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Possible Cities

Mirror Mission Cities Hub Romania

Integrated toolkit for climate neutrality

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Possible Cities

Integrated toolkit
for climate neutrality

Introduction

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The project Towards Climate-Neutral and Smart Cities through Mutual Learning, Engagement and Capacity-Building is the first initiative of the M100 National Hub, inspired by the EU mission to create 100 climate-neutral cities by 2030.

To replicate the European model on a larger scale in the country, the M100 Mirror Mission was born to facilitate the competitive attraction of 10 other Romanian cities in the national program that faithfully follows the steps of the chosen 100 European cities. Thus, the 10 selected cities will develop on a similar common structure Climate Neutrality Plans and Action Plans that will guarantee results by 2035.

The Romanian Order of Architects is a partner in the consortium piloting the 10 selected cities and understands this role by integrating and communicating how the built environment and landscape participate in climate neutrality. This contribution is not limited to statistics on consumption and emissions, but also targets the ability to integrate, in climate neutrality plans and action plans, cultural values worth preserving and passing on, as well as the motivating power of the community, attached to the existing built environment, landscapes, public spaces, and social life.
We are convinced that the effort of transforming cities towards climate neutrality is a complex cultural effort of the whole society, requiring not only technical progress and responsible behaviour, but also a community perspective decanted towards a broad cultural understanding of the context of the inevitable future of our cities.

You will notice that this publication is complex and detailed and a presence with personality through graphic design and volume. It has become so elaborate to occupy a too large and empty a place between unsystematized and harmonized legislation of several major fields (administration, planning, energy, construction, environment) and publications dedicated only to separate sectors, without technical knowledge and without connections between fields.

To highlight the need for an integrated approach to the issue of neutrality, the Order of Architects of Romania, together with UEFISCDI and its partners – Nordic Edge, the Norwegian University of Science and Technology (NTNU) from Norway, and the Icelandic Centre for Research – RANNÍS from Iceland, invited recognized and respected specialists from each field to present a modus operandi and understanding of the technical issues. The differences in the narratives are their own and we thought it only natural to collect their voices as heard from university departments, administrative headquarters, firms or specialized NGOs. We are convinced that this will give you the best access to technical and management or social knowledge.

Therefore, the purpose of this collection of themes is to illustrate the necessary complexity of themes that need to contribute simultaneously to improving the way cities are lived in; these areas of competence are technical, administrative, citizenship, social and economic and subscribe to a shared urban culture. The areas covered in the guide are neither presented hierarchically nor chronologically on the scale of implementation, as they all contribute simultaneously to improving urban living for all citizens.

The Romanian Order of Architects recognizes the need to “translate” the concept of climate neutrality into accessible language, to explain how different domains contribute to and, above all, condition each other, and to clarify technical notions that are not yet part of the common baggage of terms widely understood in our society. The selected positive examples and case studies come from Romania, its partners in Norway and Iceland, as well as from other European countries to balance ‘foreign’ models with locally recognized results produced in recent years. Through the professional networks we confirm that in all these fields there are specialists prepared not only to act responsibly, but also to facilitate the transmission of technical knowledge and way of action to administrative and political decision-makers, citizens and the private sector. The need for models of action is growing, and the Romanian Order of Architects joins the national effort to guide and motivate Romanian society at large to act decisively and in full knowledge of the facts. The concept of sustainability is also seen as an opportunity for prosperity; companies, key partners, in turn need local governments aligned with sustainability values and goals to collaborate and streamline their work.

It is the responsibility of companies to assess and significantly reduce their environmental, social and governance (ESG) impact. For a quality ecosystem, companies that want to be prosperous in the future must also choose to operate in localities whose administrations are conscientious in setting and meeting ambitious goals and in the sustainability of their activities. The prosperity of companies also spills over into the communities where they operate by creating jobs, attracting capable and skilled staff into teams - to the extent that cities can provide an attractive living environment for those with these skills, and by using sustainable processes in the way the company carries out its specific activities. This growth - in tandem - is much more likely to be successful and can be accelerated in a climate of trust and stability through coherent medium and long-term visions and strategies from both companies and local governments.

It is not only technical tools that contribute to achieving sustainability; the Romanian Order of Architects advocates the return on trust as a key determinant of the value of organizations, revealing the direct relationship between the level of trust of the population and the economic prosperity of societies and communities. Public administrations mostly need the trust of institutions, business, civil society and citizens in general to streamline their efforts and maximize their impact - this is why the guide encourages the Return on Trust perspective and the need for organizations of all kinds to consciously and consistently cultivate trust in relation to all stakeholders

The future of cities in Romania, like and the rest of Europe, depends on the contribution to well-being through urban planning, landscape and biodiversity, mobility, buildings, energy systems, circularity and the way the administration integrates with dedicated tools these areas and especially catalyses the contribution and understanding of urban communities of the need to transform the way we live.

The M100 Guide developed by the Romanian Order of Architects is a commitment to action on behalf of our profession and the others included in this guide and describes a learning framework for those who plan, build and manage cities. However, it is also directly addressed to those who live and will live in them, for a sustainable future, as responsible citizens regardless of their role in the social fabric of cities.

Change starts with bold decisions, innovative ideas, but most of all with a shared commitment, and the future of our cities depends on what we do today.
We wish you a reading that will bring you inspiration, knowledge, motivation and energy for the necessary transformation of cities and of ourselves as citizens.

The authors.

Mirror Mission
Cities Hub Romania

The built environment

Green buildings — new and existing
Heritage — renovation and adaptation
Standards and certification

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The built environment

Green buildings - new and existing

Heritage - renovation and adaptation

Standards and certification

Contents

1 Introduction

The built environment is responsible for greenhouse gas emissions throughout the life cycle of buildings, i.e. before, during and after their operational life.

The 2050 vision for a decarbonized building stock goes beyond the current focus on greenhouse gas emissions from building operations. Buildings are important repositories of materials, a reservoir of resources over several decades, and design choices and material options greatly influence the emissions generated over the whole life cycle for both new and renovated buildings. Therefore, the life-cycle performance of buildings should be considered not only for new buildings, but also for renovated buildings, by including policies to reduce lifecycle greenhouse gas emissions in regional or local building renovation plans. Minimizing greenhouse gas emissions from buildings throughout their life cycle requires resource efficiency and circularity. This can be also include turning parts of the built stock of buildings into a temporary carbon sink.

Buildings, on the other hand, currently account for more than a third of the EU's energy-related greenhouse gas emissions in operation, while 75% of the Union's buildings are still energy inefficient. Natural gas plays the most significant role in heating buildings, accounting for about 39% of the energy used for space heating in the residential sector. In this context, reducing energy demand in line with the 'energy efficiency first' principle[1] [2] and the use of energy from renewable sources in the buildings sector are important measures needed to reduce greenhouse gas emissions and energy poverty. Reduced energy consumption and increased use of renewable energy, in particular solar energy, also play a key role in reducing energy dependency on fossil fuels, promoting security of energy supply, promoting technological developments and creating opportunities for employment and regional development, particularly on islands, in rural areas and off-grid communities.

Measures aimed at improving the energy performance of buildings should consider local climatic conditions, including adaptation to climate change, indoor climate and cost-effectiveness and other local conditions. Those measures should be without prejudice to other building requirements such as accessibility, fire protection, seismic safety and the intended use of the building.

1
Directive (EU) 2023/1791 of the European Parliament and of the Council of September 13, 2023 on energy efficiency and amending Regulation (EU) 2023/955 (OJ L 231, 20.9.2023).

2
Regulation (EU) 2018/1999 of the European Parliament and of the Council of December 11, 2018 on the governance of the energy union and climate action, amending Regulations (EC) No 663/2009 and (EC) No. 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council (OJ L 328, 21.12.2018).

2 Energy efficiency in buildings

Standards for new buildings and specific end-uses have improved significantly over the last 20-30 years; as a result, the theoretical consumption of a new building is today about 40% lower than for housing built before 1990. However, the stock of buildings is still highly inefficient and progress in improvement is slow for several reasons, technical as well as administrative, economic and social.

Most buildings have been built before the advent of thermal requirements and energy performance building codes, while the share of new dwellings is around 0.68% per year (Fabbri 2018). Assuming the same rate of construction, a maximum of 25% of the building stock will be new in 2050. If compliance is ensured, these buildings will be built to near-zero energy building standard. On the other hand, 75% of buildings in 2050 are already built today at the current average energy performance rate (Figure x). Only 12% of all renovations of residential buildings can be considered "deep renovations" (Fabbri 2018). At the current average annual rate of renovation (less than 1%), it would take about a century to achieve climate neutrality of the building stock.

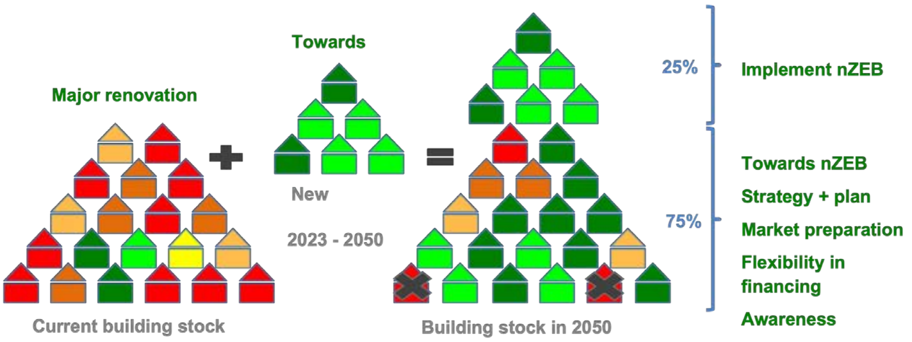

Fig. 1

The stock of buildings - projection 2050
Source : adapted from an illustration by Mareen De Groote (2015)

In short, the energy performance of the EU's built environment is dominated by existing buildings and shallow renovations, which has important implications for the building stock for 2030 and 2050. Increasing emphasis needs to be put on existing buildings and 90% of the building stock should be deeply renovated or demolished by 2030 to achieve a climate neutral building stock. This means that 3-4% of buildings should be (deeply) renovated per year.

Therefore, the **sure way towards a climate-neutral building stock** is to **increase the required performance levels of new buildings** (meeting minimum energy performance requirements and **ensuring the transition from the near-zero energy building standard - nZEB to the zero emission building standard - ZEB**) and to support the **deep renovation of existing buildings** (targeting **nZEB and ZEB performance levels respectively**).

To facilitate this, the following are necessary:

1. The development and implementation of the long-term national renovation strategy[3], the local energy and climate strategies and the national renovation plans (EPBD 2024),
2. market readiness (through support and collaboration between public administration and business, nZEB Roadshow / nZEB Days[4], training),
3. ensuring flexibility in funding (ensuring the multiplier effect of public funding + correct sizing of funding), respectively stimulating consumer awareness (through information - awareness campaigns).

3
GD no. 1034 of November 27, 2020, for the approval of the National Long-Term Renovation Strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private, and its gradual transformation into a highly energy-efficient and decarbonized building stock by 2050, M.Of. no. 1247 of December 17, 2020

4
http://www.nzebroadshow.eu/nzeb-days.html

2.1 What is nZEB?

nZEB - "nearly zero-energy building - a building with very high energy performance, in which the energy required to achieve the energy performance is nearly zero or very low and at least 30% of the energy needed to ensure the energy performance is covered [...] by energy from renewable sources, including energy from renewable sources produced on-site or nearby, within a radius of 30 km from the GPS coordinates of the building [...]"

(Law 372/2005 with later amendments and additions, republished January 2021)[5]

5
L.372 a fost modificată în 2024 și urmează a fi modificată prin transpunerea noii directive EPBD (mai 2024) — termen sem. I 2026.

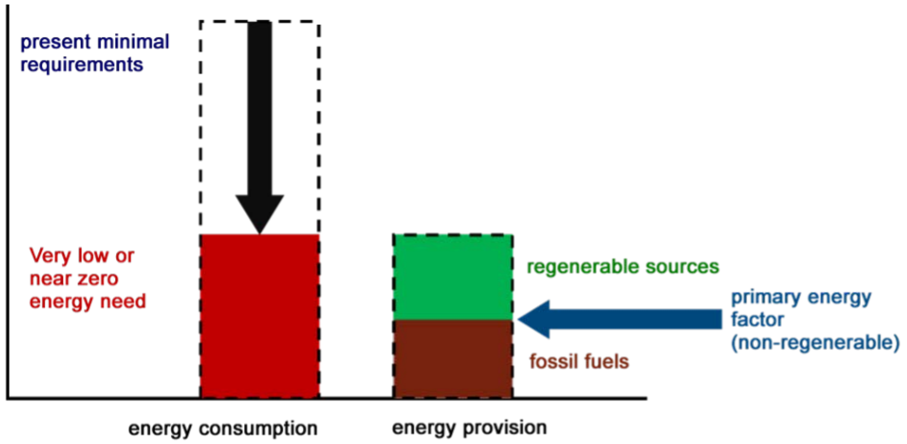

Fig. 2

Graphical interpretation of the NZEB definition according to Articles 2 and 9 of the EPBD (Directive 2010/31/EU) Source: Overview of national applications of the Nearly Zero-Energy Building (NZEB) definition, CA EPBD (2016)

2.2 Performance indicators ("nZEB standard")

The nZEB performance levels are set by MC001-2022 (depending on building type and climate zone) for the following indicators for the whole building:

— the maximum permissible limit values of total primary energy consumption (from renewable and non-renewable sources), under the conditions of indoor comfort, following the technical regulations in force,
— the maximum permissible CO2 equivalent emission limit values related to the energy consumption of the building,
— at least 30% of the total primary energy demand is provided by renewable sources, including energy from renewable sources produced on-site or nearby, within a radius of 30 km from the GPS coordinates of the building.

The conception, design, construction and use of a building at nZEB performance level must be based on a series of criteria and performance indicators (overall or partial) aimed to be achieved, following the national legislation in force. First of all, ensuring the lowest possible energy requirements for the health and comfort of the occupants is achieved by correctly addressing the thermal envelope of the building and correctly sizing all technical systems/installations of the building in a highly energy efficient way, in order to comply with the maximum limits imposed for the **primary energy demand**, expressed in kWh/m²-year, depending on the climatic zone, the type of building and its intended use. Secondly, the **minimum threshold of energy from renewable sources** obtained on-site or nearby (according to the rules in force), expressed as a percentage of the total primary energy demand, should be aimed at. The lower the energy demand, the easier it will be to reach this (relatively) required percentage of renewable energy. In practical terms, the **maximum accepted values for carbon dioxide equivalent emissions**, expressed in kg/m2-year, can be met if the two steps described above have been correctly followed.

2.3 How do we achieve nZEB performance? (The 9 pillars of the nZEB Concept)

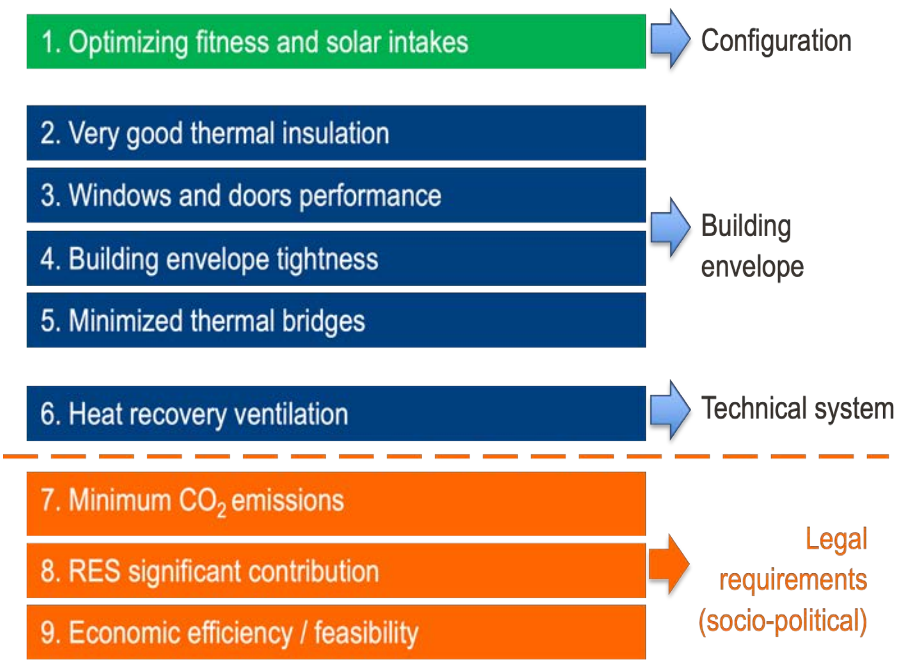

Fig. 3

Detail of nZEB pillars

2.3.1 Shape optimization and solar gains

Building geometry and orientation

More compact geometry can ensure a higher level of energy performance by minimizing the heat transfer surface area; this is shown by the ratio of the external envelope area to the total internal building volume (A/V). Achieving a certain degree of compactness of a building has a major influence on how to meet the requirements of a nearly zero energy building. In the case of less compact geometry the energy performance of the building can be compensated by increasing the thermal insulation of opaque/transparent elements and by increasing the energy efficiency of building installations and equipment.

Building compactness is particularly important in the design of new buildings, but it can also play a significant role in interventions on existing buildings, for example through re-partitioning. The partitioning should meet the requirements of the building's beneficiaries/users, but at the same time bring a benefit in terms of reducing the influence of the building's volumetry on energy performance. Thinking efficiently about interior spaces and making the building as compact as possible has the following benefits:

- achieving high energy performance by optimizing insulation thickness;
- reducing installation routes (e.g. reducing ventilation routes);
- reducing material consumption.

Partial performance indicator

building compactness factor, recommended value
$A/V \leq 0{,}7\ m^2/m^3$

Optimizing solar gains and shading solutions

Optimizing solar gains significantly reduces the need for heating in the cold season. Also, the correct sizing of the glazing envelope by considering the ratio of glazed area to floor area reduces energy consumption for lighting interior spaces. This action should be pursued at the same time as the ratio of opaque to glazed surface optimizing stage, the stage of efficient partitioning of interior spaces and the stage dealing with the flexibility and adaptability of interior spaces.

Understanding the site conditions correctly and arranging the building accordingly will directly lead to a reduction of the need for heating or cooling of the interior space. The orientation of the building in relation to the cardinal points should aim to achieve a high solar gain to maximize the passive heating phenomenon. The risk of overheating in the warm season, which may lead to increased energy requirements for cooling the indoor space, should consider passive or active shading solutions in the warm season.

Solving this challenge correctly at the design stage leads to:

- reducing the energy needs for heating/cooling in the cold season and in the warm season (minimizing the possibility of overheating);
- reduce energy consumption for lighting.

2.3.2 Very good insulation

Proper compliance of envelope elements leads to increased or maintained indoor thermal, acoustic, visual and air quality comfort proper to the function of the building and at the same time to reduced thermal losses, thus also to reduced energy consumption and CO2 equivalent emissions.

It is necessary to design an adequate level of thermal insulation and a **continuous layer of thermal insulation** to enclose the entire conditioned space. Correctly conforming the thermal envelope cuts the risk of surface condensation, which can cause mold growth, and the risk of condensation in the structure of the element, which can form during the cold season with the possibility of evaporation during the warm season. Obtaining high corrected thermal resistances, choosing proper thermal insulation thicknesses, correlated with their thermal conductivity coefficient values, and correctly designing areas that may have thermal bridges, can help designers of installation systems to ensure minimum values of energy from renewable resources.

It is recommended that the thickness of thermal insulation made of common materials with a designed thermal conductivity in the range 0,037-0,042 W/mK in the construction elements of the thermal envelope, depending on the type of element, should be at least:

- 15 cm on exterior walls with a brick or BCA masonry or BCA masonry resistance layer,
- 20 cm in case of exterior walls with monolithic reinforced concrete or large panels,
- 25 cm at floors above the top floor, under terraces, respectively at floors above the top floor, under attics/attic roof,
- 15 cm to floors over unheated basements and cellars,
- 5 cm to walls next to closed joints,
- 25 cm at the floors delimiting the building at the bottom from the outside (at bow windows, gangways, etc.),

— 15 cm to slabs on the ground (above the systematized ground elevation - SLA), to slabs on the underside of basements or heated basements (below the SLA), or to exterior walls, below the SLA, in basements or heated basements.

Where high-performance thermal insulation is used, the thickness of the insulation shall be determined according to the thermal conductivity coefficient of the insulation. The values for the thickness of thermal insulation shall be set in such a way that the building as a whole complies with the energy performance indicators in force at the time of design.

Materials with *Environmental Product Declarations* (EPD) should be used to quantify the impact of the materials used. It is recommended to use materials that are environmentally friendly or have minimal impact on the health of the building users, i.e. materials and/or construction solutions that allow for circular economy after their end of life / operational life.

Partial performance indicators

maximum thermal transmittances - U', W/m²/m²KK (minimum thermal resistances - R', m²K/W), recommended values according to MC001-2022.

2.3.3 Efficient windows and doors

Windows and doors, generally glazed elements or those that make up the movable openings in the building envelope, are components of the envelope characterized by higher thermal losses than those in the opaque area (walls, floors, etc.) and represent a system usually consisting of glazing, frame/joinery and mounting system, and the thermal performance of the system depends on the performance of each component. On the other hand, the glazed part of the thermal envelope can significantly influence the energy balance of the building by utilizing solar gains during the cold season.

