belts, and driveways. The standard was created by specialists from different fields, including architects, urban planners, landscape architects, lighting specialists, and representatives of the municipality. It was preceded by the analysis of thematic areas and the generation of potential solutions for each of them. The team looked for best practices both in Vilnius and abroad and explored how to practically apply the selected standards.

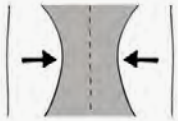
This standard is the main document for the design of Vilnius' streets. Other approved municipal documents (recommendations on pedestrian, bicycle projects, surfaces, etc.) are implemented as long as they do not contradict the standard.

Vilnius's 12 principles for better streets
Infographics of the city of Vilnius

01.
Trees always first



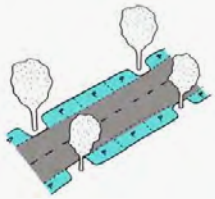
02.
Trees & bushes as a buffer



03.
Roadways as narrow as possible

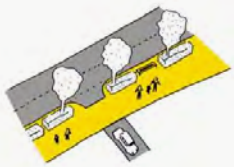
04.
Safer crossings

05.
Street lighting priority for pedestrians



06.
Side parking with trees in between

07.
Black elements for architectural distinction

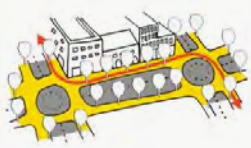


08.
Pavement as a symbol of priority

09.
Functional surfaces distinguished by covering

10.
Visual cleanliness - freedom from excessive elements

11.
Space 'ownership' at the façade



12.
Minimum intersections and turning radius

Data and digitalisation

Information and communications technology is one of the critical enablers of cities' acceleration towards safer, more efficient, more convenient, and more environmentally friendly urban mobility. In addition, digital tools help to boost public engagement and encourage residents to co-create solutions to urban challenges. Cities can develop online mobility services and mobile applications using a variety of open-source software tools, such as:

- **OpenStreetMap (OSM): a collaborative project to create a free editable map of the world, It provides geospatial data that can be used in urban mobility applications for mapping, navigation, and spatial analysis;**
- **General Transit Feed Specification (GTFS): an open format that defines a common framework for public transportation schedules and associated geographic information. Cities and transit agencies use GTFS to publish their transit data, which can then be used by software developers to create applications for route planning, scheduling, and real-time transit information;**
- **OneBusAway: an open-source platform that provides real-time transit information to users through web and mobile applications, enhancing the accessibility of public transit systems;**
- **OpenTripPlanner (OTP): an open-source multi-modal trip planning software that uses data like GTFS and OSM to provide itinerary planning across various modes of transportation, including walking, cycling, public transit, and more;**
- **Simulation of Urban Mobility (SUMO): an open-source, highly portable, microscopic and continuous road traffic simulation package designed to handle large road networks. It's used for traffic analysis, transportation planning, and to evaluate new transportation concepts and technologies.**

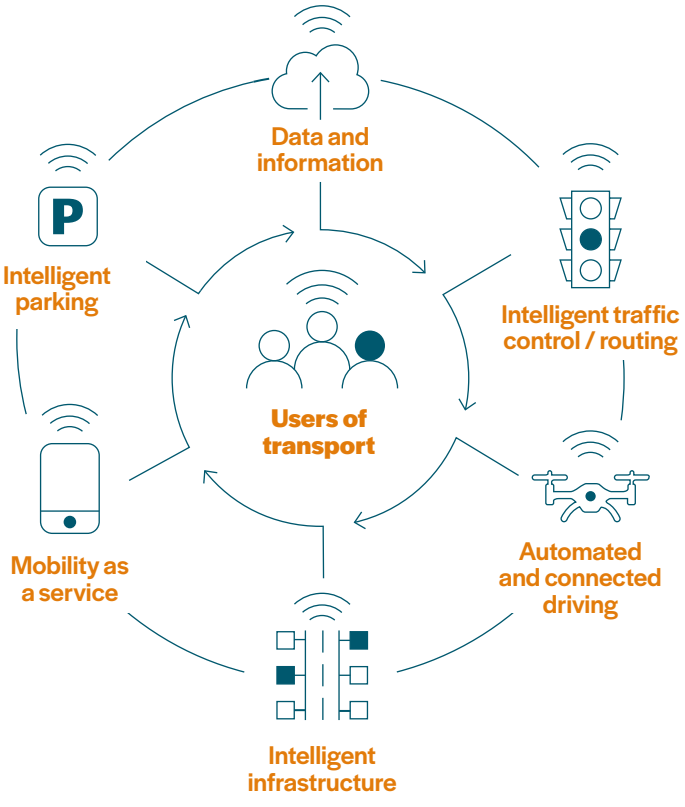
Furthermore, cities increasingly accelerate smart transport solutions and local economy development through open data and creation of Urban Data Platforms. Transformative Urban Mobility Initiative highlights seven key datasets for urban mobility planning:

1. Urban form and land use;
2. Road network;
3. Digital public transport timetables;
4. Population / demographics;
5. Administrative boundaries;
6. 3rd party movement data;
7. Modal split / modal share.