The choice of the joinery shall be made taking into account the minimum thermal resistances according to MC 001-2022 (recommended), but in order to achieve a verifiably high performance, limit values should be defined for both the minimum thermal transmittance/resistance of the system and the characteristics of the components. The correct positioning of the external joinery in relation to the constructional make-up of the opaque part and correct edge sealing is recommended to reduce the unfavorable effect of thermal bridging by mounting the windows as far as possible in the plane of the thermal insulation or in the boundary zone of the resistance layer with special mounting elements.

For glazed elements in residential buildings, which are part of the building envelope, where, in addition to their maximum corrected thermal transmittance, there is also a requirement to optimize solar gains by choosing a proper solar factor. Where there are external shading systems, which can be used to regulate the amount of solar energy incident on the glazing surface, the solar factor **g** is recommended to be greater than 0,50.

A window with high thermal performance should have glazing with a minimum of three glazing sheets with low-e and/or solar shading treatment, inert gases between the glazing sheets and the warm glazing bead, a thermally broken profile joinery, low air permeability; a mounting system that ensures correct positioning in relation to the constructional composition of the opaque part and correct sealing on the contour, control of a solar energy transmission factor, g, adapted to the particular conditions of each façade (according to the intended use, percentage of glazing, comfort conditions, orientation, etc.) as well as the provision of appropriate solar thermal shading devices where appropriate.

Partial performance indicators

Maximum system (window/door) thermal transmittance - Uw, W/m²K (minimum thermal resistance - Rw, m²K/W), maximum glazing thermal transmittance - Ug, W/m²K (minimum thermal resistance - Rg, m²K/W), maximum frame/joinery thermal transmittance - Uf, W/m²K (minimum thermal resistance

- Rf, m^2K/W), linear thermal transmittance along the glazing contour, Ψg - mK/W and solar factor g; recommended values Uw < 1 $W/m^2/m^2K$ (but not higher than the values recommended by MC001-2022), Ug < 1,2 W/m^2K, Ug < 0,6 W/m^2K, Ψg < 0,02 mK/W.

2.3.4 Sealed envelope

The airtightness of a building envelope is particularly important both from the perspective of ensuring indoor health and comfort and protecting the building against structural damage, as well as for ensuring nZEB energy requirement levels, is ensured by designing a continuous airtight envelope airtightness layer and is a measurable performance.

An airtight building envelope is important for the following reasons:

— Prevents condensation inside the building (structural damage),
— It keeps dry air out and prevents cold air zones on the ground floor (living comfort),
— Prevents harmful substances from outside into indoor air,
— Ensures proper functioning of the ventilation system (air quality) and heat recovery efficiency,
— Ensures the thermal insulating effect of external building components,
— Ensures effective sound insulation of the building envelope.

A rigorous building airtightness design process, a well-executed airtightness solution and a thermal envelope inspection for airtightness performance are absolutely necessary to achieve nZEB performance.

Checking the airtightness of a building should be a prerequisite for assessing its energy performance and a relevant step in determining the quality of the work.

This performance test is carried out in accordance with SR EN ISO 9972 and is intended to assess the air flow at a standardized pressure differential, but also to check how the carpentry has been fitted or whether discontinuities in the opaque area have been resolved, as a measure of building envelope quality assurance.

For the final assessment of the airtightness of a building, the blower door test must be conducted on completion of the works to certify the performance obtained in relation to the requirements imposed following the technical regulations in force. This test may also be conducted at an earlier stage, during the construction phase, after the glazing elements and the opaque envelope layers have been installed, but with access to the sealing layer to allow any remedial work to be conducted.

In order to comply with the minimum hygrothermal comfort requirements for the whole building in terms of minimum airtightness performance, it is recommended that the specification should mention the technologies needed to achieve the required airtightness performance (e.g, for plastering work on buildings with brick masonry or BCA walls or the use of continuous, warm-faced sealing layers for air-permeable lightweight residential walls), i.e. the requirement to carry out the blower door performance test in accordance with SR EN ISO 9972, specifying the number of tests and their timing.

Partial performance indicators

number of air changes through infiltration at a pressure difference of 50 Pa, n50 [1/h] or air permeability of the building envelope at 50 Pa, q50 [$m^3/h/m^2$]; recommended values n50 < 1,0 sch/h at 50 Pa or q50 < 1,0 $m^3/(h.m^2)$.

2.3.5 Minimized thermal bridges

A careful approach to thermal bridging should ensure the continuity of the thermal insulation layer of the building envelope and limit thermal bridges (at the level of thermal insulation of opaque elements, at the junction of windows, doors and other openings in the building envelope with opaque building elements, penetrated thermal bridges).

There is a close link between correcting thermal bridges and the users' comfort and health, including benefits such as:

- eliminating the risk of surface condensation, which can cause mold growth, and the risk of condensation in the structure of the element, which can form during the cold season with the possibility of evaporation during the warm season;
- eliminating significant differences between the inside air temperature and the building envelope's inside surface temperature.

Note: A complementary issue to the energy performance of buildings is building acoustics which includes sound insulation defined by airborne sound insulation and impact sound insulation, sound treatment and the establishment of a reverberation time appropriate to the building use. Building acoustics is significantly influenced by the materials used in the construction of building elements.

The correction of thermal bridges in order to achieve the nZEB standard involves decreasing the heat transfer coefficients of linear or point thermal bridges in order to ensure that the average linear thermal transmittance value at envelope level, □(med), is below the maximum permissible value, in order to obtain an overall thermal insulation coefficient that shows that the building as a whole complies with the performance indicators in force at the time of design.

By correcting the thermal bridges, corrected thermal resistances can be obtained to help plant system designers to ensure minimum renewable energy values.

Partial performance indicator

linear thermal transmittance of thermal bridges, recommended value Ψ(med) < 0,15 W/mK (it is necessary to elaborate the details of execution in the technical design and to submit the calculations of thermal bridges to fulfill the condition).

2.3.6 Heat recovery ventilation

Efficient ventilation is essential to benefit from high indoor air quality while significantly reducing the energy required for heating/cooling the building. Indoor - outdoor air exchange is most efficiently achieved by the provision of double-flow mechanical ventilation systems with heat recovery (with high thermal/recovery efficiency and very low specific energy consumption for air movement).

To use these systems in an energy-efficient way, the air permeability of the building envelope should be kept as low as possible. It is recommended to use mechanical ventilation systems with the lowest possible noise level as well as ventilation ducts with the highest possible noise attenuation or the use of noise attenuators.

Partial performance indicators

In new residential buildings (NZEB) it is recommended to provide for heat recovery ventilation systems with rated efficiency ≥ 75% and specific electrical consumption ≤ 0.15...0.30 Wh/m^3 and in new non-residential buildings (NZEB) it is recommended to introduce mechanical ventilation systems with heat recovery with rated efficiency ≥ 75% and specific electrical consumption ≤ 0.15...0.30 Wh/m^3.

2.3.7 Minimum CO_2 emissions

The environmental performance of a building shall be assessed and certified (by classifying it in classes defined in relation to the level of pollution in the energy performance certificate) by the CO_2 equivalent emissions indicator, expressed in [kgCO_2/m^{2}year] - the amount of CO_2 equivalent emissions of the building in relation to the reference floor area (conditioned building space).

The CO_2 equivalent emissions of the building shall be determined on the basis of the energy demand of the building using transformation factors ($kgCO_2/kWh$), taking into account the CO_2 equivalent amount emitted during the course of a process (such as the combustion of a fuel) by which a primary resource becomes usable as energy at an end-user (may include CO_2 equivalent emissions of other greenhouse gases). For the determination of CO_2-equivalent emissions, conversion factors are set out in MC001-2022.

Depending on the value of the specific CO_2 equivalent emission index, calculated according to MC001-2022 by converting the total primary energy consumed, and expressed in $kgCO_2/(m^2,year)$, the environmental class to which the objective under consideration will fall is determined.

Partial performance indicator

CO2 equivalent emission indicator maximum values, depending on the building type and climate zone, according to MC001-2022.

2.3.8 Significant contribution of RES

The use of Renewable Energy Sources (RES) in the building for various utilities such as water heating, space heating/cooling and electricity generation is the defining feature of nZEB buildings. The main objectives of installing renewable energy technologies are to reduce the use of fossil fuels and reduce CO2 emissions. Renewable energy technologies can be wind generators, photovoltaic systems, solar thermal systems, biomass power plants, biomass cogeneration, biogas or biofuels and different types of heat pumps.

Solar-thermal systems

Using solar panel systems for domestic hot water and heating is a simple and efficient way of generating heat using renewable sources. Two different solar panel systems are currently used: the flat absorber collector with absorber and transparent cover (with a wide range of uses and reasonable costs) and the evacuated tube collector (used where there are high temperature requirements, e.g. in industrial and commercial applications. Depending on the size and energy performance of the building, about 70% of the heat demand can be covered for domestic hot water heating and between 10% and 50% for space heating.

It is important to manage the solar surplus in the summer months during the planning phase. It is therefore recommended to store the extra heat in the storage tank for heating purposes. The preparation of domestic hot water could be realized by a piped water supply system using the heat from the storage tank via an external heat exchanger. In this case a combination with space heating systems can be realized relatively easily.

As solar thermal systems have been widespread and in use for many years, there is already good experience in their planning, design and use. Design optimization might be more expensive than standard design, but can reduce investment and operating costs.

Photovoltaic systems

The cost of purchasing and installing photovoltaic panels has fallen considerably in recent years and their cost-effectiveness has increased as global energy prices have risen.

Photovoltaic solar panels convert direct and diffuse sunlight into electricity. For power generation, either grid-connected systems (on-grid) or stand-alone solutions are used, sized based on the assumption of peak load and storage in a battery system (off-grid) or a combination of both (hybrid).

Off-grid system
It is generally applied in situations where there is no grid connection, and from an economic point of view the installation of a grid connection would cost more than the PV panel system. The system implies the need for storage batteries for independent operation.

On-grid system
The power produced by this system is instantly used by the building, resulting in less purchased energy, therefore a lower bill. If the on-grid PV system produces more electricity than is consumed, the surplus electricity can be fed into the public grid.

Heat pumps

A heat pump is a working thermal machine, which consumes drive energy to transport heat from a low temperature source (usually - the environment) to a high temperature source (the heat user). The Coefficient of Performance (COP) of a heat pump is the ratio of the heat energy obtained to the amount of electricity used for operation, averaged over one year. The higher the COP, the more efficient the heat pump. The driving energy is generally electricity, thus the heating process based on the use of heat pumps is called "electrification of heating". Heat pumps can be reversible, i.e. they can also run in cooling mode.

The heat sources for heat pumps are:

— *Groundwater:*
This is a reliable heat source that ensures a constant heat source temperature virtually all year round - the temperature of the source being virtually equal to the temperature of the ground from which the water is extracted. Careful case-by-case analysis is required, the system needs at least 2 wells: an extraction well and a reinjection well. Approvals from the water authority are required. The system also allows "free cooling" operation without the heat pump compressor. By using low-temperature heating terminals (e.g. underfloor heating systems or fan convectors), good performance can be achieved.

— *Soil - using vertical ground heat exchangers (geothermal probes):*
It ensures a constant heat source temperature virtually all year round, but requires higher investment costs and space for the heat exchanger with the ground field to be located. Approvals from the water authority are required. The system also allows "free cooling" operation without the heat pump compressor. By using low-temperature heating terminals (e.g. underfloor heating systems or fan convectors), good performance can be achieved.

— *Ground - using horizontal ground-source heat exchangers (horizontal coils:*
The system requires a large surface area for installation. It can be used in new or existing building projects with large sites. As the depth at which the coils are mounted is about 2 m, the influence of climatic factors is stronger than with vertical heat exchangers, so the thermodynamic efficiency of the heat pump system decreases at the end of the heating season. The system also allows operation in "free cooling" mode without the heat pump compressor.

— *Air:*
The use of an air source heat pump has the advantage of being easy to install, with minimal expense compared to all previous solutions, but with lower thermodynamic performance. This is due to the fact that, during the heating period, the heat source (the outside air) has low temperatures, which requires a higher consumption of drive energy both for raising the temperature level of the heat supplied to the consumer and for defrosting the vaporizer. In addition, heat pumps that use ambient air as a heat source cannot recover condensation heat in summer as well as heat pumps that use the ground as a heat source.

Biomass power plants
Biomass differs from other Renewable Energy Sources (RES) as there is a wide diversity of feedstocks that can be converted into gaseous, liquid and solid fuels, through various conversion processes. In energy production, biomass is most efficiently used in cogeneration plants (high efficiency cogeneration), applied for district heating or other integrated cogeneration processes. In these cases by-products and residues are burned with up to 90% efficiency. Efficiency can be increased by applying advanced solutions, e.g. if solutions/systems for biofuel or bio-liquid production are also integrated in the cogeneration plant.

The traditional use of woody biomass in rural Romania has been in the form of firewood (especially in areas where there is no natural gas distribution network), used for heating and hot water preparation. However, certification of wood origin (for classification as biomass) can be a problem, and the use of combustion plants with very low efficiencies (around 20-40%) makes these systems inefficient and polluting. Support is needed through national/regional programs to switch from these inefficient plants to modern boilers with proper efficiencies (> 75%).

Partial performance indicator

RER, recommended value (minimum) 30%.

2.3.9 Economic efficiency/feasibility

The regulated minimum energy performance requirements for buildings and building elements are set following Regulation 244/2012 implementing Directive 2010/31/EU with a view to achieving cost-optimal levels.

The economic analysis of energy renovation measures for an existing building is conducted using specific economic indicators:

— **overall discounted cost**, i.e. the sum of initial investment costs, annual operating costs, replacement costs (with reference to the first year), as well as disposal (demolition) costs if necessary, **CG(m)** [lei, Euro], determined over a given period of time (TC=20 years commercial buildings, 50 years residential buildings, 30 years other categories of buildings);

— **payback period** for the implementation of an energy efficiency project, **PB** [years] (PayBack), representing the time from the moment the investment is made (e.g. energy retrofit of a building) until the net present value of the overall cost becomes 0 or negative (or the cash-flow of the investment becomes positive).

The economic efficiency calculation is performed according to SR EN 15459-1 and can be applied to both new buildings (NZEB) and existing buildings under renovation.

The calculation method is used to aggregate past, current and future costs over a calculation period. When this period includes the demolition of the building, the disposal costs (i.e. for demolition/decommissioning) are also included.

The overall discounted cost is obtained according to the scenarios, limits and data used for the calculation. The result can be used to compare different options or solutions. The payback period illustrates the potential of the different options compared to a baseline situation when the initial investment is expected to be recovered.

Partial performance indicator

CG(m) [lei, Euro], **PB** [years], recommended values CG(m) < 0 over the service life of the building, PB < the set lifetime of the intervention measures.

nZEB performance requirements and the transition to ZEB
The nZEB performance levels have been mandatory since 2001 for all **new buildings**, and for existing buildings undergoing **major renovation** *(interventions where the total cost of the works designed and carried out on the building envelope and/or its technical systems exceeds 25% of the rateable value*

of the building excluding the value of the land on which the building is situated) MC001-2022 sets performance level thresholds almost as ambitious as those set for nZEB.

The latest revision of the Energy Performance of Buildings Directive (EPBD) in May 2024[6] foresees the new energy performance standard of "Zero Emission Building" (ZEB) which will replace the current nZEB standard from 2028 for public buildings and from 2030 for all buildings. ZEB is defined as a building with very high energy performance that requires zero or very low energy, produces zero on-site fossil fuel carbon emissions, and produces zero or very low operational greenhouse gas emissions.

For a building to be ZEB, its total annual primary energy consumption must be covered by one of the following options:

— renewable energy produced on-site, nearby or supplied by a renewable energy community,
— energy from efficient district heating and cooling,
— energy from carbon-neutral sources.

Ce reprezintă ZEB?

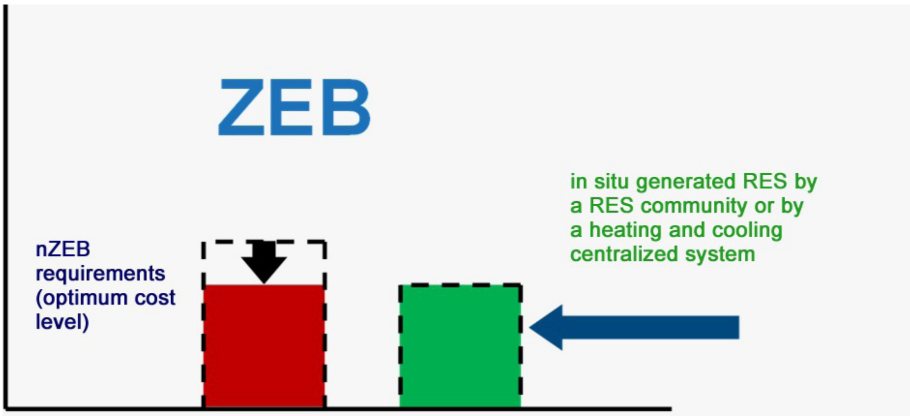

Fig. 4

Graphical interpretation of the ZEB definition according to EPBD recast (May 2024).

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Directive (EU) 2024/1275 of the European Parliament and of the Council of April 24, 2024 on the energy performance of buildings (recast), published in the Official Journal of the European Union, Series L of 8.05.2024

Renovation interventions

The aim of the intervention works is to increase the energy efficiency of existing buildings, resulting in a significant reduction in greenhouse gas emissions from burning fossil fuels. At the same time, energy-saving and thermal insulation interventions contribute to improved living or use conditions by providing a healthy and comfortable environment. An energy audit of the building is necessary to determine whether it is necessary to conduct these interventions.

The first step in the energy renovation process is an **energy audit of the building[7]**. This results in the classification of the building in an energy performance class and the definition of scenarios for the implementation of energy renovation measures based on technical and economic calculations. The decision to intervene is taken by the beneficiary/owner(s) association or building manager, based on the feasibility scenarios provided by the building energy audit.

When defining and implementing public financing programs, it is proper to impose minimum performance requirements for the building to be brought up to following energy renovation, higher than those imposed by the legislation and technical regulations in force. For example, certain performance classes can be set for the renovated building, or the energy performance of the building may have to be improved by reducing its energy consumption by a minimum percentage, clearly determined in the documents relating to the funding programs. The provision of partial performance indicators in line with the nine pillars of the nZEB concept, and the level of ambition set by these values in public funding, as well as the provision of conditions for verifying performance (e.g. mandatory air permeability testing with a blower door), make a significant contribution to ensuring performance in reality and can generate good practice in the construction market by setting an example for public authorities.

It may also be envisaged that the related measures and requirements on the energy performance of buildings lead to a reduction in heating energy consumption of at least 50%-60% compared to the pre-retrofit condition. According to the legal framework in force at the time of drafting the guidelines, a major renovation of a building aims at improving by more than 60% the energy performance of the building, as calculated according to the MC001/2022 methodology, in relation to the current condition and normal use of the building.

Following the transposition into national legislation of the provisions of the new EPBD revision (May 2024) "**deep renovation**" is considered as a renovation that is in line with the "energy efficiency first" principle, that focuses on essential building elements and that transforms a building or building unit with nearly zero energy consumption - nZEB (before January 1, 2030) or a zero-emission building - ZEB (from January 1, 2030).

Extensive renovation of a building generally involves measures such as:

— Reducing the energy demand for heating/cooling by increasing the thermal performance of the building envelope to at least the requirements recommended by MC001-2022;
— Increased comfort and energy efficiency, including by bringing the HVAC (heating, mechanical ventilation and cooling), domestic hot water and lighting installations within the performance parameters specified in the technical regulations;
— Introducing local renewable sources of electricity and heat;
— Measures to educate users with the aim of rational energy use in buildings.

Connecting to the district heating network could be an effective solution for providing a low-emission energy source for the new reduced heating demand and domestic hot water by providing renewable energy sources at system level, which can provide a percentage of the building's energy consumption.

These measures aim to achieve effects such as:

— Sustainable reduction of operating costs and utilities consumption: heat and electricity through energy efficiency and the introduction of renewable energy sources;

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The activities specific to the energy audit and finalized with the audit report are carried out according to the technical regulation Methodology for calculating the energy performance of buildings Mc 001 and nZEB levels defined in the legislation in force

- Restoring the functional ability, resistance, comfort and aesthetic appearance so that the buildings and installations can be operated in maximum safety;
- Implementation and compliance with legislation on environmental protection, fire prevention and extinguishing, waste collection, as well as technical building regulations.