Hamburg's intelligent transport plan

In its Intelligent Transport Systems (ITS) strategy, **Hamburg** outlines six fields of action: data and information, smart traffic management and control, intelligent infrastructure, smart parking, mobility as a service, and automatic and interconnected driving. Among the implemented digital projects is the hvv switch app which allows users to find the most sustainable mobility option to reach their destination in Hamburg and the surrounding area and buy their ticket. Ongoing initiatives include bicycle traffic counting to optimise maintenance works, a traffic light forecast service, and others.

Six fields of Hamburg's mobility digitalisation
Based on the infographics of the city of Hamburg

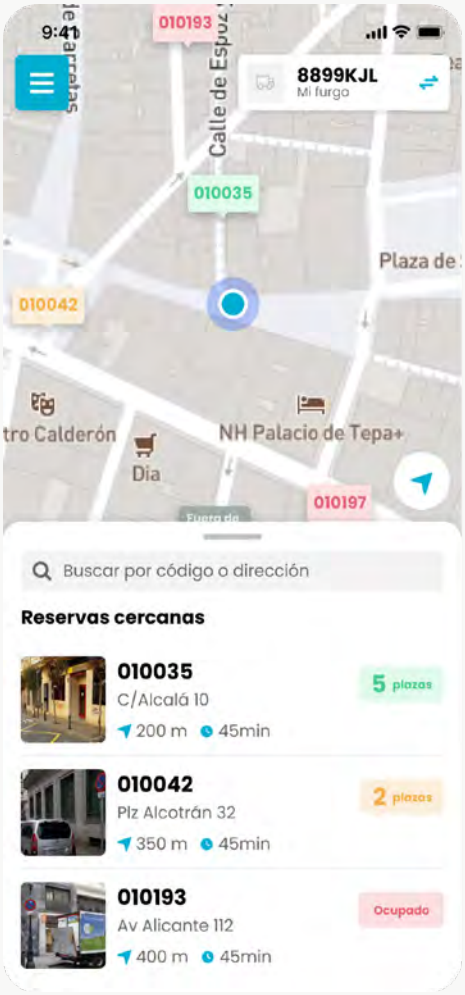


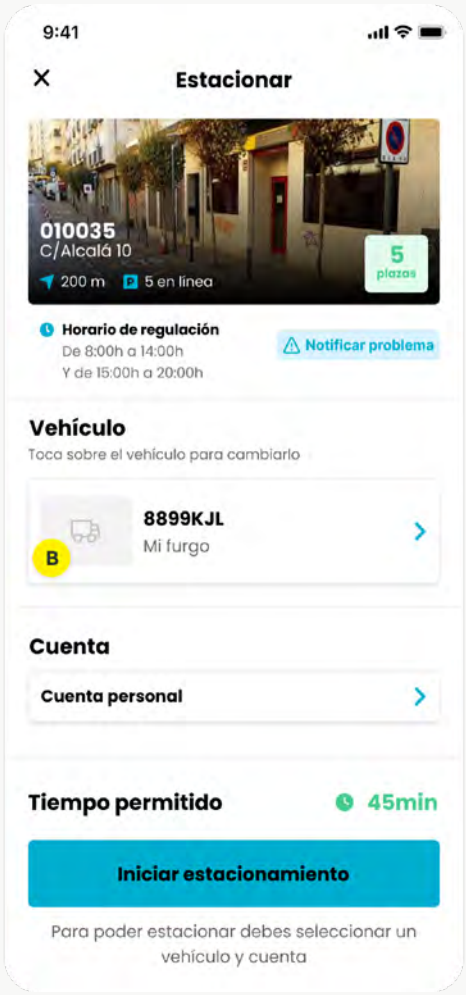
Madrid's Mobility 360 app is a digital local trip planner that provides information about bus occupancy levels, calculates multimodal routes with different mobility solutions, and enables bus ticket purchasing. The city is further advancing the digitalisation of urban mobility through the creation of a 'smart app' designed to improve urban freight distribution by managing the occupancy of loading/unloading bays.

Useful tools

EasyWay is a free service that provides information about all public transport routes and stops in 73 cities of Ukraine, including Kyiv, Kharkiv , Odesa and others. There are also cities from Moldova, Bulgaria, Uzbekistan, Serbia, Croatia, Kazakhstan, Poland, Greece and Turkey

Madrid 360 DUM app for urban (un-)loading of goods





Mobility Pyramid
Based on the infographics of www.share-north.eu