Indicative list of in-depth renovation measures:

a. Intervention work on the building envelope:
   - On the glazed part of the facade - replacement of the existing external joinery, including that related to the access to the building, with thermal insulating joinery (triple glazing solutions, with thermal transmittance values below the maximum allowable limit for high energy performance buildings);
   - thermal insulation of the facade - opaque part, with thermal insulation systems with sustainable, low environmental impact and high efficiency materials;
   - thermo-hydro-insulating the unheated terrace or unheated attic with thermal insulation systems, where proper; replacing the roofing with an alternative solution, as far as justified by a better thermal performance, which would contribute to the energy performance of the building (improved insulation and thermal inertia);
   - provision of adaptable solar shading systems, including adjustable blinds, in façade areas with significant solar gain in the hot season;
   - thermal insulation of the unheated basement floor, basement walls (when the basement is used for business or areas of it);
   - Ensuring a high level of air tightness of the building, both by properly fitting the thermal insulating joinery in the building envelope and by applying appropriate technologies to reduce the air permeability of the opaque envelope elements and to ensure the continuity of the airtight layer in the building envelope.

b. Intervention works on the heating system / hot water supply system:

   In buildings connected to centralized heat supply systems
   - repair/replacement of the distribution installation in the basement area, the thermal duct and the heating plant building, if necessary, including its thermal insulation, as well as the installation of differential pressure valves at the base of the heating columns in order to increase the efficiency of the heating system by thermo-hydraulic self-regulation of the network;
   - rehabilitation and modernization of the distribution installation of thermal agent - heating and domestic hot water, including zoning (regulation by zones) and balancing of thermal installations, installation of thermostatic valves on radiators;
   - Replacement of the current vertical distribution system with a horizontal distribution system (this involves reducing the number of vertical columns arranged along the height of the block, with columns found at stairwell level, allowing each apartment on that level to be connected);
   - the installation of flow meters on hot and cold water connections and heat meters, including those fitted with remote data recording and transmission devices;
   - providing an efficient recirculation system for domestic hot water,

Buildings with their own energy supply systems:
— the repair/replacement of boilers and/or burners in the central heating plant, the repair/replacement of the central heating plant, the replacement of existing boilers, to increase efficiency and reduce CO2 equivalent emissions, including heat pumps or micro-cogeneration plants, if technically and economically feasible;
— Assessing the possibility of installing gas-fired heat recovery units in the central heating plant, if appropriate, following an energy audit of the building;
— replacement/fitting with radiators/fan coil units;
— repair/replacement of the installation for the distribution of heat for heating and domestic hot water;
— partial or total redesign and refurbishment of the heating distribution and transfer installations in the building, where applicable, so as to minimize heat loss in unheated areas, to ensure compatibility with the cooling transfer system (by fan coil units, where applicable), to ensure locally regulated indoor climatic comfort and an integrated look and feel in the interior design;
— installation of thermostatic valves on radiators;
— providing water saving solutions at the point of use.

c. installation of alternative systems for the production of electricity and/or heat for own consumption,

d. Installation, where appropriate, of alternative energy production systems: decentralized renewable energy supply systems, such as solar thermal collector installations, photovoltaic solar panel installations, high efficiency cogeneration and centralized heating and/or cooling plants, heat pumps and/or biomass thermal or cogeneration plants, ground-to-air heat exchangers, heat recovery units, in order to reduce energy consumption from conventional sources and greenhouse gas emissions, etc.

e. installation/replacement/modernization of cooling, natural ventilation and mechanical ventilation systems to ensure indoor air quality:
— ensuring indoor air quality through organized natural ventilation or hybrid ventilation (including common spaces), repairing/replacing ventilation ducts to maintain/achieve organized natural ventilation of occupied spaces;
— repair/replacement/assembly of cooling systems/equipment, air conditioning, mechanical ventilation installations with heat recovery, as proper, air-only cooling systems for ventilation and/or heating/cooling, air humidifiers/dehumidifiers, air-to-water cooling systems with fan coils, heat pumps, as appropriate;
— introduction of centralized air conditioning and centralized mechanical ventilation with high-efficiency heat recovery for the whole building;
— installation of local mechanical ventilation systems with heat recovery and centralized operation (as a whole-space conditioned ventilation system), e.g. through an automation system.

f. rehabilitation/ modernization of lighting installation in buildings:
— rehabilitation/ modernization of the lighting installation;
— Replacing fluorescent and incandescent luminaires with energy-efficient, long-life luminaires;
— installation of luminaires with motion/presence sensors, where required for energy savings;
— replacement of electrical installations general interior lighting, safety lighting for marking escape routes and hydrant positions, installations for general use sockets for extensions;

— redesign and replacement of existing lighting systems with energy-efficient lighting systems and appliances, LED or other sources, including light tubes, if applicable, with automatic local and/or centralized control of the lighting level, so as to ensure the priority lighting technical parameters (illuminance level, colour rendering index, colour temperature, lighting uniformity, etc.) and the level of lighting comfort required by the standards in force for the category of spaces under analysis. Those in common spaces (corridors, staircases, GS) are provided with presence and daylight sensors;
— installation of natural and artificial lighting level sensors with intensity adjustment.

g. integrated energy management works for buildings and other activities leading to the achievement of the building energy efficiency project objectives (as defined in the energy audit solution):
— installation of intelligent metering, tracking and recording of energy consumption, and/or, where proper, installation of integrated energy management systems, such as automation, control and/or monitoring systems, which aim at and enable energy savings in the technical building systems;
— installation of equipment for measuring energy consumption in the building for heating and hot water;
— Implementation of energy consumption management systems: purchase and installation of intelligent systems for electricity/natural gas management;
— installation of active control systems, such as automation, control and/or monitoring systems, aimed at energy savings, preferably *Building Energy Management Systems* - BEMS;
— connecting/reconnecting the building to the centralized system of production and/or supply of thermal energy.

h. Other technical solutions that can help achieve nZEB levels:
— implementation of passive energy efficiency measures through architectural reconfiguration, if technically and financially possible (e.g. solar spaces attached to existing buildings or indoor/outdoor shading elements on facades, with the possibility of automated operation);
— analyzing the possibility of installing temperature sensors in the rooms, connected to the automation system so that when the temperature rises or falls, they can switch off/on the heating/cooling systems;
— the introduction of centralized or decentralized VAV variable-flow mechanical ventilation and air-handling systems with high heat recovery (recommended for non-residential buildings); it should be possible to adjust the HVAC separately per room according to the requirements of the room's intended use;
— the introduction of centralized or decentralized cooling systems, considering the needs created by the development of new premises in the sizing calculation, if necessary. Choosing the cooling source should consider at least 3 options: the electric chiller with compression system, the thermo-chemical chiller system and the trigeneration system. The opportunity of distributing the climate agent by fan coil or mechanical ventilation system will also be analysed;
— providing free cooling and/or heat recovery for premises where servers and IT systems are or will be located;
— the introduction of heat accumulators for storing surplus heat, in conjunction with local CHP or renewable generation, solar thermal collectors;

— producing, at least partially, the cooling needs by using renewable sources, solar thermal collectors in combination with thermochemical chillers - solar cooling;
— solutions for the implementation of an energy metering and monitoring system for utilities and consumption areas, so as to demonstrate the level of energy consumption achieved after the modernization and the increase in efficiency, respectively to enable the building energy management, in accordance with the ISO 50001 Energy Management System standard, with monitoring and tracking (M&T) tools, respectively for measuring and verifying the savings achieved (M&V), according to the International Performance Measurement and Verification Protocol (IPMVP).

Renovation passport

Law 372/2005 with subsequent amendments and additions (February 2025) defines **the Passport for the energy renovation of buildings** as a document or set of documents, structured in electronic and physical format, containing information relevant to the energy renovation of the building and allowing the maintenance of the overall picture of the building's history and the planning of renovation stages in order to achieve major renovation levels with a long time horizon. The Building Energy Renovation Passport includes the developed Building Energy Renovation **Roadmap** - as a customized building energy renovation plan, obtained through the building energy audit activity, which assesses the building as a whole, taking into account the needs of the occupants, and provides a building renovation strategy with a carbon savings target agreed with the building owner and a phased implementation plan of reasonable and coordinated measures to improve the building's energy performance in the long term.

According to the revised EPBD[8] the renovation passport means a tailor-made roadmap for the deep renovation of a building in a maximum number of steps that will significantly improve its energy performance. The deep renovation is the renovation of the building according to the energy efficiency first principle, which focuses on key building elements and transforms a building or building unit into a nearly zero energy building (nZEB) before 1 January 2030 or a zero emission building (ZEB) from 1 January 2030.

Thus, all existing buildings that undergo an energy audit for inclusion in public financing programs for energy renovation will have a renovation passport at the end of the audit, which will consider:

— phased (step-by-step) renovations gradually leading to a deep renovation,
— avoiding mistakes by early preparing for later renovation measures,
— aligning with overall national construction objectives,
— informing on future requirements and obligations (e.g. fossil fuel ban, minimum energy performance standards) to prepare the building and meet all legal requirements.

The Renovation Passport is basically the **result of the energy audit of the building for in-depth renovation with a step-by-step presentation of the proposed intervention solutions**. It is a diagnostic tool for the energy performance of the building and a phased renovation plan for building owners. It substantiates the renovation financing sources, either from the owners' own sources or for providing insurances to financing institutions, to grant the necessary funds for major energy renovations.

iBRoad2EPC: a modular approach

The iBRoad2EPC project funded by the EU through the Horizon 2020 program has developed a flexible and affordable renovation passport that meets EPBD requirements. This modular tool bridges the gap between Energy Performance Certificates (EPCs) and renovation passports, motivating building owners to undertake deep renovations. The iBRoad2EPC

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tool provides an easy-to-use web interface for energy efficiency professionals, generating standardized, printable documents. The Renovation Passport includes various modules, such as investment costs and energy requirements, which can be tailored to national priorities.

Check items for different types of intervention

Intervention works to existing buildings should ensure that there are no major negative influences in terms of achieving environmental objectives on the activity itself or on people, nature or assets, and improvements to the built environment should aim to consider the full life-cycle impacts.

The impact of the intervention (renovation) measures in reducing CO2 emissions shall be proven by comparing the assessments before and after the energy renovation works. The verification elements for energy renovation are:

a. before the works are started:
   - energy performance certificate;
   - the energy audit report (or the renovation passport) with the proposed renovation measures necessary to achieve the energy efficiency indicators foreseen by the project, respectively the energy efficiency indicator values expected to be achieved after the renovation; in the case of phased renovation, the renovation passport will include the performance indicators to be achieved for each phase, respectively the final level of performance (after the last phase of intervention);
   - provisions in the specifications for the preparation of the technical-economic documentation and the technical design (description of how to reduce greenhouse gas emissions both during construction and building compliance).

b. after the completion of the works (for each stage of intervention): the energy performance certificate on completion of the works.

Integrated renovation interventions

Guidelines for integrated intervention works in multifamily residential and public buildings (RTC 1 - 2022)[9] *includes information on:*

- the benefits of an integrated approach to interventions on existing buildings
- Triggers for integrated intervention, which inform the intervention decision.

Buildings of historical and architectural value

Intervention Methodology for non-invasive approach to energy efficiency in buildings with historical and architectural value[10] describes the intervention framework for improving the energy performance of buildings that are listed as historical monuments and those with environmental and cultural value. The methodology includes best practice principles and framework solutions, facilitating replicability across building systems or building typologies, putting each intervention case in context.

Identification of strategic solutions for modern and sustainable development of the built environment in connection with centralized heat and energy supply systems (SACET)

The concept of nZEB and/or comprehensive energy retrofit of buildings refers to an integrated approach to the **construction, installations and use of renewable energy sources**, both at the building level and by extending the approach to a group of buildings, neighbourhood, community. Thus, if centralized heat and energy supply systems (ro. SACET) are available, the approach to interventions in the built environment should consider integrative urban utility infrastructure measures, including both the modernization of transfer and distribution networks, and of the energy generation sources.

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Approved by ORDER No 3.230 of December 14, 2022, published in the Official Monitor of Romania, Part I, No 1213 of December 19, 2022

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Approved by ORDER no. 3.568 of December 22, 2022, published in the Official Monitor of Romania, Part I, no. 1260 of December 28, 2022

For the existing building stock energy renovation, the already in place infrastructure of the existing SACETs in the country should be considered as a possible solution. It should take into consideration the present situation and the history of this utility structure type in the country, the relevant number of dwellings connected to the district heating in some urban areas (e.g. Bucharest, Timișoara, Oradea, etc.), and the important areas in the municipalities that it still serves (large residential neighbourhoods with high density of housing)

SACET can be a solution to the mass energy renovation that is expected in the coming years in the buildings sector, having very strict energy efficiency requirements in terms of primary energy consumption and CO2 emissions. This level of performance will be difficult to meet by providing energy from conventional sources, together with energy from renewable sources found at building level, managed by the apartment owners.

Thus, the necessary technical-economic measures, which concern thermal energy production installations (heating and hot water for consumption), should be managed at institutional level (procurement of financing, implementation of systems and their operation), through an energy supplier. This solution is identified as attractive and of great interest for both institutions and apartment owners.

In this context, there is an important opportunity for the relaunch of SACET, its modernization **closely following the legal requirements for buildings**. The existing stock of buildings should be a key factor in the modernization of SACET, as they represent the company's current and potential customers.

The modernization of district heating in the country's municipalities can become a widely applicable solution for achieving the mandatory nZEB performance level for all new buildings. It can include the requirement of ensuring a minimum contribution of 30% of the building's energy consumption from renewable sources found within a 30 km distance from the building's GPS coordinates - for both the residential and non-residential, public and private sectors.

Special attention is given to the existing built stock, for which **the current district heating network converges towards the fourth stage of the transition towards intelligent energy systems.** This is a possible technical solution in transforming it into a zero-emission built stock, in line with the requirements of the new Directive on the energy performance of buildings[11].

The renovation of the existing building stock, in conjunction with the modernization of the district heating network, leads to the prioritization of the heating network upgrade within the renovation plans of the existing buildings of the respective area.

It is identified as being attractive and of interest (**including for apartment owners**) that the necessary technical-economic measures, which are aimed at thermal energy production installations (heating and hot water), be managed at institutional level (procurement of financing, implementation of systems and their operation), through an energy operator. This **practically transfers the necessary costs of these investments from the household to an institution, with a positive effect on reducing energy poverty, with direct support for vulnerable consumers.**

The strategic approach of transforming the district heating network into a technically feasible technical-economic option for consumers in municipalities in Romania, where it exists as an infrastructure, as a direct solution to the legal requirements applicable to buildings, will subsequently allow the implementation of measures (e.g., through local regulations) such as: for all new buildings located in areas served by SACET, heating and preparation of hot water for consumption must be provided by connection to SACET.

Recommendation for the use of financing for public buildings: the requirement in the specifications drawn up by the Public Authority that

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when renovating public buildings, the source of heating and hot water preparation should be provided by the district heating network, if there is a network in the area in question or if an existing network can be extended nearby.

3 Green buildings

Green (or sustainable) buildings are structures designed, built and operated with minimal resource consumption to improve people's quality of life and reduce negative impacts on the environment (natural or built). These buildings contribute to the transition towards climate neutrality by reducing the carbon footprint of the construction sector.

The main characteristics of a green building are:

1. Energy efficiency
   — High-performance thermal insulation and efficient joinery to reduce heat transfer to the outside in winter and reduce overheating in summer.
   — Using the most energy-efficient systems.
   — Integration of renewable energy (solar panels, heat pumps, etc.)

2. Material
   — Raising awareness and reducing the carbon footprint of stored carbon.
   — Use recycled, high recycled content or local materials.
   — Use finishes with the lowest possible emissions of volatile organic substances or formaldehyde.
   — Ability of the building to adapt to use changes.
   — Building resilience to climate change.

3. Comfort and health conditions for building users
   — Thermal comfort
   — Access to natural daylight, outside view, natural ventilation possible
   — Acoustic comfort
   — Quality of artificial light
   — Encouraging movement
   — Ergonomic furniture
   — Crisis (e.g. sanitary or climatic) measures, procedures and facilities in place

4. Water management
   — Reducing drinking water consumption
   — Greywater reuse
   — On-ground retention of rainwater, reducing the amount discharged into sewers

5. Urban heat island effect
   — Reducing impervious surfaces
   — Use high albedo finishes for waterproof surfaces
   — Shade

6. Impact of building sites
   — Ensuring safety and comfort for those on site
   — Reducing environmental impact
   — Separate collection of construction site waste

7. Reducing the impact on the natural environment
   — Protecting ecological assets
   — Creating green spaces, green roofs, planting, infrastructure for birds and insects

8. Running buildings efficiently
   - Testing procedures for the functioning of systems within the designed parameters
   - Environmental policies
   - Energy management
   - Annual reduction targets for utilities consumption and waste generation.

Voluntary certifications

As the topic of sustainability of the built environment covers a very wide range of topics, with performance levels often under discussion, related to several specializations, subject to constantly changing regulations, some organizations have developed their own criteria for assessing the sustainability of the built environment. This gave rise to voluntary building certification schemes, among the best known being BREEAM (Building Research Establishment's Environmental Assessment Method) and LEED (Leadership in Energy and Environmental Design), created by BRE (Building Research Establishment) and USGBC (United States Green Building Council) respectively.

DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen e.V.) is the rating system developed by the German Society for Sustainable Building.

LBC (Living Building Challenge) is another certification system created in the USA by the Living Future Institute. Unlike the first 3 certification schemes described above, it is not designed as an assessment, resulting in levels of certification, but aims to be less bureaucratic and only attest to very high levels of performance. For example, it does not define a lot of measures that contribute to reducing energy consumption, but only requires monitoring systems to be in place and to produce 5% more energy than is consumed in a year, which has to be demonstrated in reality, not through studies or simulations.

Main features of BREEAM, LEED, DGNB and LBC certification schemes

1. **Based on science and research.** Requirements, methodology, performance levels, based on science, standards, legislation. With each new release, all data is reviewed, new regulations integrated.
2. **They set more ambitious performance levels than legislation.** Being voluntary certification schemes, the aim is to define a legally binding higher performance.
3. **Comparability.** The weight of each requirement in the final score depends on the chapter, the type of building, the existence of systems, facilities, the country. Thus, a calibration of the value of each requirement in the final score is conducted to enable a comparison of the sustainability performance of any building by the final score it gets, regardless of its use or location.
4. **Credibility.** Certifications are conducted by independent auditors and the documentation they produce is audited each time by the organization issuing the certificate. The reputation of these organizations depends primarily on the quality of these audits. The certification documents are drawn up in such detail that they are always open to challenge. As a result, society, building users, financing institutions, building owners, etc. can be confident that an obtained voluntary certification shows the level of environmental performance of a building.

BREEAM, LEED and DGNB are voluntary building sustainability rating systems. This means that there are several mandatory requirements, after which almost any building can be certified. Therefore, if we are talking about environmental performance, it is particularly important to consider the score and/or the level achieved.

Also, the certifications are fit for purpose: urban planning projects, new buildings, existing buildings, major refurbishments, interior design. We propose to encourage only urban planning projects, new buildings and major refurbishments, whose maximum levels would be as follows:

— BREEAM Communities Outstanding (score min. 85%) - urban planning projects
— BREEAM New Construction Outstanding (min score 85%) - new buildings
— BREEAM Refurbishment & Fit-Out (min. Part 1 and Part 2) Outstanding (score min. 85%) - major refurbishments
— LEED Neighborhood Development Platinum (score min. 80) - urban planning projects
— LEED Building Design and Construction Platinum (min. score 80) - new buildings and major renovations
— DGNB Districts Platinum (score min. 80) - urban planning projects
— DGNC New Construction Platinum (score min. 80) - new projects or major refurbishments
— Living Community Challenge - Certified - urban planning projects
— Living Building Challenge - Certified - for new projects and major renovations

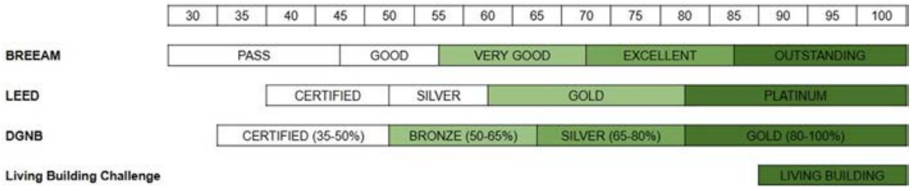

Fig. 5

Scores for the certification levels of the 4 certification schemes presented
Source: Adrian Pop

There are many other certification schemes. The 4 outlined above are the most important holistic certification schemes, addressing resource savings, user comfort and reducing environmental impact. Other certification schemes deal exclusively with energy efficiency (e.g. Passive House), resource savings (e.g. EDGE scheme) or only with the comfort conditions of building users (e.g. WELL).

Fig. 6

The logos of the 7 certification schemes presented
Source: Adrian Pop

Passive House Institute

The Passive House Institute - PHI was started in 1996 by Dr. Wolfgang Geist after having realized in 1990 the first passive house project - Kranichstein Passive House, Darmstadt, Germany. The first research and discussions started in the 1980s by a group of engineers and architects in Germany. The question was: why did buildings at that time consume so much energy, why did people get cold in winter and why were the costs so high?

According to the PHI website www.passivehouse.com the differences between a passive house and a low-energy house are:

— 'Passive Houses enable up to 90% energy savings for space heating and cooling compared to the current stock of buildings and over 75% compared to the average new build. Passive Houses use less than 1.5 litres of oil or 1.5 m3 of methane gas to heat one square meter of living space per year - substantially less than a typical "low consumption" building. Large energy savings have been proven in hot climates, where typical buildings also require active cooling.
— Passive Houses make efficient use of the sun, internal heat sources and recover heat, eliminating the need for conventional heating systems even in the coldest winters. During warmer months, Passive Houses use passive cooling techniques such as strategic shading to keep the interior space comfortable.
— Passive houses are appreciated for the high level of comfort they offer. The temperature of interior surfaces varies little from the indoor air temperature. Special windows and a building envelope consisting of an extremely well insulated roof and floor, as well as extremely well insulated exterior walls, keep the desired warmth in the house and the unwanted warmth out.
— An imperceptible ventilation system constantly supplies fresh air, creating superior air quality without unpleasant draughts. A heat recovery system allows reuse of heat from the exhaust air.'

The best-known requirement is for the heating energy requirement to be less than 15 kWh/m2/year, at a time (2000) when even lighting consumption was higher than this. Indoor air tightness is extremely important, with a maximum of 0.6 air changes/hour at a pressure of 50 Pascal (ACH50).

There are no special requirements for artificial or natural lighting in this certification scheme. There is only one special requirement for windows, namely that 'window frames must be properly insulated and fitted with low-e glazing filled with argon or krypton to reduce heat transfer. For most cold temperate climates, this means U-values of 0.80 W/(m²K) or less, with g-values around 50% (g-value = total solar transmittance, the proportion of solar energy available in the room)'. For lighting in residential buildings, two pages of calculations will indicate the daily and annual usage, room orientation and geometry, and window sizes and heights for daylight use of each space. Artificial lighting is complementary to natural lighting.

In the case of the Passive House the focus is on thermal insulation and airtightness, which are passive elements, and less on lighting, whether artificial or natural. There is no particular interest in the materials used, as long as the Passive House targets are met, and the concept fits well with the New Green Deal.

The carbon footprint of a building

The carbon footprint analysis of buildings calculates the entire life cycle of a building, from the extraction of raw materials, the production of building materials, their transportation to construction sites, construction processes, construction site waste, the operation of the building over a period of 50 or 60 years, the maintenance, repair or replacement of building components, to the demolition or major renovation of the building.

Building life cycle information																Supplementary information beyond the building life cycle
Product stage			Construction process stage		Use stage							End of life stage				Benefits and loans beyond the system boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacturing	Transport	Construction installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction / demolition	Transport	Waste processing	Disposal	Reuse, recovery, and recycling potential

Fig. 7

Life stages of a building
Source: Adrian Pop

Currently, the stored carbon footprint of a new building, i.e. the carbon footprint of the early stages of a building's life cycle up to the handover of the building, accounts for between 33% and 70% of the total carbon footprint. As the energy required to run a building decreases and the energy supplied by the grid is decarbonized, the stored carbon footprint will become increasingly important. As a result, it is very important to adopt measures that also reduce the stored carbon footprint.

The materials with the highest carbon footprint impact are concrete and steel. The transportation of materials has a fairly large impact in this carbon footprint calculation, whereas wood has a negative carbon footprint in the stored carbon footprint calculation, as it is considered to have stored carbon dioxide from the atmosphere before becoming a building material.

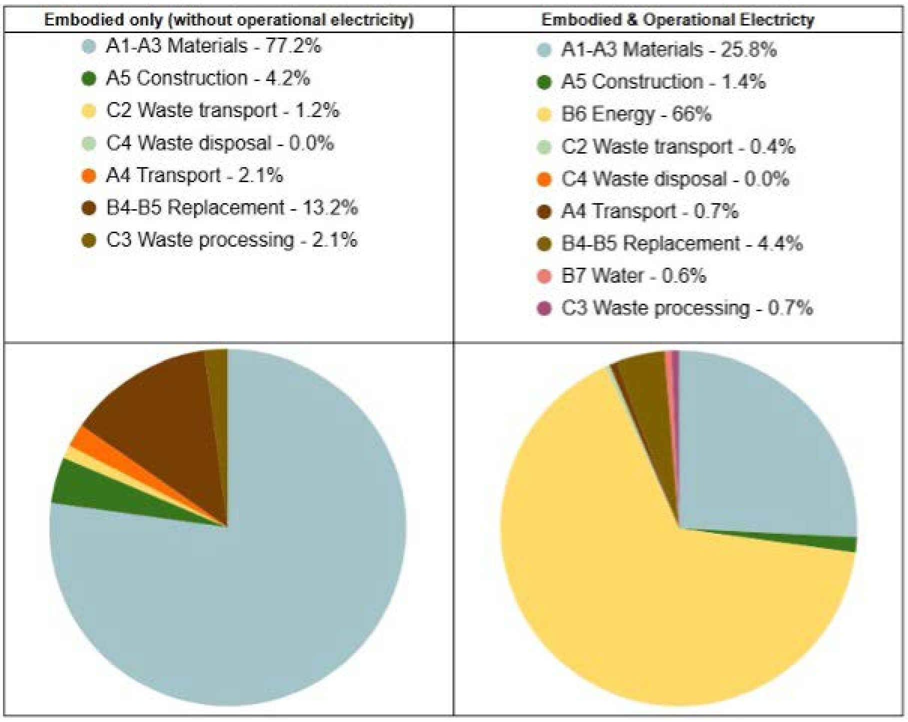

Fig. 8

The carbon footprint broken down by life stages without operational energy consumption (left) and including operational energy (right), respectively, of a projected office building in 2021
Source: Adrian Pop

Restorations, major refurbishments, renovations therefore have a key role to play in this respect, as they have the potential to greatly reduce the carbon footprint. However, on a case-by-case basis, whether they can also provide the necessary comfort conditions and whether efficient land use can still be ensured. The cultural value of buildings classified as historical monuments cannot be quantified in terms of CO_2 emissions.

Local public administrations may impose several measures as mandatory or scored criteria in tenders for public works, or they may introduce these requirements in the approval stages of urban planning documents. Examples of measures:

— Exclusive use of eco-friendly concrete with high recycled aggregate content;
— Use of FSC-certified or similar wood for structural elements, reducing concrete and steel consumption;
— Use of local materials, mined and processed within a radius of up to 250 km
— Use of recycled building materials;
— Construction and demolition waste management - see chapter **Waste management and the circular economy**.

4 Tools for the transition to climate neutrality

Local governments have several tools at their disposal that can incentivize the environmental performance of buildings and significantly reduce the carbon footprint of buildings, both the stored carbon footprint from the construction process and the operational carbon footprint from the use of the building. These instruments can be strict, mandatory rules to ensure a minimum, or a system of rewards and penalties to aim for high performance.

1. **Tax relief**: Tax relief for environmentally efficient buildings can stimulate sustainable investment. A building tax rebate of up to 75% for 5 years can be granted to buildings that achieve voluntary certifications such as BREEAM New Construction / Refurbishment Outstanding level, LEED BD+C Platinum level, DGNB New Construction / Renovation Platinum level or Living Building Challenge - Living Certification. Lower levels of certification should be removed to reflect current standards of excellence.
2. **Criteria in public tenders**: Public works may include mandatory requirements or additional scores for environmental performance. For example, 10-15% of a tender score can be given to the implementation of environmental measures. Penalties for non-compliance must be proportional to the score obtained.

Related areas:

— **Rehabilitation and transformation of urban spaces:**
  — Conversion of old buildings,
  — creating urban green spaces.

— **Reduce resource consumption:**
  — Water management efficiency technologies
  — minimizing polluting construction materials.

4.1 The impact of building audit: from energy inefficiency to NZEB

In public buildings, at the same time as **energy inefficiency**, another phenomenon is happening: **energy poverty**. As we use high cost energy and do not ensure indoor comfort in buildings, heat is either in excess or deficient in the north-facing parts of buildings, lighting is substandard and, above all, indoor air quality is significantly degraded.

This phenomenon is also well reflected in the ratio of electrical/thermal consumption: while for residential buildings this ratio is in the usual 3-5 range, for public buildings the range is much wider, between 4-10, according to multi-yearly statistics from over 50 energy efficiency improvement programs.

Improving the energy efficiency of the existing stock of public buildings is essential both for achieving national targets on energy efficiency and CO2 reduction (climate neutrality), but also for reducing energy costs for local public authorities, improving indoor comfort and avoiding energy poverty.

First of all we need to know how, where and when energy is used in the building, and this is achieved through a building energy audit, according to the law on energy performance of buildings and the related MC001 Methodology, respectively as appropriate and according to the energy efficiency law, no. 121/2014. The main objective of the audit is to substantiate and quantify, through cost-benefit analysis, an integrated and correlated package of feasible solutions to increase energy efficiency, respectively to ensure local renewable sources as much as possible for the more efficient consumption. The energy performance of a building is determined by assessing 5 consumption vectors, namely: heating, domestic hot water, cooling, mechanical ventilation (with heat recovery) and lighting.

So an energy audit is NOT just the energy certification of the building.

The energy performance certificate provides an assessment of a building's energy efficiency, but in a standardized way. It provides information about the estimated energy consumption under a standardized building operating regime and assigns an energy rating on a scale from A+ to G, where A+ represents the most energy efficient building and G the least energy efficient or in specialized terms the highest or lowest energy performance.

In the case of buildings under the administration or ownership of public authorities, according to HG 907/2015 with all subsequent additions, the energy audit developed according to the MC001 Methodology is mandatory before any renovation work is carried out on buildings, it has the role of identifying and substantiating the package of necessary interventions.

In the case of commercial or private buildings, in order to conduct a major renovation of the building, the owners must obtain a building permit which will be issued on the basis of a technical documentation including a Building Energy Audit.

According to Law No 372, major renovation refers to "works designed and carried out on the building envelope and/or its technical systems, the cost of which exceeds 25% of the building's taxable value, excluding the value of the land on which the building is situated".

On the other hand, beyond the legislative aspects and requirements, in our experience, implementing one-off solutions without having an overview of consumption and a well-developed plan will not achieve the desired results.

The building audit gives us a strategy so that we know which solutions to implement, at what cost, in what order and with what impact on the building's energy efficiency and indoor comfort.

Energy audit solutions begin with the reduction of the heat flow and uncontrolled heat losses through the building envelope, as well as better efficiencies throughout the local energy production, distribution and exchange chain. Almost all the solutions proposed for all heating, air-conditioning or mechanical ventilation installations, or renewable energy sources are directly dependent on and influenced by the level of energy performance that can be achieved at the building envelope.

Also in practice, the first solutions to be implemented involve interventions at the level of the thermal envelope, as reducing the heat flow through the envelope elements and increasing air tightness has a direct impact on the proper sizing of the systems.

Building energy audit:

- It proposes and parameterizes from a thermo-technical point of view all the building envelope components, so that heat losses are minimal;
- It parameterizes in terms of efficiency all indoor installations, abbreviated as HVAC (heating, ventilation, cooling), lighting and DHW (domestic hot water);
- It brings safety in operation through new solutions and by proposing the effective integration of technical systems on the 5 consumption branches HVAC, lighting and ACC, at a time when in most public buildings there are no ventilation, cooling and even hot water systems for sanitary purposes;
- Propose energy efficiency on all energy components of production, distribution and use regime and analyse the feasibility of these solutions;
- Propose local (renewable) sources to cover at least part of the energy consumption;
- Propose solutions to ensure electric vehicle charging;
- It proposes solutions for monitoring and adaptive control of indoor comfort parameters and energy consumption and production - Building Energy Management System.

The building audit also provides concrete and immediate solutions to prevent energy waste from happening by:

- Heating rooms used at higher than recommended temperatures and heating rooms that are not inhabited.

— Uncontrolled air escaping while using heating or cooling systems.
— Heating domestic water to temperatures higher than necessary.

Due to degradation caused by prolonged use, buildings periodically need to be renovated / rehabilitated / modernized. It is therefore a favourable time for buildings to consider energy efficiency in the process of envelope retrofitting / refurbishment and upgrading interior installations that are reaching an advanced degree of wear. Retrofitting a building, making it "all new" does not imply that the building becomes energy efficient. This is where the building energy audit comes in, which charts the way forward towards energy efficiency and increased indoor comfort.

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Benefits of a building energy audit (direct):

— You have a strategy in place, so you know which solutions to implement, at what cost, in what order and with what impact on building energy efficiency and indoor comfort.
— It offers an overview of your building's energy efficiency potential.
— It informs on the potential for cost savings at building level.
— More efficient investments: the building audit helps you identify the most efficient investments in technology and equipment to improve the energy performance of your building.

Indirect benefits (as a result of implementing the solutions proposed in the audit):

— Reduced CO_2 emissions and complying with standards.
— Reduced energy consumption and costs, saving money that can be channelled into other investments.
— Increased property values for both sale and rent because energy efficient buildings are more valuable on the real estate market.
— Improved interior comfort for occupants.
— Image benefits - you differentiate yourself from your competitors through innovation and positioning, including the green buildings category.

Of course, local public authorities - city halls - initiate the procurement of energy audits only when the source of funding for the modernization and renovation of buildings is available and generally do it together with the DALI documentation, which makes sense. At the same time, it is important for both the energy audit and the feasibility documentation to inform the design brief, with clear requirements, aligned with the funding guidelines as well as with the specific needs of the buildings.

This design brief is also important to impose clear qualifications and similar experience requirements, with the choice of the most advantageous offer from a technical-economic point of view. These clarifications are made not as a novelty, but to raise awareness of the fact that if the energy auditor is taken 'as a package' in the architect's team, there is a good chance that the energy audit will be seen as an additional cost imposed and not as the starting point for the entire renovation or even new construction project, This subsequently leads to the unfounded elimination, in the design and execution of the project, of solutions for insulating the technical systems - in an audit that is well supported by calculations - solutions for ensuring the energy performance of the technical systems, and in the end the resulting energy performance of the building differs significantly from that assessed in the energy audit report.

4.2 The role of BEMS monitoring and control systems

Systems for monitoring and control of comfort parameters and energy flows, generically referred to as *Building Energy Management Systems* (BEMS), have the role of integrating the technical systems in buildings, also generically referred to as *Heating Ventilation Air Conditioning* (HVAC), indoor, outdoor and perimeter lighting installations, local renewable energy sources and energy storage capacities, electric vehicle charging stations, and through this integration they ensure real-time monitoring and control of technical systems, building energy optimization, and optimal comfort in indoor spaces in terms of temperature, humidity and indoor air quality.

A functional and impactful BEMS starts from the energy audit stage where the data and energy flows to be integrated, monitored and controlled are clearly grounded. Subsequently, at the DALI stage, if properly budgeted at the design and execution stage, it is likely to be well implemented and have a lasting operational impact in the building operation.

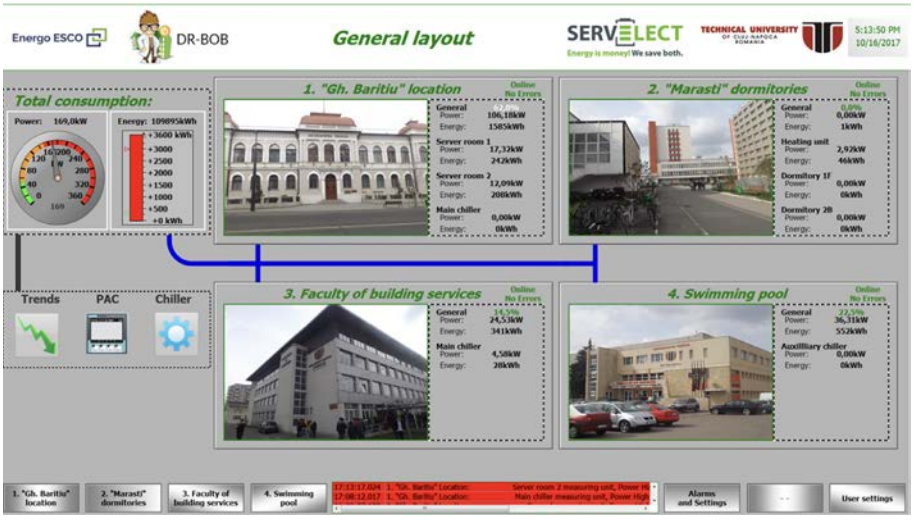

Fig. 9

Example of a functional and actively used BEMS for public buildings at campus level

At present, the specific costs of a BEMS are in the range of 80-120 euro/sqm., in relation to the total built floor area of the building, and reflect the full integration of the technical systems listed above, but not only in the classical *Building Management System* (BMS) sense. BMS has traditionally been promoted at building level, where the BMS controls the technical HVAC and lighting systems but does not monitor their energy consumption, nor does it correlate with influencing factors or perform any energy optimization.

A BEMS becomes useful and impactful in the long-term operation of a building when it is used, and this can be where the biggest challenge lies. If we are implementing a BEMS in a school and access to the system is restricted to management staff, who may not even have the skills to use it, then there is a good chance that the monitoring and control system will be useless. The BEMS needs to be made accessible to the Energy Manager of the municipality, employed or outsourced, made available as an alternative to a utility company at the municipality level (the heating company, for example) or to a *building facility management* service provider.

The active use of BEMS allows to track and adapt the consumption to the occupancy of the building or buildings integrated in the system, to the influencing factors - mainly outside temperature - and most likely automated. It allows to periodically extract reports on the functioning, operation and behaviour of technical systems, energy consumption and production, to display the degree of consumption from local renewable sources, generated and avoided energy costs and CO2 emissions.

All this information makes it possible to determine the real energy performance of the building, to apply energy optimization solutions in operation, to record a history of energy flows, and to clearly and coherently determine the effect and impact of intervention solutions. Most importantly, the active use of a BEMS ensures indoor micro-climatic comfort for the people in the building.

4.3 Necessary inspection for new constructions or during renovations and upon acceptance of works

Traditionally, the building energy auditor has had no role in the on-going evolution of the construction of a new building or in the renovation of existing ones. Thus, the specific competence of on-site monitoring of energy performance interventions is not effectively covered, neither by specialized designers nor by site management.

Specifically, checking the correct application of the thermo-system, starting from the floor slabs, to the foundations and continuing to the building envelope, checking the correct installation of the joinery, with and according to certain execution details, is essential. Correct and competent assembly ensures durable insulation, the sealing of the envelope, in particular the joinery (windows and exterior doors), both of which are essential to the building's energy performance.

Example of a pre-framed window in a building renovation:

Fig. 10

Example of a window assembly on an exterior pre-frame, during the renovation of a public building

During on site construction works, a well-trained building energy auditor or city energy manager should be involved, on behalf of the municipality or outsourced, to attend the inspection of hidden works as the construction or renovation progresses. It is a necessity, which should be imposed in the design brief, in the specifications for the design and execution procurement, budgeted appropriately at the DALI stage.

The experience of the PNRR Renovation Wave funding for public buildings, revealed many cases of building construction works without clearly defined execution details, where the energy auditor was requested on-site for clarifications. The consequence was often the abandonment of the initially proposed solution regarding the thermo-system thickness, due to the difficulty of installing the insulation boards. These issues can be avoided and prevented in the first place if the specialized design team at the DALI stage coordinates with the energy auditor, and subsequently if an advisory and on-site verification role for a building energy auditor and/or a local energy manager is foreseen at the design and execution stage.

Another widely encountered issue in the construction phase relates to the installation of joinery on the outside of the walls on the pre-frames and correct sealing. In most cases, the builder complained about lack of experience in fitting, lack of execution details, impossibility of fastening due to the low strength of the walls, all of which could be dealt with at the DALI stage.

For this reason, in order to stimulate an increase in the quality of construction works, it is a legal opportunity for public authorities to include in the tender specifications, requirements regarding evidence of training for operators and fitters in construction on such works, respectively at the design stage details of execution on all categories of works.

Within the acceptance of works, it is essential to also request the energy performance testing of the building envelope to ensure the proper application of the thermo-system - infrared thermo-scanning (thermo-vision), respectively for the envelope sealing - blowdoor leakage test. These tests must be required in the tender specification for construction works. Once these tests have been conducted, the builder has the opportunity to remedy any non-conformities, which is very important for the quality of the work and for ensuring that the planned energy performance is maintained.

4.4 Energy performance versus actual in-service consumption

The energy performance of a building, as explicitly and clearly presented in the above sections, is certified by the building's energy performance certificate, both as a reflection before and after renovation. This relates to a standardized level of indoor microclimatic comfort, in terms of temperature and air exchange with the outside environment.

In operation, maintaining energy performance depends to a large extent on how the operating modes of the technical systems are set, how the operating parameters are set, the internal temperatures set in the thermostats, the actual operation of the mechanical ventilation system, the idling modes of the heating and cooling sources, the thermal agent recirculation mode, the correlation and synchronization of energy consumption with local production from renewable sources, in particular photovoltaic, etc.

First of all, with or without BEMS, it is important that local public authorities, through the energy manager and with the support of the property managers trained for this purpose, keep a record of energy consumption, set targets and thresholds for optimized energy consumption set in correlation with occupancy, season and outside temperature, and monitor that the actual level of consumption is within these thresholds in the long term.

Otherwise, when we renovate a building, we receive an energy performance certificate (EPC) which gives us a calculated energy performance level, but in the actual operation of the building we still get in terms of specific energy consumption, kWh/ sqm. per year, a major discrepancy with what is written in this EPC

4.5 Means and tools for training, education and awareness raising

The role of one-stop-shops for energy efficiency

On June 29, 2024, the Romanian Government adopted the Emergency Ordinance 92/2024, which provides for the creation of a national network of One Stop Shops for energy efficiency (One Stop Shop - OSS) at the level of county councils and Bucharest City Hall.

Through this initiative, a legal framework has been established (stated to be solid and functional) to help Romania meet its commitments under Component C16. *REPowerEU* of the National Recovery and Resilience Plan (NRRP). It is further specified that these counters have an important role in providing information and technical advice on energy efficiency in buildings and households, the use of renewable energy sources and access to available funding programs, to support citizens in the transition to a sustainable and energy efficient built environment.

The obligations of county councils are spelled out, but still waiting to be operationalized in terms of:

— Providing information and technical advice to homeowners, homeowner associations and interested communities on energy efficiency and the use of renewable sources.
— Guiding citizens in developing energy renovation projects and accessing available financing.
— Provide legislative information related to the energy performance of buildings.
— Organize information campaigns.
— Facilitate collaboration with public authorities and institutions to ensure the prioritization of the authorization and endorsement process of projects started with the support of the one-stop shops.
— Half-yearly reporting to the Ministry of Development on accomplished and planned investments in energy renovation, as well as progress towards national energy efficiency and decarbonization targets.

It is precisely in this context, in which the county councils, through the EE desks, are also given responsibilities in this area, particularly in terms of relations with the population, that the local town halls must initiate cooperation, support the desks' efforts, provide data and information, and receive statistics that are very useful in assessing progress in energy efficiency, renewable sources and decarbonization.

4.6 Integration of renewable energy sources

A sound approach to local renewable energy sources at local level should start from the concrete and precise sizing of the local production potential on the terraces and roofs of buildings, on the ground on available and suitable land for photovoltaic systems, in direct correlation with the energy needs, with the inventories of aggregate energy consumption of public buildings, street and architectural lighting, from the consumption of public objectives of the city hall (pumping stations, electric vehicle charging stations, etc.).

With such a global aggregated dimensioning of the energy production potential, adding here other local distributed sources (high efficiency cogeneration, micro-hydro plants on water supply pipelines if the water supply system is owned by the municipality, biomass boilers and others), the municipality and the local council have a global and long-term picture, can decide the prioritization and viability in relation to the reduction of energy cost, but also in relation to other investment objectives at local level.

Another important aspect relates to the long-term operation of local distributed generation capacities. The local authority has to decide to whom it will lease the management of these systems, to ensure optimal maintenance and operation with maximized benefits for the local community. If it is assumed that the systems will run by themselves, this will not happen, and after 3-5 years of operation, failures will start to occur and energy production for self-consumption will start to decrease drastically.

With the entry into operation of local distributed capacities on buildings for the production of energy from renewable sources, the classification of the grid user - the building - from passive consumer in relation to the grid to prosumer, by amending and updating the Technical Connection Notice (ATR) and issuing the Prosumer Certificate (CPR), a situation that changes according to the current legislation also the energy settlement, in the sense that the accountant is allowed to compensate the energy consumption realized at any time during a settlement period with the excess production delivered to the grid.

On the other hand, without a local BEMS or an energy management system to manage, preferably automated, the bidirectional flows of energy consumed from the grid and delivered to the grid from the local source, stored for self-consumption, prosumers will be in a strongly disadvantageous situation after the end of the energy price capping and compensation period. The will have to deliver energy to the grid at a price that is insignificant in value, or even free of charge, or they will be forced to limit production to self-consumption, while the energy taken from the grid will be priced at a much higher rate. In other words, the joy of prosumers and photovoltaics will pass from being a cost-saving system to becoming a system that generates additional costs overall.

For this reason, it is important to consider what will come after this wave of photovoltaics for public objectives, what will happen with the installed renewables in the long term, how they will be managed and maximize their impact.

5 Energy efficiency of buildings with historical and architectural value

Context and relevance of the theme for climate neutrality

„From an energy point of view, historic buildings store energy and carbon dioxide in their structure. "The greenest building is the one that already exists" has become the explanatory phrase for initiatives to promote the reuse of existing buildings as a primary measure to reduce the impact of the construction industry on the built environment”[1].

The energy efficiency of the existing built stock is considered a priority measure to achieve the EU's climate and energy objectives. Efficient implementation would mean a reduction of about 40% of the EU's total energy consumption and 36% of greenhouse gas emissions. In Europe, official statistics estimate that 14% of existing buildings were built before 1919, while 26% date back before 1945. The historic building stock in Romania represents 31% of buildings, being dated before 1961. Though only some are listed as historical monuments, the existing stock of buildings is essential to the local identity of communities and should be protected and managed as such.

The main legal act regulating energy efficiency interventions is **Law 372/2005 on the energy performance of buildings**, with subsequent additions and amendments. However, the requirements of this law do not apply to buildings and monuments protected by heritage legislation. Consequently, as an alternative measure to create a methodological framework for interventions tailored to heritage buildings, to avoid their alteration or even destruction, **the Ministry of Culture** issued **Order No. 3.568** in December 2022 **for the approval of the Intervention Methodology for the non-invasive approach to energy efficiency in buildings with historical and architectural value**. From a structural and architectural point of view, historic buildings were built with the resources

1

Order of the Ministry of Culture no. 3.568/2022 for the approval of *the Intervention Methodology for the non-invasive approach to energy efficiency in buildings with historical and architectural value*, chapter Introduction, pp. 4-10, Official Monitor of Romania, Part I, no. 1260 bis/28.XII. 2022.

and technologies available at the time of their construction, therefore they have deficiencies in contemporary use, which pursues other comfort standards. The methodology requires that interventions on these buildings are conducted following the principles of conservation-restoration, ensuring the safeguard of cultural values.

The methodology for non-invasive intervention[2] was developed within the framework of the National Recovery and Resilience Plan (NRRP), *Pillar I. Green Transition, Component C5 - Renovation Wave* and was developed with the aim of protecting historical monuments and heritage buildings in the broader context of the need to increase the energy efficiency of the historical built heritage, without degrading its historical and cultural substance. The document addresses both those who have decision-making power in defining the regulatory and methodological framework and those who implement local, regional, national and international energy efficiency programs, as well as owners and managers of heritage buildings.

The methodology is addressed both to owners or managers of buildings with heritage value, as well as to those "with special architectural or historical value" as defined in **Law 50/1991 on the authorization of construction works**, which refers to buildings with special historical and architectural value. Also, according to the legal framework in Romania, energy efficiency interventions in buildings of historical and architectural value are conducted only with the approval of the Ministry of Culture, through its deconcentrated services at local level.

This methodology is one of the basic tools for defining interventions to increase energy efficiency in buildings of historical and architectural value, by creating a framework for a coherent basis for measures, including investments realized by the NRRP, which are currently underway. Through this document, the creation of the 4 pilot centres, considered essential for the correct and coherent implementation of measures to reduce the impact of climate change on today's society, is also based on the knowledge of the effects that the construction sector has on the environment, measures detailed in the presentation of investment I.4 in the PNRR documentation[3].

Since recent years, investments from public funds have required the technical and economic documentation to be supplemented with criteria applicable to the DNSH (*Do No Significant Harm*) principle. In relation to construction and demolition waste, DNSH refers to the principle that projects financed by EU funds or other public sources must comply with strict environmental criteria, ensuring that they do not significantly harm sustainability objectives. Relevant criteria for building interventions include:

— Not lead to significant greenhouse gas emissions;
— Do not lead to an increase in the negative effect of the current and future climate on the measure itself, people, nature or the built environment;
— Significantly reduce pollutant emissions to air, water or soil.

Romania is among the countries in which research and evaluation of the energy component of existing buildings with historical and architectural values is extremely limited, especially in relation to the major European investment funds (Renovation Wave and Green Deal). Without a coherent basis for energy efficiency measures, these buildings are subject to pressures to alter their values, to cancel their specific identity characteristics, to real estate depreciation, and to measures considered usual or formal, often with negative effects on the health and well-being of the population.

Recommended types of measures
Concrete examples, description of benefits and justification

Energy efficiency in heritage buildings is perceived as an additional challenge as interventions must be compatible with their historical and architectural character. Measures must balance the need to reduce energy consumption with respect for original materials and techniques. Traditional heritage building materials (brick, stone) are hygroscopic and need to 'breathe'. Standard insulations (e.g. polystyrene) can cause wall

2

Order of the Ministry of Culture no. 3.568/2022 for *the approval of the Intervention Methodology for the non-invasive approach to energy efficiency in buildings with historical and architectural value*, chapter Introduction, pp. 4-10, Official Monitor of Romania, Part I, no. 1260 bis/28.XII. 2022

3

For more information see the National Recovery and Resilience Plan Program of the National Heritage Institute https://patrimoniu.ro/ro//articles/planul-national-de-redresare-si-rezilienta degradation through moisture accumulation. WTO 3568/2022 covers several categories of recommended measures:

1. **Founding interventions upon preliminary analysis**
   It is recommended to conduct geometric or detail measurements, surveys, as well as consumption assessments and indoor comfort parameters, which are necessary to understand the building's use and its deficiencies.
2. **Elaboration of specific studies and expertise with the aim of defining construction characteristics**
   The approval of interventions on valuable historic buildings requires specific studies (historical study, technical expertise, geotechnical study, biological study, etc.). OMC 3.568/2022 also proposes the *Evaluation sheet for buildings of historical and architectural value*, annexed to the methodology, which provides a framework for the technical and economic documentation of energy efficiency with the purpose of centralizing the specific needs of the studied building.
3. **Definition of architectural and structural intervention types**
   The approach to interventions on historic buildings requires avoiding "recipe" type interventions, technical solutions are needed to eliminate dampness or thermal bridges without affecting the appearance/aesthetics of the building. The most common measures are interventions on the areas of contact with unheated space (attics, cellars), as well as optimizing the technical characteristics of glazed areas and joinery. The use of lime and silicate-based thermal insulating plasters for exterior walls (without decoration) can reduce heat loss without affecting the appearance of the façade. Vapour permeable thermal insulation boards (e.g. porous limestone, wood fibre or cork panels) applied to the interior are a solution to avoid condensation and mould problems while maintaining the permeability of the wall.
4. **Optimizing indoor comfort**
   Restrictions on interventions in heritage buildings (e.g. exterior/interior wall thermal insulation, as recommended for interventions with no historical or architectural value) can be compensated by making installation systems and user behaviour more efficient. Technical solutions in terms of HVAC or lighting systems have developed greatly in recent years, so that the comfort of a historic building can approach that of a new building. Heat pumps can be integrated discreetly, using renewable sources without requiring major building alterations. LEDs offer energy savings without detracting from the aesthetics of the building, being integrated into the original luminaires.
5. **Integration of renewable energy sources and smart systems**
   Upgrading facilities has an inherent increase in energy consumption, so green energy is recommended. Solar panels can be mounted on less visible roofs, fences or annexes, while respecting heritage building regulations.

Proposed indicators
Clear indicators to monitor progress

Monitoring the energy efficiency progress of heritage buildings requires both tracking relevant energy performance assessment indicators and the impact on heritage.

1. **Energy consumption indicators (kWh/m²/year)**
   Although interventions on heritage cannot reach the performance criteria of new buildings (passive houses), reducing specific energy consumption by up to 50% is possible in any historic building, even with the implementation of minimal

architectural and structural measures (eliminating damp, attic insulation, floor/cellar insulation, optimizing joinery, etc.).

2. **Thermal comfort and air quality indicators**
   It measures the maintenance of an optimal indoor climate without excessive energy consumption, with the avoidance of condensation and mold problems, which are important for the preservation of the building. It is however mandatory to assess the level of ventilation and the impact of insulation measures. Although in passive buildings the degree of ventilation is reduced by applying almost total airtightness, in historic buildings - which have functioned on the basis of thermal inertia and ventilation - it is considered beneficial to provide a level of ventilation by eliminating materials that act as permeability barriers (such as polystyrene-based products).
3. **Sustainability and renewable energy indicators**
   The energy efficiency of historic buildings can be harnessed primarily through real savings on the natural resources used in construction, thus contributing to reduced CO_2 emissions (kg CO_2/mp/year). Reusing existing structures as efficiently as possible leads to a reduction in the use of new materials. This adds to the amount of energy from renewable sources (solar panels, heat pumps).
4. **Heritage impact indicators**
   Unfortunately, many energy efficiency interventions on heritage buildings have led to the alteration of their values by mutilating or even destroying them using the wrong materials (the case of polystyrene on the plinth or facade leading to interior condensation). Such interventions should optimize the compatibility of materials, reduce the level of intervention on original elements and improve the index of architectural integrity, evaluating the preservation of original elements (e.g. carpentry, facades, decorations).

Methodologies for measuring results
Techniques and tools used to track performance

To correctly measure the results of energy efficiency interventions in heritage buildings, proper methodologies are needed to ensure the preservation of their historic character. These methodologies should combine specific measurements with conservation impact assessments.

1. **Energy audit for heritage buildings**
   The purpose of an energy audit on buildings with historical and architectural value is to know the vulnerabilities that prevent the interior space to be optimal for human activities, with a focus on electricity production components. The Energy Audit for heritage buildings aims to identify the current situation of the building and the potential solutions for improving energy efficiency and indoor comfort for users, in relation to present use opportunities.
2. **Energy certification for heritage buildings**
   Energy certification of buildings of historical and architectural value is thus a complex process, which will consider several intervention principles. Since it is not regulated by the current laws as mandatory, the accepted thermal insulation solutions are subject to restrictions due to building character. Therefore it is worth emphasizing that there are no standard solutions for the energy retrofitting of a heritage building and that the directives for heritage protection are aimed at reducing energy consumption through intelligent retrofitting measures that would also protect these buildings against the effects of extreme temperatures, humidity or other phenomena. They do not aim the same requirements of energy efficiency for new building. However, solutions on the market are constantly being developed.

3. **Education and professionalization tools**
The workforce required for interventions on heritage buildings is probably the smallest in the construction industry, although the field has benefited from significantly increased public and private funding in recent years. It is therefore necessary to develop local training tools for craftsmen and builders to meet the specific requirements of historic buildings.

Case study
Relevant examples from other cities

Romania does not have a database of historic buildings that have had energy efficiency interventions. Although public institutions have undergone such projects, most of them have undergone alterations to the historic substance, with total replacement of historic roofing, carpentry or plaster. Research in the field is also limited, and several restoration interventions have been identified to have low energy efficiency elements.

Example

1. **Energy efficiency of tin cladding - Lövstabruk, 18th century stable (commercial conversion), Leufsta Foundation, Sweden**
The original metal sheet cladding has been replaced by solar panels integrated in new metal sheets, specially adapted for the placement of solar panels. The installation involved preparing the wood bedding layer, the insulation layer and the folded metal sheeting to a narrower than the ordinary/standard size (about 400 mm wide), which matched the thin solar foil glued to the sheeting exterior. Thus, the 'solar cell foil' solution involved extensive intervention to the roof itself, but significantly less visual impact compared to conventional solar cell panels that are mounted upon the existing roof. This solution can be adapted to buildings with metal sheet roofing and on the annex buildings of houses with ceramic tile roofing.
More information here: https://hiberatlas.eurac.edu/en/loevstabruk-stable-building--2-297.html

2. **Energy efficient joinery - Malmo knitting factory, 1900 (conversion to office space), Sweden**
Most of the existing windows dated from the ‘70s. The windows that were not damaged have been kept, repaired and insulated with new internal frames (thermal insulating glass) and restored to their original appearance. The glazing sashes have been replaced with thermal insulating glass, adapted to the dimensions of the historic joinery.
The degraded windows have been rebuilt in accordance with the original geometry, but also with insulating glass. The new windows are thus copies of the original windows in terms of material, shape (arched or rectangular top), wood dimensions, dividers, hangers, drip moldings and other details.
In addition, the windows on the sun-facing façades have been fitted with an interior sunscreen, which can be controlled according to sunlight and temperature. The building has been divided into different sections. Each section is controlled by a sensor on the roof. It reacts to the sun so that when the sun is shining, the curtains close automatically and open automatically when the sun is no longer shining directly on the windows. To avoid raising and lowering the curtains when the sun is overcast (cloudy), the curtains can be temporarily controlled at each window and then automatically move to the position indicated by the sensor to minimize the need for cooling on sunny days.
More info here: https://hiberatlas.eurac.edu/en/trikfabriken--2-299.html

3. **Thermal insulation facade with aerogel - Gründerzeit building 19th century (Vienna, Austria)**

Aerogel has been used on the exterior of a mid-19th century historic building on a secondary facade of about 205 m² in Austria. Five centimetres of machine-applied aerogel plaster is equivalent to a conventional 15-centimeter-thick insulation board.

The main facade has been partially rebuilt due to an accidental explosion and has been moved inwards to fix 20 cm of hemp insulation.

The south-facing windows received new textile window awnings. Roll-down sunscreen textile sunscreens have been mounted on the energy efficient windows.

More info here: https://hiberatlas.eurac.edu/en/mariahilfer-strasse--2-62.html#section2

Normative reference documents

Law no. 10/1995 on quality in construction, republished, with subsequent amendments and additions.

Law no. 50/1991 on the authorization for the execution of construction works, republished, with subsequent amendments and additions.

Law No 121/2014 on energy efficiency, as amended.

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Methodology for calculating the energy performance of buildings, indicative Mc 001/1-2022, approved by Order of the Minister of Transport, Construction and Tourism no. 16 of January 5, 2023 with subsequent amendments and additions, published in the Official Monitor of Romania, Part I, no. 46 of January 17, 2023.

Normative for the design, execution and operation of ventilation and air-conditioning installations, indicative I5-2022, approved by Order of the Minister of Regional Development and Tourism no. 173 of February 1, 2023, published in the Official Monitor of Romania, Part I, no. 108 and 108 bis of February 8, 2023.

Government Emergency Ordinance no. 18/2009 on increasing the energy performance of residential buildings, with subsequent amendments and additions.

EU Recommendation 2019/786 - on the renovation of buildings, published in the Official Journal of the European Union L 127/34 of 16.05.2019.

RTC 1-2022, Integrated Interventions Guide.

RTC 3 and 4 of 2022 - nZEB Guidelines.

Long-term national renovation strategy for supporting the renovation of the national stock of residential and non-residential buildings, both public and private, and its gradual transformation into a highly energy-efficient and decarbonized building stock by 2050, approved by Government Decision no. 1034/2020.

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Mirror Mission
Cities Hub Romania

Possible Cities

Integrated toolkit
for climate neutrality

Energy systems

Energy management of cities — production, transportation, use
Sources, distribution networks and consumption

Andrei Ceclan
Horia Petran

2

Energy systems

Energy management of cities - production, transportation, use.

Sources, distribution networks and consumption

Contents

1 Introduction

The energy transition towards climate neutrality comes with some challenges, but also opportunities for local communities, both urban and rural, the goal being not only to reach the destination of achieving climate neutrality, but also to bring about several societal transformations, technological and built environment advancement, all with the aim of enhancing and developing people's civilization and livelihoods.

From an energy point of view, addressing these decarbonization challenges must start with defining the energy contour of cities, how the energy contour is effectively demarcated in relation to the built environment on the one hand, and on the other hand, defining urban energy systems.

This last definition breaks energy systems into two categories:

1. 1) Large urban energy systems (electricity networks, natural gas networks, district heating networks, drinking water networks, sewage networks, public street lighting, telecommunications systems, local public transport system, waste collection system and others) that provide the essential public utilities for cities;
2. 2) Small, domestic systems and technologies, which include all functional and energy-using equipment in dwellings as well as buildings in all other categories, including HVAC, lighting and recently also local (renewable) energy producing systems.

From an urban energy perspective, but also from a decarbonization ambition perspective, the concentration of technical solutions, technology adoption and retrofitting must therefore take place in both types of urban energy systems, with different resources, different approaches and policies, and different models of local governance.

To this end, it is necessary to model cities both technically and societally, starting from the definition of their contours, including energy and emissions, and continuing with the models established in the literature: cities viewed as thermodynamic systems, cities viewed as metabolic systems, cities viewed as complex systems, plus socio-technical models involving a differentiated approach to the two broad categories of urban energy systems - large and small, domestic systems (Urban Energy Systems, An Integrated Approach, edited by James Keirstead and Nilah Shah, 2013).

The concrete challenges in the energy transition can be derived from the following phenomena with multiple and complex trigger mechanisms:

— the widespread emergence of distributed generation, in the form of prosumers;
— the fact that energy flow to and from the grid user is already bi-directional;
— prosumers will be the owners of the energy sources, from which they will provide at least part of their consumption needs, but they will also become suppliers of energy to the grid;
— the level of investment supported by public authorities vs. private companies;
— the evolution of the vulnerable consumer;
— the emergence of the vulnerable prosumer;
— the emergence of energy communities;
— the emergence of energy islands, etc.

2 Centralized district heating systems

The centralized district heating and domestic hot water (DHW system is usually found in urban areas. It consists of the production plant(s), transmission network, thermal points and heat distribution networks.

These systems were set up before 1990 to supply the blocks of flats built at that time. At the time they were built they were efficient but due to the ageing of the system, high network losses and low investment in modernization, they started, after 2000, to become financially uncompetitive and to be replaced by apartment or block/household central heating systems. This migration was mainly to reduce costs and increase indoor comfort, and the wave of disconnections from the centralized system has not yet ended

With the market penetration of high efficiency cogeneration systems, but more recently also of renewable sources, and the emergence of much more energy efficient transmission and distribution pipelines, CHP systems are once again starting to become a feasible option for heating apartments and producing hot water. Centralized energy production also contributes to reducing greenhouse gas emissions, increasing operational safety and user comfort, and ensuring annual repairs and maintenance. Both at European level and in Romania, substantial funds are being allocated for the upgrading of the process of producing, transporting and distributing thermal energy in the SACET, with the aim of increasing energy efficiency and reducing greenhouse gas emissions at local community level.

Local public policies also have the following tasks: promote centrally produced heat, limit the installation of apartment heating plants and allocate resources to make SACETs competitive again. Funding sources for the rehabilitation of district heating systems include: NRRP, Modernization Fund, RePower EU funding, M100 initiative.

After 1989, the management of the district heating companies or heating companies was taken over by persons, in many cases political appointees, but also without technical and managerial skills, which led to the insolvency or bankruptcy of these companies, against the background of increasing expenses to cover the energy losses of SACET, against the background of late collection of government and local subsidies for heat energy to reach end users at a bearable price.

Almost generalized, according to the thermal balance sheets submitted by the district heating regions/companies to ANRE, the level of thermal energy losses, starting from the production sources, continuing with the transportation and distribution networks, statistically reach the 35-60% of the total primary energy used, this performance being particularly low and with direct consequences in a high price of the final energy sold, usually expressed in Gcal.

As far as subsidization is concerned, statistical data show that, in relation to the annual public budget of a municipality, the subsidy rate is in the 5-30% range; in other words, up to 30% of the local budget is allocated to subsidizing thermal energy for the population, which leads to a high cost and generates significant pressure on local governments. In the long term, the available funds of the local public authority are directed to cover real mass and thermal losses of energy, hot water leaking into the ground.

SACETs offer an opportunity to provide green, low-emission energy for heating buildings, so the chance for district heating systems in the context of current and near future grant funding is to transform themselves, through the implementation of renewable sources, into the main supplier of green energy to cities, in the context that statistically over 50% of the GHG emissions in cities come from buildings and mostly from the thermal energy used in buildings.

According to an internal analysis of the association of district heating companies - COGEN Romania - the financing needs of the SACETs to transform them into low-emission, technically efficient and economically viable district heating systems, without depending on subsidies, is over 20 billion euros.

The transformation of SACETs into low-emission district heating systems may also mean a shift from centralized sources to decentralized renewable sources, i.e. a transition from SACETs to SADETs.

Another aspect related to the current centralized sources of the SACETs, the high efficiency cogeneration sources, which produce both heat and electricity, is that they are also secure sources of energy in the cities they serve, i.e. they have an important contribution in the National Electricity System (SEN), and their decommissioning in the medium and long term must be carefully analysed as an impact from this perspective.

The decarbonization of SACETs, is closely related to the buildings themselves and the way they are supplied with energy. Traditionally, mostly blocks of flats have indoor thermal installations in apartments with thermal energy distributed vertically from floor to floor through the same stacked rooms (bedrooms, kitchen, bathrooms). This system does not allow direct metering of heat consumption and, what is more, does not allow control of this consumption.

For this reason, even if in most cities that still have functioning SACETs the subsidized price of thermal energy is bearable, the level of thermal comfort provided is oversaturated, i.e. in the cold season usually, due to the lack of individual control of heating, but also because the price is subsidized, the indoor temperature is well above the level of decent comfort, and in many apartments in the middle of winter the windows are open.

In the case of domestic hot water, supplied in blocks of flats, the waiting time until the hot water reaches the tap is a major inconvenience and is probably the most important reason why consumers have disconnected and are still disconnecting from the system. The water is metered as hot, but the meter registers a consumption of cold water each time until it starts running hot. Another widely known fact.

As far as the renovation of buildings is concerned, the modernization of SACETs and the reduction of consumption needs are solutions closely linked to the need to replace the vertical distribution of thermal installations in apartments with horizontal distribution and metering at the entrance to each apartment.

The modernization of energy distribution and transmission networks must be linked to new distributed energy sources, ensuring a transition to more efficient and sustainable infrastructures as the entire energy chain - from consumption to production - evolves.

2.1 Local public transportation system

The local public transport system is managed by the Territorial Administrative Unit (TAU) either directly or through a management delegation contract.

The main means of transport owned by public transport companies are buses (diesel/ electric/ hybrid), minibuses, trolleybuses, trams. The energy used for public transport is electricity and fossil fuel.

Public policies can promote public transport, and efforts can be made to shift from private cars to public transport. Funding is available for the purchase of modern, fuel-efficient and low polluting means of transport. Dedicated lanes for public transport are also being promoted in local strategies to make public transport an optimal travel time option, especially in congested areas. Public transport is favourable in terms of fuel costs, for travel in areas where there is no parking or for short distance travel within cities.

A city that wants to keep pace with sustainable development must invest in modernizing existing transport means and infrastructure, extending the transport network in newly built areas and upgrading stations. The digital component also brings added value, which can be used to monitor consumption, optimize routes, allocate additional means of transport according to the traffic monitored, and inform citizens in real time about waiting times and the location of means of transport.

The future of transport is moving towards electrification. By funding for the purchase of electric buses and charging infrastructure, we can see a significant increase in the use of these means of transport locally.

Due to its low GHG emissions during operation, electric transport is a viable solution for an environmentally friendly city that aims to reduce pollution within the city, achieve climate neutrality, reduce air pollution and lower noise levels.

There is also the issue of providing energy for electric bus charging stations from local renewable sources belonging to the TAUs. This can be achieved if battery electricity storage capacity is added, otherwise with small exceptions there is no synchronization between overnight bus charging and daytime PV generation.

The reuse and recycling of electric batteries in buses after 5-7 years of operation is an important aspect to manage. A first possible use is their integration into stationary energy storage systems in buildings. A viable alternative is to include a buy-back option with suppliers in bus purchase contracts, whereby used batteries are taken back after the period of operation in exchange for new batteries purchased at a reduced price.

2.2 Drinking water supply, wastewater collection and treatment systems

In most counties, drinking water supply systems and wastewater collection and treatment systems are concessioned to water companies in which the county councils are majority shareholders. From a technical point of view, drinking water supply systems are characterized, like district heating systems, by water losses in the 30-50% range, i.e. for every 100 cubic meters of drinking water pumped to consumers, approximately 30-50 cubic meters are lost in the distribution networks underground in the cities. So, under the asphalt and asphalt in the city we have permanent irrigation with tens and hundreds of thousands of cubic meters of water lost annually.

At the level of a locality, the consumption of energy, primarily electricity, for pumping and treating drinking water and wastewater is comparable to the consumption of a medium-sized factory, i.e. in the order of several thousand MWh/year, which means corresponding GHG emissions. For this reason, decarbonizing water companies must be a local priority.

2.3 Public lighting system

The public lighting infrastructure is part of the technical and public utilities infrastructure of the UAT and aims to increase the level of road, pedestrian and general safety in a locality. This infrastructure is present in most urban and rural communities in Romania and consists of all the networks, lighting points, poles, lighting fixtures, remote management system. The public lighting system consists of street-road lighting, street-pedestrian lighting, architectural lighting, ornamental lighting and ornamental-festival lighting.

The management of the public lighting system is regulated by Law 230/2006 on the public lighting service which establishes the unitary legal and institutional framework for the establishment, organization, operation, management, financing, monitoring and control of the functioning of the public lighting service in municipalities, towns and cities

Among the objectives of public lighting service, according to Law 230/2006 we can mention:

— raising civilization, comfort and quality of life;
— to increase individual and collective safety in local communities, as well as road and pedestrian safety;

— highlighting, by appropriate lighting, the architectural and landscape features of localities, as well as marking festive events and legal or religious holidays;
— supporting and stimulating the economic and social development of localities;
— the safe, cost-effective and economically efficient functioning and operation of the infrastructure related to the service.

A relevant document in this area is the SR EN 13201 standard for public lighting, which provides guidance on the selection of lighting classes, performance requirements, performance calculation, photometric performance measurement methods and energy performance indicators.

For the most part, the street lighting infrastructure in Romanian localities was established in the second half of the 20th century and has been extended and improved since then. The demarcation of the public lighting installation from the distribution network is made in the public lighting measurement and protection block (BMP-IP). The power supply to the lighting equipment is carried out by overhead and underground power lines.

In most localities, overhead power lines predominate and only to a small extent are underground. It should be noted that according to current legislation, new overhead networks can no longer be built, only underground. Lighting poles are mostly metal and concrete, but there are also areas where they are made of wood. The existing lighting fixtures in the localities are sodium-based, and those installed or replaced in the last decade are LED-based and usually with remote control

The average number of operating hours of luminaires in Romania is approx. 4000 hours/year. The average installed wattage is approx. 130 W/luminaire. The number of luminaires in a locality varies depending on the number of kilometres of roads and the percentage of them illuminated. For road lighting, there are on average 30 poles/km, while for pedestrian lighting the density can be higher.

Replacing sodium luminaires with LED luminaires and remote management system helps in most situations to achieve energy savings. Energy savings are achieved due to the higher efficiency of LED lamps and the use of remote management to reduce the luminous flux of luminaires during periods of low traffic.

Reducing the luminous flux at certain times of the day can lead to energy savings of more than 40%, so we recommend capitalizing on this potential benefit of the system, which is also particularly important for combating light pollution, both for people and urban biodiversity. In addition to the energy savings, by replacing luminaires, the level of lighting can be correlated with the level of traffic, as the latter may be different from when the original infrastructure was built.

Several sources of non-reimbursable funding have been available recently for investments in public lighting infrastructure, including funds from the Environmental Fund Administration, Swiss funds, Norwegian funds. The Regional Operational Program etc. These sources of funding can partially or totally cover the investment in the replacement of lighting appliances to reduce greenhouse gas emissions, the implementation of remote management systems, the modernization of networks or the extension of networks.

Management of the public lighting system can be carried out either by direct management by the TAU or by delegated management. Under direct management, the city hall provides the equipment, qualified staff and on-site intervention, while in the case of delegated management, these activities are carried out by an external operator. In either case, it is important to have working procedures in place that provide for both occasional fault intervention and preventive and corrective maintenance. To facilitate the resolution of non-functionalities in the shortest possible time, it is important to have electrical schematics of the lighting systems. If they do not exist, they can be based on energy audits.

2.4 Local renewable energy system

Cities are also starting to have their own distributed renewable systems, with capacities installed on public buildings and on the ground, in the order of hundreds or even thousands of kW. By the beginning of 2025, the installed capacity of photovoltaic installations on rooftops or in the backyards of energy consumers will exceed 2000 MW, making them prosumers. The effects of this change are visible not only in a reduction of individual consumption from the grid, but also in a transformation of the national load curve.

If in the cold season, in the middle of the day, there is already a pronounced load gap in Romania's total consumption, the data available on the Transelectrica (national company) portal show that during the previous summer, this phenomenon was even more pronounced. The increase in production from renewable energy sources such as photovoltaics and wind power, together with production from conventional sources, will amplify this effect in the coming months, leading to a significant load gap in the middle of the day.

This means that the prosumers' photovoltaics are doing their job and covering our consumption with flying colours. It also means that we will have a surplus from photovoltaic production on the home or public buildings, which will go into the electricity distribution grids. It also means, and this is the most important thing, that we expect that in the very middle of the day the price of energy will fall, against the background of the reduction in SEN consumption and the availability of energy in the SEN.

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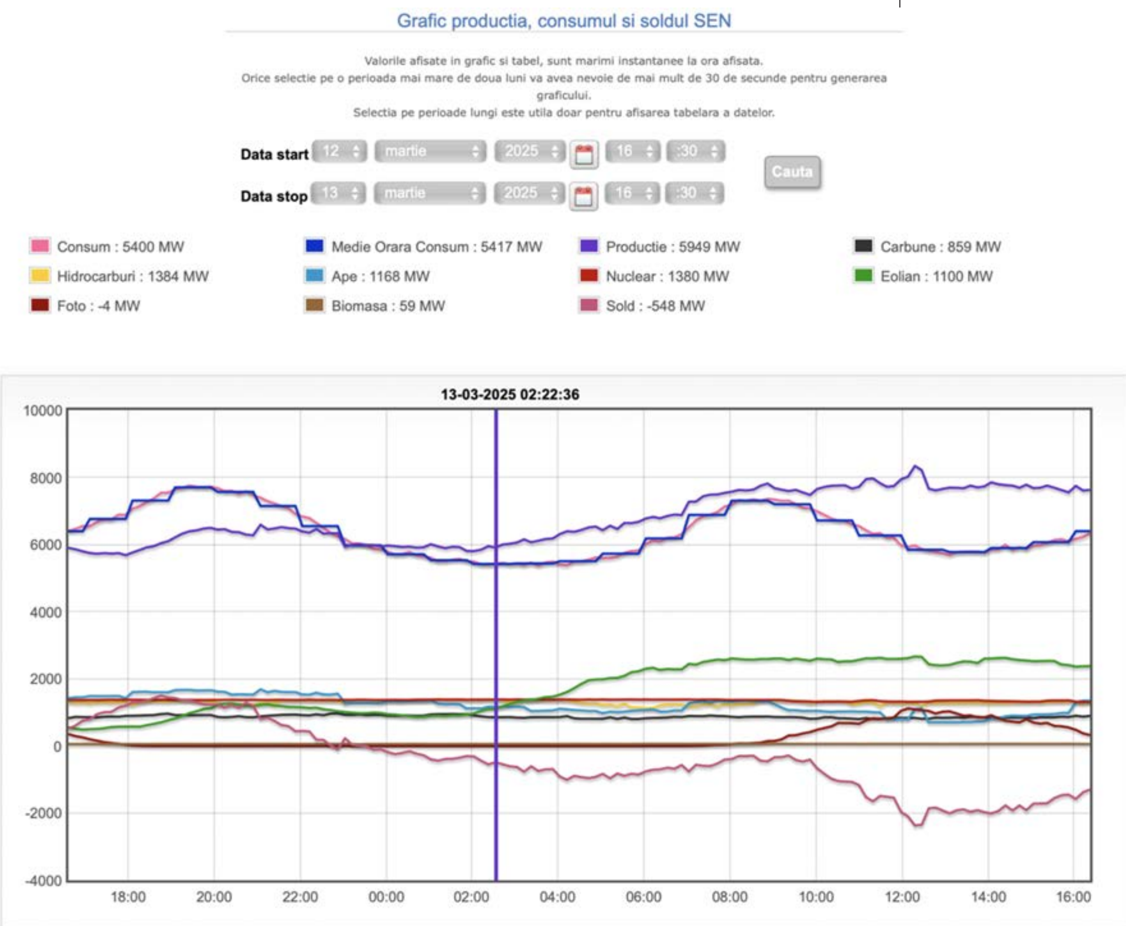

Graph production, consumption and SEN balance

The statistics of the financing programs for photovoltaic systems (PNRR, Modernization Fund, AFIR, PDD, Swiss Funds, Norwegian Funds, AFM, etc.) and especially the statistics of the tenders publicly run through SEAP show that in 2024 projects with a cumulative value of over 450,000,000 euros have materialized only at the prosumers level, an equivalent in power entering the National Energy System (SEN) of approx. 700-800 MW of newly installed photovoltaic, an additional of about 500 GWh/year of energy produced from the sun. In 2025, more than 600-800 million euros of photovoltaics and prosumer battery electrics are expected to be auctioned.

But like the sun's tan, its energy is fleeting, even if day after day it refuels us. In the morning, evening and night we still need energy, and increasingly we also take it from additional storage capacity, if we still install it in the context of the funding programs that make it available to us. And yet they are still not enough and will not be enough for years to come.

Conventional sources - hydroelectric, nuclear, coal, coal, gas and, to a lesser extent, biomass - continue to be used as secure sources of energy.

They require constant operation, preferably throughout the day. Limiting their output during the day because of a surplus of solar energy and restarting them in the evening to cover consumption leads to higher energy prices precisely at the times when their own production is insufficient - in the morning and evening.

From 2025 and beyond, the energy market will move towards a system of differentiated prices, like the one successfully applied more than 15 years ago and long used in Western Europe and globally. Lower daytime and night-time tariffs are expected, with significant increases in the morning and evening peak consumption periods.

This transition will have a direct impact on energy bill costs, and without adaptation measures, the benefits of prosumers' own production may be diminished, especially if they remain passive users of the grid. This is why conventional sources - hydro, nuclear, coal, coal, gas and biomass power plants, the last to a very small extent - are still used and are generically referred to as secure energy sources.

The problem with these sources is the need for constant operation, ideally throughout the day; if their operation is controlled or limited - during the day because of the solar surplus and in the evening to cover consumption - the price of energy increases precisely at the times of insufficient production: in the morning and evening.

In 2025 and beyond, the energy market is expected to enter a swing to differential pricing, returning to a system that worked efficiently more than 15 years ago and has been used successfully for many years in Western Europe and globally. The energy price differential market implies low tariffs during the day and nights, while during peak periods - morning and evening - high prices are expected.

This transformation increases the cost of the energy bill and may even cancel out the benefits of prosumers' own PV, if they remain passive grid users.

The current energy situation can turn a threat into an opportunity to reduce energy costs and consumption. National peak load avoidance can be achieved by:

— use of local energy storage capacities;
— implementation of energy monitoring and management systems;
— implementing energy efficiency measures.

2.5 Electric vehicle charging station system

The system of charging stations for electric vehicles is one of the newest infrastructures being developed around localities. These systems have gained momentum with the market entry of electric cars. .

There are 2 main types of charging stations/modalities for electric cars:

— AC (alternating current) charging stations;
— DC (direct current) charging stations.

DC stations offer fast charging for electric vehicles and are recommended to be installed in transit areas, at exits of towns or in areas visited by tourists. AC stations provide a slow charge and are typically used in residential areas, long-stay parking lots or company premises.

For LPAs, it is recommended to draw up a general plan for the realization of a network of charging stations. It is important to determine the areas where these stations can be installed, what types of stations are needed for each area, what power availability can be made available by the electricity distributor. Consideration should be given to the need to cover the area of the locality as reasonably as possible, so that residents have the possibility of charging close to their homes and do not hinder traffic due to the need to travel just to recharge their vehicle.

It is recommended to set a fair charge for charging, covering both the energy consumed and the maintenance costs of the stations. Attention should also be paid to the integration of all stations in the locality into a management and payment platform. This can be an existing one on the market or one developed specifically for the beneficiary.

The financing of the charging stations has been realized through various grants, such as funds from the Environmental Fund Administration, PNRR, Swiss Funds etc.

In parallel with the development of the infrastructure for citizens and people in transit, it is necessary to develop the infrastructure for electric public transport. It is important that the development of the charging station network keeps pace with the growth in the number of electric vehicles. It is recommended that the involvement of the TAU should not be limited to the implementation of projects for the installation of stations, but should also include operation, rapid repair of faults, and maintenance operations with qualified personnel.

2.6 Electricity distribution networks

The electricity distribution grids are concessioned to regional operators that ensure the distribution and continuity of energy supply, according to the quality standards imposed by ANRE.

The specificity of electricity distribution networks is that they operate with a so-called technological own consumption (TOC) or inherent energy losses, in the 9-15% range, i.e. out of every 100-kWh produced and injected into the grid, approximately 10-12 kWh are lost through the heat effect. This makes this CPT the main operating cost of the distribution companies, which the grid users (consumers) pay through distribution tariffs, which, based on 1 (one) MWh of energy delivered, amount to about 250-300 lei/MWh

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1.6.1 Smart microgrids

A microgrid is a collection of electricity and/or heat sources connected directly to energy users, allowing us to generate our own energy locally and use it when we need it, all in an optimized way. Microgrids can be connected to public distribution networks or operate in a disconnected, "islanded" mode.

A microgrid can integrate various energy sources such as photovoltaic power plants, cogeneration systems (simultaneous production of electricity and heat or cooling) and heat pumps, as well as energy storage systems.

The design, configuration and implementation of microgrids suitable for the specific activity of a local public authority starts from:

— analyze according to specific needs the types of energy used, energy quality, quantity and energy parameters required in buildings and possible technological processes fed from the microgrid;
— assessment of possible available residual energy resources, feasible to be harnessed by the micro-grid, available areas for renewable energy generation and storage opportunities.
— sizing the energy sources and, where appropriate, the storage system according to the need in the technological process: hot water, chilled water, steam, electricity, so as to maximize the use of local renewable sources and minimize the cost of grid energy;
— automation of the entire intelligent system, capitalizing locally as much as possible on dynamically produced energy from renewable sources, ensuring utilities at the required consumption parameters.

All this approach and context of micro-grids comes to fulfill the ambition of decarbonizing the energy footprint, at a time when we are currently using mostly methane gas in public buildings and objectives.

With a microgrid we have this possibility, because we integrate and control heat pumps, co/trigeneration, photovoltaic plants, energy storage systems, energy consumers, all using a Measurement Optimization & Verification Instrument (MOVI).

The benefits obtained from the realization of micro-grids in public buildings, groups of public buildings or platforms where public utility operators operate:

Low and predictable costs:

— Ensures an optimized price per kWh, but also predictable over the lifetime of the microgrid;
— Benefit from greater predictability in energy and operational costs.

Resilience / Energy Security:

— Increase security of energy supply and reduce losses in the event of disruptions in the distribution operator's network.
— Increases flexibility and energy independence at community level.
— Energy quality is improved by protecting sensitive equipment/consumers.

Sustainability/Decarbon:

— It reduces the carbon footprint, contributing to the sustainability goals of the assumed and the transition to Zero CO2 Emissions.
— There are image benefits: a sustainable, green, environmentally concerned locality.

2.7 Natural gas distribution networks

The natural gas distribution networks are concessioned to regional operators that ensure the distribution and continuity of natural gas supply, according to the quality standards imposed by ANRE.

The specific feature of natural gas distribution networks is that they operate with a so-called technological own consumption (TOC) or inherent energy losses, in the 2-5% range, i.e. out of every 100 cubic meters of gas extracted and injected into the network, approximately 2-5 cubic meters are lost through leaks, leaks and leaks. This makes this CPT a main operating cost of the distribution companies, which the network users (consumers) pay through distribution tariffs, which, in relation to 1 (one) MWh of energy delivered, amount to approx. 50-150 lei/MWh. On the other hand, these gas escapes also come with a high contribution in GHG emissions, given that the greenhouse effect of methane gas is 27 times higher than in volumetric equivalent of carbon dioxide.

3 Energy management for municipalities

Climate change, with adaptation and mitigation, is on the average agenda of European countries without exception. We are talking about decarbonizing our cities by significantly reducing greenhouse gas emissions from energy consumption.

The Energy Efficiency Act requires us that at a minimum, localities with more than 20,000 inhabitants must have an in-house or outsourced energy manager for the locality and prepare an energy efficiency improvement program each year.

The national statistics extracted from the second European financial framework 2014-2020 based on data presented by the Ministry of European Funds show that from the operational programs POIM Large and Regional Infrastructure about half of the European money attracted goes to energy, for projects with impact on energy, renewable effects.

Cities are the largest consumers of energy at national level, accounting for around 55-60% of final consumption.

We have an average of 7% for the cost of energy from the local budget to which, in cities with centralized heating systems, we add another 7% for the subsidy of gigacacalory thermal energy for the population.

The energy bill paid by Romania's large cities for public buildings and street lighting is between 3% for county capitals and up to 15% for small municipalities, compared to the annual local budget.

First, let's say what the energy manager is not: a political decision-maker, the equivalent of the city manager, nor does he or she have direct powers in the town halls.

But what is and what does the energy manager do? It's an internal role, employed within the city or outsourced, that deals with energy management. Follows and informs the mayor and staff with precise data on energy consumption and emissions. It is also the energy manager who identifies all energy consumers and energy efficiency potential in public buildings, street lighting and any other energy consuming targets of the local authority. He can draw up a plan for the installation of electric vehicle charging stations.

It is the energy manager who assesses the potential and impact of renewable energy production, especially photovoltaics. And for these projects to materialize, he/she can also initiate and prepare the need statements with clear indications for the design themes from which the ambition starts the impact assessment and the clear expectation of what will happen, the specifications with technical requirements for the procurement of services and solutions or products. The energy manager is the role that tracks actions, funding opportunities in the field. They present these to the mayor and those responsible in the departments of the municipalities.

The energy manager checks the drafting documents, feasibility studies/DALI and energy audit reports, ensures that the maximum investment and minimum energy performance indicators are realistic and adapted to the project.

Further, when the projects are being implemented, it monitors their status and at the end verifies and validates the energy performance assumed. It prepares proposals and solutions to protect **vulnerable consumers** and combat **energy poverty** in the local community, liaises with utility companies - water, district heating, local public transport, sanitation, and with electricity and gas network operators. Especially now that more and more public objectives are becoming **prosumers** (energy producers) and with the connection permits come consumer certificates.

Another task of this position is to keep an up-to-date record of all energy consumption, related costs, emission inventories and especially the status of energy efficiency projects. In that annual energy efficiency improvement program, the energy manager automatically contributes to all other strategic documents that the municipalities make mandatory or voluntary. The integrated urban development strategy SIDU, the city's district heating strategy required by ANRE, the Action Plan for Climate and Sustainable Energy PACED, the multiannual plan for buildings NZeb, the Circular Economy Plan and any other contributions, information and reports, many in number, that the central public authorities request each year.

This range of activities assumed by the Energy Manager ensures him a significant role and impact in the work of the City Hall, including as a specialized advisor to the mayor.

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Mirror Mission
Cities Hub Romania

Mobility

Modal shift — low emission travel
Traffic management

Tudor Măcicășan
Maria Cristina Găvozdea

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Mobility

Modal shift - low emission travel

Traffic management

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Introduction

Within the European Union, the transport sector contributes approximately 25% of greenhouse gas emissions. Around three-quarters of these emissions are generated by road traffic, which significantly contributes to the urban heat island effect, as well as noise, light, air, and water pollution. Additionally, car traffic has a major impact on the landscape and requires more land per passenger capacity than any other mode of transport, with significant socio-economic impacts at both personal and collective levels.

Mobility is therefore a key factor in the transition to climate neutrality, as well as in promoting public health, equity, inclusion, and biodiversity. The urban mobility landscape is best illustrated by the modal split, a key global indicator that reflects the percentage of city trips made using the four main transport modes: private cars, public transport, cycling (including other related slow modes), and walking.

Tabel 1
Raport modal urban, procente călătorii efectuate în oraș

Source: Author

Means of Transportation	Unsustainable city	Medium city	Sustainable city
personal car	> 75%	50–60%	< 25%
public transport	< 10%	10–25%	> 25%
cycling	< 1%	2–5%	> 5%
walking	< 10%	15–20%	> 20%

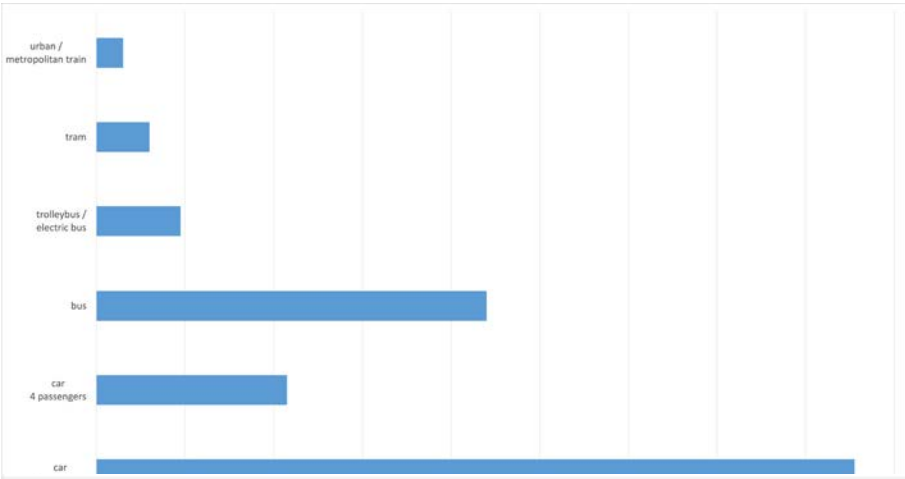

Fig. 1

CO2 Emissions per Person per Kilometer Traveled Using Different Modes of Transport. Source: Tudor Măcicășan.

In unsustainable cities, private cars dominate the mode of transport, followed by walking in smaller proportions, with public transport and cycling often contributing almost nothing.

In sustainable cities, mobility measures and related services redirect the majority of trips toward public transport or other non-polluting modes, with private cars typically accounting for less than 25% of trips within the city.

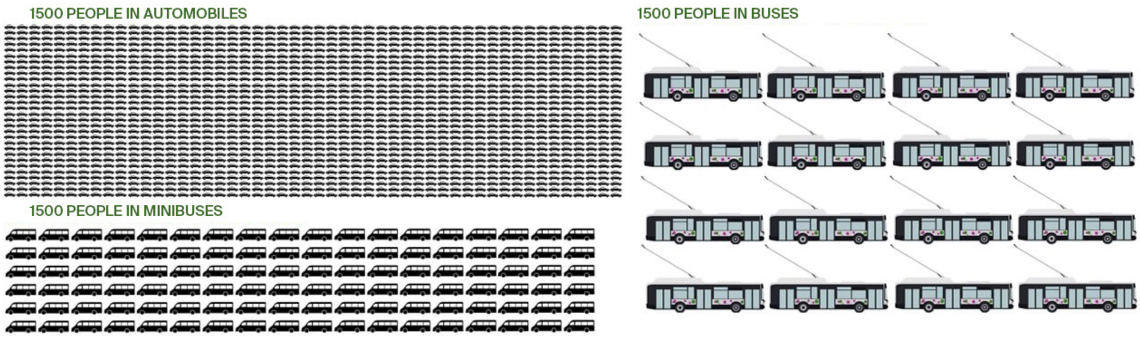

Fig. 2

Comparative chart of the number of vehicles needed to transport 1500 people in private cars, minibuses, and trolleybuses. Source: Author.

The experience of each journey begins with the decision to travel and the choice of transport modes, based on factors such as ease of access (information, distance-time, cost, universal access), safety, efficiency, and comfort.

The modal split reflects the population's preferences for specific transport modes. These preferences can be altered by reducing the need for motorized transport and increasing the appeal of sustainable transport modes, particularly public transport and active mobility (walking and cycling). To achieve this, several actions require coordination:

— Urban planning centered on proximity and connectivity principles—such as Transit-Oriented Development, the 15-minute city, and others—**detailed in Chapter 6: Urban Planning**. Here, mobility plans are closely tied to functional zoning, population density, building infrastructure, activities, and more.
— Public policies related to active mobility, public spaces, green-blue infrastructure, biodiversity, parking regulations, etc.
— Urban development projects with a transdisciplinary, integrated approach, focusing not just on segments of transportation routes but on significant areas that include at least the surrounding buildings and functions. The most effective solution in this context is to procure complete design services through a competition, **as detailed in Chapter 8: Administrative Tools**.
— Taxes and fees for congestion, pollution, car ownership/parking spaces.
— Awareness campaigns, citizen engagement, and cultivating civic responsibility, **as outlined in Chapter 9: Participatory Governance**.

The goal of mobility plans and projects is to significantly shift the modal split toward active mobility. The objectives of the mobility plan are:

1. Ensuring accessibility to current destinations and essential services through public transport or active commuting.
2. Enhancing safety for alternative modes of transport.
3. Reducing environmental impact, energy consumption, GHG emissions, and all forms of pollution (air, noise, etc.).
4. Providing transport services and infrastructure with improved efficiency and cost-effectiveness, both for people and goods.
5. Creating a more attractive and higher-quality urban environment and landscape, with a positive impact on citizens' quality of life, the economy, and society as a whole.

The proportion of car use can be reduced through coordinated measures that offer viable, safe, and attractive alternatives, such as quality public transport, well-designed cycling infrastructure, and pleasant, well-equipped pedestrian spaces. These should be complemented by restrictive measures on parking and car movement in specific areas and time slots.

1 Promotion of public transport

1.1 Indicators for evaluating public transport

Public transport is the backbone of urban communities and a core function of a smart city. The performance of public transport is crucial to the city's functionality and the quality of life for its residents, serving as the main alternative to using private cars.

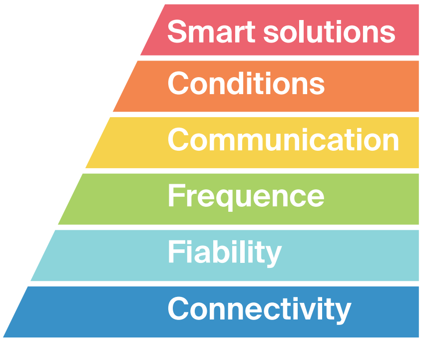

Fig. 3

Hierarchy of Performance Indicators in Public Transportation, Modeled after Maslow's Pyramid

Similar to Maslow's hierarchy of human needs, the graphic above contains the key performance indicators (KPIs) of public transport and outlines how to build a system where quality criteria are structured as follows:

— **Connectivity** describes the ability to cover/serve as many origin-destination relationships as possible, being conditioned by the transport operation route. The essence of public transport involves moving people according to real geographical needs.
— **Reliability** of a transport system describes its ability to systematically and predictably perform its function, meeting planned parameters such as speed, time, schedules, safety, etc.
— **Frequency** of a transport service strongly influences its attractiveness. The specialized literature indicates that when the interval between services is less than 15 minutes, passengers tend not to check the schedule, perceiving the system as frequent enough.
— **The communication interface with passengers** covers the entire range of active and passive information, including maps and posters, brochures and tickets, apps and websites, call centers, or information centers. Specific travel information—routes, stops, schedules, etc.—should be readily available, easily accessible, and highly adaptive.
— **Travel conditions** are determined by the comfort characteristics of the vehicle and the quality of both exterior and interior maintenance. This indicator tracks aspects such as cleanliness, climate control, seat comfort, soundproofing, suspension performance, etc.
— **Smart solutions** naturally belong in a high-performing system where previous criteria are successfully met. Therefore, contactless ticketing systems, interactive information systems, apps, or even autonomous operating solutions cannot make up for shortcomings in connectivity, reliability, frequency, communication, or travel conditions.

1.2 Modernization and electrification of the public transport fleet

The modernization of public transport must also cover the associated infrastructure, as the dedicated urban furniture at public transport stations plays an important role. Part of the public transport experience is shaped by the journey to the station and the waiting time at the station, making it essential to have shelters equipped with information solutions.

The electrification of the public transport fleet eliminates local emissions and helps reduce noise pollution in urban areas. Depending on the context and the targeted transport capacity, solutions for public transport electrification can range from battery-electric buses and autonomous trolleybuses to trams.

capacity	10 min	5 min	2 min
65	390	780	1950
100	600	1200	3000
95	570	1140	2850
150	900	1800	4500
190	1140	2280	5700
300	1800	3600	9000
250	1500	3000	7500
400	2400	4800	12000

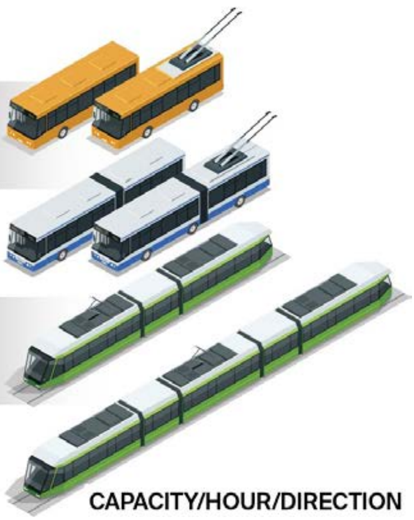

Fig. 4

Transport capacities for trolleybuses and trams, depending on service frequency.
Source: Author

3000 passengers 60′

46 1′18″	30 2′00″
32 1′52″	20 3′00″
16 3′45″	10 6′00″
12 5′00″	8 7′30″

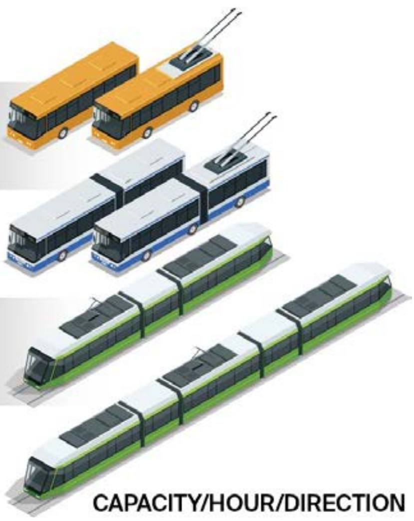

Fig. 5

Required service frequency for trolleybuses and trams, depending on their capacity, to ensure the transportation of 3,000 passengers within 60 minutes. Source: Author

SWOT analysis for public transport options

Strengths	Weaknesses
New buses are accessible, featuring 100% low-floor design	Some solutions require additional infrastructure
All solutions present low pollutant emissions	High initial costs for most eco-friendly solutions
New buses come equipped with smart/IT features	Diesel solutions still offer unbeatable advantages
Opportunities	**Threats**
Numerous technical solutions available	Some popular solutions present risks due to lack of maturity
Wide range of manufacturers and models on the market	Eco-friendly solutions involve high initial costs
Broad price range (from €0.05 to €0.65 million)	Innovative vehicles may result in extended downtime

Charging infrastructure for electric buses is vital to eliminating diesel buses from cities. The current performance of electric buses allows them to operate throughout the entire day, with potential fast charging at terminal stations and slow charging at depots. More than 200 cities across the country have included electric bus acquisitions in their strategies, with over 1,000 associated charging stations planned.

To increase transport capacity, a new trolleybus catenary network allows in-motion charging of battery-powered trolleybuses, enabling them to operate up to 25 km beyond the network coverage area.

A new tram network involves significant initial costs but also offers substantial transport capacity and a favorable cost per passenger, making it the optimal solution for main routes in large county capitals.

For transit distances typical of a metropolitan area of regional interest, only rail transport can ensure sustainable, high-capacity commuting. Capitalizing on an extensive and complex railway network—partially modernized and partially electrified—major growth hubs have the opportunity to develop interconnected rail services, both among themselves and with the existing urban public transport network, enabling multimodal transit through easy interchange between transport modes.

An efficient metropolitan train service meets all key performance indicators (KPIs) specific to public transport, offering extensive connectivity and reliability with good and predictable frequency. It provides clear communication both at stations and through digital platforms, while being fare-integrated with the existing urban/metropolitan road transport system.

Such a project aims to introduce a new transport service with new stop points, associated investments such as park-and-ride facilities or multimodal hubs, and, where necessary, targeted infrastructure upgrades through partnerships with CFR Infrastructure

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2 Promoting active mobility

Active travel, namely walking or cycling, represents the most democratic, equitable, and inclusive means of transportation, being accessible to all categories regardless of age, gender, origin, (dis)ability, or socioeconomic status. Active mobility combats sedentary lifestyles and loneliness—major public health concerns—by integrating daily physical activity, essential for maintaining good health, into routine activities with different purposes, as well as providing spontaneous socializing opportunities. Its speed and flexibility allow routes to adapt to spontaneous events, such as encountering a friend or buying a product spotted in a shop window or noticed through its scent.

The experience of an active traveler is multisensory, offering beneficial effects related to thermoregulation and connection with nature and its rhythms. Airflow speed, degree of sunlight or shade, scents, humidity, temperature, colors and lighting, textures—all contribute to the travel experience. Consequently, enhancing the appeal of active mobility requires careful design of this synesthetic experience.

Active mobility, therefore, has beneficial effects on the local (and individual) economy, on the physical, mental, and emotional health of residents, and on social and community relationships.

"Sedentary lifestyle is to people what rust is to cars."
Charles Montgomery, Happy City

Walking and cycling are the least polluting modes of transportation, and therefore the most desirable in a sustainable city. Elevating active mobility to the top of people's preferences is encouraged by ensuring daily activities can occur nearby, independently, safely, and comfortably.

2.1 Promoting pedestrial travel

A series of measures support reclaiming urban space for pedestrians, playing a decisive role in discouraging systematic car usage:

— Ensuring continuity of pedestrian routes, with a minimum functional width free of obstacles;
— Widening sidewalks at the expense of traffic lanes and parking spaces;
— Redesigning intersections to minimize space allocated to vehicles and maximize areas designated for pedestrians, cyclists, and greenery;
— Prioritizing active travel by ensuring continuous level surfaces and reducing car speeds – through shared spaces and living streets (woonerf), where children’s play is encouraged;
— Temporary or permanent pedestrianization of certain public spaces previously used for car traffic and parking;
— Equipping sidewalks and public spaces created by these measures with street furniture for rest and recreation, possibly reserving economically active zones in front of ground-floor retail spaces;
— Promoting the benefits and value of walking.

Occasional or permanent street closures to vehicle traffic, converting roads into pedestrian-friendly public spaces, encourage social, cultural, and economic activities, thus enhancing walking as an attractive transport choice.

Occasional pedestrianization involves closing central streets during holidays or weekends, a common practice in Cannes, Lugano, and also Bucharest, where over one million people annually pass through Calea Victoriei, pedestrianized on weekends between April and October as part of the “Open Streets” initiative. Similarly, neighborhood street closures enable children's play and various community activities, such as sports events, flea markets, and neighborhood gatherings.

Comparison of Passenger Transport Means and/or Systems
Acquisition cost / transport unit
Operating cost / km
Operating cost / km per passenger
Optimal frequency
Autonomy – distance
Infrastructure cost / km
Infrastructure maintenance cost / km-year
EU funding eligibility
Capacity / transport unit
Optimal capacity / hour per direction
Average commercial speed
Average useful life
Vehicle Maintenance interval
Active days / year
Fleet utilization coefficient
Carbon emissions (GHG)

Table 2
Multi-criteria comparative analysis for public transport electrification solutions.

Source: Author

	Autobuz diesel	Autobuz electric	troleibuz	tramvai	metrou	cel mai bun rezultat	Autobuz diesel	autobuz electric	troleibuz	Tramvai	metrou
EURO	310.000	680.000	680.000	2.900.000	6.000.000	Minim	100	93,49736	93,49736	54,48155	0
EURO	2,5	2,9	2,5	3,2	7,2	Minim	100	91,48936	100	85,10638	0
EURO	0,0167	0,0215	0,0167	0,0107	0,0080	Minim	35,71429	0	35,71429	80,21978	100
min	20	10	6	5	2	Minim	0	55,55556	77,77778	83,33333	100
km	600	215	20	0	0	Maxim	100	35,83333	3,333333	0	100
EURO	0	50.000	400.000	7.500.000	100.000.000	Minim	100	99,95	99,6	92,5	0
EURO	0	1.200	1.800	4.000	50.000	Minim	100	97,6	96,4	92	0
%	0	80	80	80	60	Maxim	0	100	100	100	75
	150	135	150	300	900	Maxim	1,960784	0	1,960784	21,56863	100
passengers	450	810	1.500	3.600	27.000	Maxim	0	1,355932	3,954802	11,86441	100
km/h	15	14	16	19	38	Maxim	4,166667	0	8,333333	20,83333	100
years	12	12	16	30	30	Maxim	0	0	22,22222	100	100
km	15.000	10.000	10.000	30.000	30.000	Maxim	25	0	0	100	100
days	345	335	345	350	345	Maxim	66,66667	0	66,66667	100	66,66667
-	0,95	0,92	0,95	0,96	0,95	Maxim	66,66667	0	66,66667	100	66,66667
kg/km	1.375	0	0	0	0	Minim	0	100	100	100	100
						medie:	43,76094	42,2051	54,75795	71,36921	69,27083

Permanent pedestrianization, fully removing cars from large areas of city centers, sends a strong message against urban car dependency and significantly contributes to urban regeneration. Extensive pedestrian spaces function effectively in tandem with efficient public transport, with tram networks generally accepted in otherwise pedestrianized areas.

Example: Barcelona has implemented the "superblock" urban concept, restricting car traffic to specific perimeter streets and reserving interior streets primarily for active mobility and, in some cases, public transportation.

2.2 Promoting cycling travel (velo)

Cycling becomes an attractive alternative to driving when cities provide residents with a strategic network of dedicated bike lanes that meet the five fundamental quality criteria for cycling infrastructure:

- Coherence (continuity)
- Direct routes (connectivity)
- Safety (segregation from other transport modes)
- Comfort (smoothness)
- Attractiveness (environment, conditions, planning)

The transportation capacity provided by a cycling network is significant. Such infrastructure, when used at full capacity, can transport as many people per hour per direction as public transit systems.

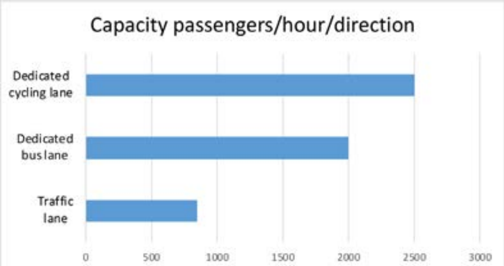


Table 3

Performance of street infrastructures in terms of capacity. Source: Author

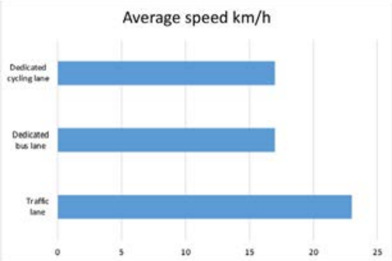


Table 4

Performance of street infrastructures in terms of average speed. Source: Author

From a cost-benefit perspective, investment in cycling infrastructure is unmatched. While a 3.5-meter-wide traffic lane can transport up to 1,000 people/hour-direction, a bike lane of similar width can accommodate over 2,500 people/hour-direction.

Cycling infrastructure should anticipate and stimulate a significant increase in regular cyclists. With a high-quality network of bike lanes, urban cycling can become a safe and attractive option, both as an independent commuting method and within a multimodal connectivity context, with major transit hubs equipped with bike parking facilities, such as railway stations or future metropolitan rail stations. Bicycle racks should be placed near every institution, public transportation stop, or points of interest. Cycling infrastructure is complete when bicycle parking infrastructure is functional and widespread.

Public bicycle and scooter rental systems complement the infrastructure, facilitating familiarity with this mode of travel for tourists and locals without the need for personal bike ownership. Best practice recommends the integration of fare systems and operations of bike-sharing and public transport, enabling common ticketing/cards and bike stations located at public transportation stops for optimal intermodality. It is recommended that every public car parking area includes a zone dedicated to bicycles, ensuring secure parking for residents.

Sustainable communities have a responsibility to invest in cycling infrastructure. The Sustainable Urban Mobility Plans (SUMPs) in Romania propose, for the coming years, 19,900 km of bike lanes and 10,086 bike racks for parking bicycles. Additionally, a total of 28,727 conventional and electric public bicycles are planned nationally under current SUMPs.

Fig. 6

Bicycle parking facilities.
Sursă autor.

2.3 Intermodality and measures related to alternative mobility

To facilitate bicycle use for the last segment of long journeys and to ease cyclists' access to distant or steep areas, effective integration of bicycle transport with public transit services—road or rail, urban or suburban/metropolitan—is recommended.

Buses can be equipped with racks capable of carrying multiple bicycles, and most trains already have designated spaces for bikes. It is recommended that bicycle transport availability be clearly indicated on operators' maps and diagrams.

It is essential that the placement of charging stations in cities also includes charging solutions for slow mobility, as the proportion of electric bicycles and scooters is continuously increasing.

Fig. 7

Bicycle racks for public transport vehicles.
Source: Author.

3 Shared mobility systems

3.1 Development of shared transport networks (bicycles and scooters)

Public bike-sharing systems are essential components of a well-functioning cycling network. An adequate bike-sharing system covers all commercial and residential areas of interest and can function properly only alongside a strategic network of bicycle paths. Rental stations should be located near public transport hubs and directly adjacent to cycling routes or lanes. The density of rental stations should correspond to the density of population and key points of interest, aiming for distances between bike-sharing stations similar to those between public transportation stops—minimum 300 meters, maximum 1 km.

Shared bicycles should be adapted to local geography (with gears or electric assistance if the city has hills/slopes) and systematically redistributed to maintain balanced occupancy levels at each station, ensuring availability of bicycles and sufficient parking spaces at all locations.

Fig. 8

Bike-sharing station.
Source: Author.

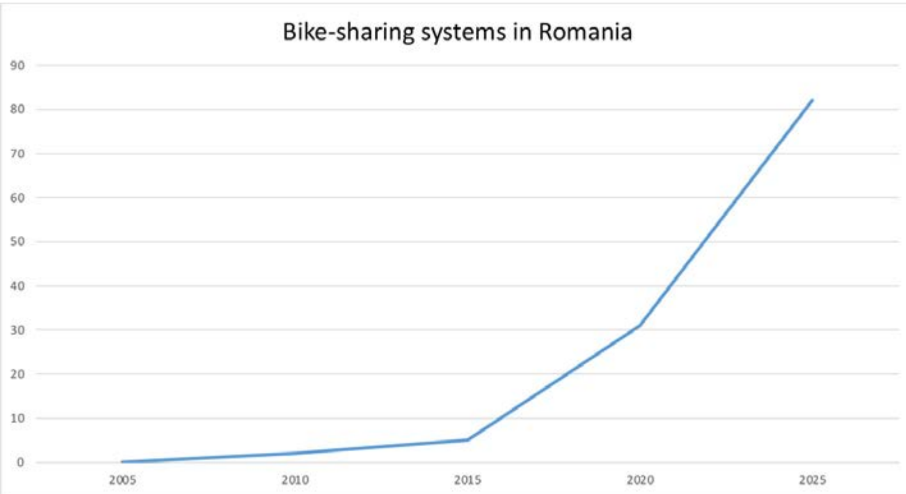


Fig. 9

Evolution of bike-sharing systems in Romania from 2005 to present.
Source: Author

3.2 Car-sharing & car-pooling systems

Car-sharing systems involve the shared use of vehicles through various rental or booking methods. The key advantage of these systems is reducing reliance on personal vehicles and their associated costs (maintenance, parking), encouraging occasional use of cars from shared public or private fleets. Car-sharing solutions fall into two categories:

— **Car sharing** – public or private driverless car rental systems, similar to bike-sharing. Such systems perform particularly well in large and dense cities to optimize utilization rates, requiring a maintenance and assistance network. In Romania, four platforms enable occasional car use via applications, employing dynamic pricing and subscriptions for regular users.

— **Ride-hailing services** (car-sharing with driver) – Popular ride-hailing applications with digital prepayment have captured a significant market share from traditional taxi services, also offering the option to combine multiple users/passengers into the same ride. Without clear regulations, this category risks evolving into an informal private taxi service lacking compliance with professional standards.

Car-pooling—sharing car journeys among multiple passengers—is a sustainable method of car travel. Such systems can function formally, facilitated by popular applications, or informally, locally organized, typically for children's school transport or neighbors commuting to the same workplace.

These systems aim to reduce the number of cars on the roads and the demand for parking spaces, as well as the necessary infrastructure and road surface, thus freeing up space for active mobility, public areas, green spaces, commercial activities, and higher-density urban development.

Best practices recommend supporting electric vehicle fleets for these services, with tax advantages and legislative constraints complementing a network of charging stations for electric vehicles.

3.3 Electric charging infrastructure

Charging infrastructure for private vehicles must be carefully managed to encourage transitioning from internal combustion engines to electric vehicles, without inadvertently promoting additional car usage within the city.

It is recommended to install electric vehicle charging stations primarily in locations where continued car presence is desirable, such as Park & Ride facilities or large commercial centers. There is a risk of increased congestion and associated particulate pollution if excessive availability of charging stations encourages unnecessary car journeys. In 2024, the number of electric vehicles in Romania surpassed 40,000, and urban strategies anticipate more than 50,000 charging stations by 2030.

4 Trafic management and congestion reduction

4.1 Implementation of smart solutions for traffic monitoring and optimization

The use of Intelligent Transport Systems (ITS) can significantly benefit urban mobility by improving traveler information, ensuring efficient infrastructure usage, reducing waiting times (e.g., bus stops, traffic lights), and directing mobility according to strategic sustainable planning documents.

Apart from implementing ITS projects, local authorities should regularly evaluate intersection performance. Significant improvements in mobility—potentially greater than those achieved through costly ITS systems—can be obtained through optimized traffic planning, adjustments to fixed-cycle traffic lights, and introducing varied traffic-light cycles according to different times of day and weekdays versus weekends.

The most basic centralized traffic monitoring system, involving data transmission to traffic-light controllers, is remote monitoring. This allows a central operator to intervene remotely at a traffic-light controller to upload error messages, download operational plans, update diagrams, and synchronize controller clocks.

Public transportation represents the most efficient use of urban road infrastructure but must ensure predictability and speed for passengers. Centralized public transport prioritization involves location-triggered data from vehicle GPS systems being transmitted through various systems to the urban traffic control system, invoking priority for public transport by communicating with relevant traffic-light controllers. Centralized adaptive traffic systems include public transport priority but subsequently take recovery measures to restore optimal traffic-light timing within the road network.

If implemented improperly or not at all, ITS projects can offer little benefit or even create additional problems. Even the most advanced adaptive traffic-light systems cannot resolve chronic road network congestion issues—adaptive signaling, at best, delays congestion onset slightly. The underlying issues can only be resolved by fundamentally rethinking urban mobility patterns towards sustainable modes of transportation—significant investment in public and alternative/non-motorized transportation, and reconsidering parking policies.

4.2 The role and effect of parking policies

Proper parking management decisively contributes to efficient city functioning, facilitating central parking space usage for many users. Sustainable parking policies contribute directly to reducing urban traffic by discouraging car trips to city centers, especially long-term ones. Parking fee principles aim to discourage prolonged parking, enabling multiple short-term users to utilize the same parking spots throughout the day.

Appropriate pricing balances parking demand with available capacity, following the principle that "there are no shortages of parking spaces, only parking prices that are too low." Correct pricing ensures 90–95% occupancy during peak hours, maintaining a few free spots at any given moment, thus eliminating artificial traffic caused by drivers searching for parking spaces.

Best practices suggest defining concentric zones with decreasing tariffs from the central area to the periphery. Zoning and hourly pricing should only apply in central and high-interest areas or major boulevards, with residential parking spots exempt from hourly charges.

Strict enforcement of parking discipline and payment should be pursued, with smaller penalties for non-payment but legal parking, compared to illegal parking in prohibited spaces, where prompt vehicle removal is recommended, especially in cases obstructing pedestrian or bicycle paths.

For central residential parking, annual subscriptions are recommended. Permanent allocation of resources for parking enforcement is advisable. A proportion of 1–5% of parking spaces should be allocated for disabled users, appropriately sized and marked, preferably painted blue, and located near commercial or recreational areas and residences.

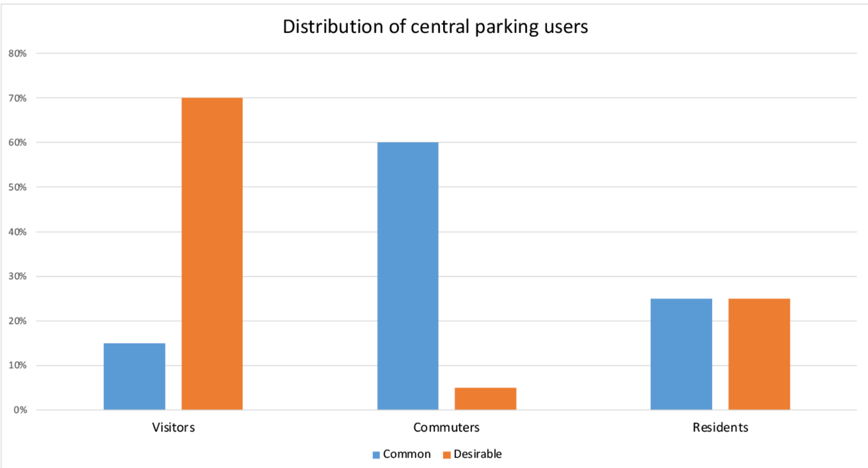


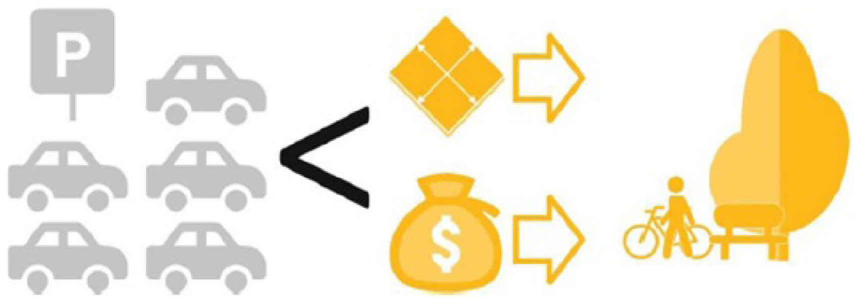
Fig. 10

Distribution of central parking users: common vs. desired situation.
Source: Author.

Reducing car presence in central areas and improving overall environmental conditions will ultimately enhance urban quality of life. Immediate effects include reduced congestion and increased parking availability. Central parking fees should apply during peak periods, recommended between 8:00 and 20:00. Three important aspects to consider:

— Revenues from parking fees, garages, and fines should be allocated exclusively to a dedicated account managing sustainable mobility initiatives in the area studied, especially maintenance and expansion of alternative transport modes—public transit and cycling.
— Parking management costs should be financed from this dedicated account, including local enforcement salaries, maintenance costs (snow removal, cleaning, regular remarking/repaving), and payment-related expenses.
— Parking fee collection should be possible through multiple channels—apps, SMS, automated machines, etc.

Reducing central area car presence through parking tariffs will inherently decrease congestion and proportionally lower pollution levels in historic areas, while enhancing mobility safety.



4.3 Regulating access for high-emission vehicles in specific zones

Central, historic, or commercially significant areas are suitable for exclusively pedestrian and non-motorized traffic, advocating for restricting or fully eliminating motorized access. Restricting vehicle access in central or protected zones can be implemented through various restrictive measures. General congestion charges—not only targeting polluting vehicles—are advisable, as all vehicles, not just older or highly polluting ones, negatively impact urban environments.

Congestion charges, first introduced in Singapore in 1975, have since been adopted by over 100 cities. This involves defining a central zone and imposing significant charges for its transit, additional to parking costs. Such charges typically disregard emission class, as even environmentally friendly vehicles contribute to traffic, noise, particulate pollution from tires/brakes, and road-space occupation.

The pollution charge adopts an approach similar to congestion charging, but with differentiated tariffs based on emission classes or even zero charges for environmentally friendly vehicles. If not carefully implemented, such measures could lead to unintended social impacts, particularly affecting drivers who cannot afford newer, less-polluting vehicles.

Local restrictive measures alone cannot effectively address shortcomings in national legislation and taxation policies. Taxing vehicles proportionally to their emissions is a national necessity that must be regulated countrywide.

The Sustainable Urban Mobility Law (155/2023) represents a step forward in reducing car use and consequently urban pollution, potentially marking the beginning of a coherent urban policy necessary for Romanian cities to achieve sustainability. The primary implications of the Sustainable Mobility Law are:

— Thirteen municipalities in Romania are required to establish Low Emission Zones (LEZs) to improve air quality. Vehicle access to these zones will be restricted and/or subject to fees, with three-quarters of the revenues earmarked for environmental protection projects.

— County-seat municipalities must establish dedicated public transport lanes on routes where the maximum travel speed is below 15 km/h. The law specifies that dedicated lanes are intended to separate specific transportation modes from others, with municipalities retaining the authority to decide whether cyclists or authorized taxis may also use these lanes.

— Municipalities are required to implement intelligent transport systems (ITS) to manage traffic with priority given to public transportation, parking management systems, journey planning applications, and real-time traveler information. If Intercommunity Development Associations (ADI) for public transport exist within these municipalities, these measures apply to all localities within their metropolitan areas.

Electric vehicles are particularly sustainable for intensive but short-distance usage. Public service vehicle fleets are particularly well-suited for electrification. Vehicles used for sanitation, street cleaning, local police patrols, and green-space maintenance represent ideal candidates for electrification, as their exclusively urban use complements the benefits of eliminating local emissions.

5 Measurement, Evaluation, and Reporting (MER)

Modal share is the primary comprehensive indicator for urban mobility. It is recommended that modal share be analyzed not only overall but also according to age groups, gender, (dis)ability, and socioeconomic status, as well as intersectional situations, to ensure equitable access and effective service provision for all user categories.

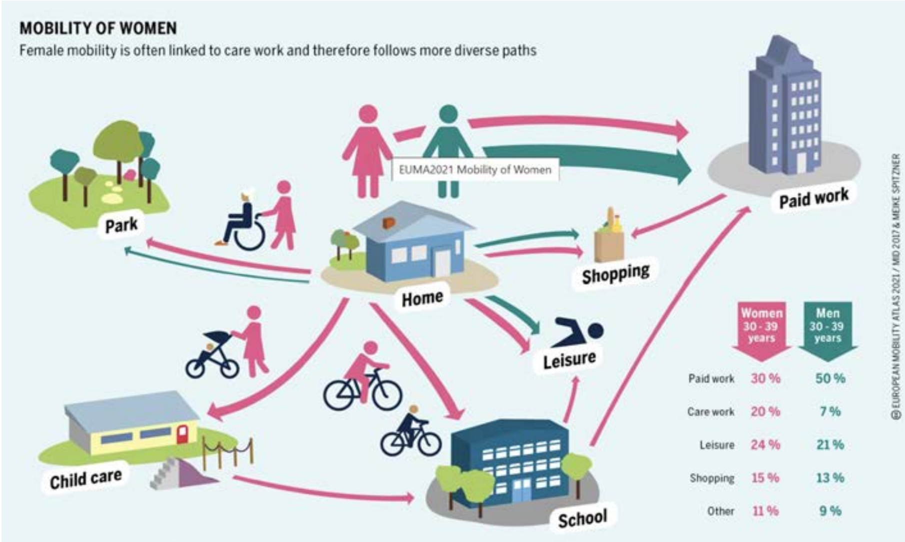


Fig. 10

Mobilitatea femeilor este adesea legată de activități de îngrijire și, prin urmare, urmează căi mai diverse decât ale bărbaților, în majoritatea culturilor. Sursa: EUMA2021 Mobilitatea femeilor, grafic: Fundația Heinrich-Böll

To effectively monitor and evaluate progress in urban mobility, improvements should be tracked using the following indicators:

- **Walking**: Percentage of accessible pedestrian crossings, kilometers of upgraded sidewalks.
- **Cycling**: Kilometers of bike lanes, number of bike-sharing stations/bicycles, bike-sharing usage rates.
- **Public transport**: Average commercial speed (km/h), number of passengers/subscribers.
- **Motorized traffic**: Number of accidents, pollutant emissions measured in traffic.
- **Rail transport**: Number of train pairs per day, number of train subscribers, number of stops.

Secondary impact indicators could include the following categories:

- **Economy**: Growth in local economic activity, increase in property values, number of jobs created in a specific area.
- **Health**: Number of medical leave days, number of reported illness cases.
- **Environment**: Indicators of biodiversity, air quality, temperature, etc.
- **Culture, diversity, and inclusion**: Cultural activities, ethnic and socio-economic diversity, age inclusiveness.
- **Quality of life through time**: Statistical distribution of time residents spend on various activities—commuting, working, recreation, socializing, etc.

Navigation apps that provide real-time travel options between points A and B can quickly reflect the impact of mobility optimization measures. They demonstrate the efficiency of various transport modes and influence user choices.

Active mobility promotion campaigns can include the reporting of the above indicators, as well as gamified applications that track individual performance compared to other users (e.g., kilometers traveled, time spent moving).

Example – Ferrara Bike2Work, detailed in Chapter 9: Participatory Governance.

This type of information can also be integrated into bike and scooter rental applications.

6 Public policy recommendations

Transit-Orientated Development (TOD)

Integrating urban development and management with mobility systems—such as through the "15-minute city" model or similar—is critical for advancing climate neutrality.

Mixed-use planning and maximizing the use of existing buildings and spaces through various activities during different times of the day and week ensures continuous human presence in public spaces, thus improving urban safety.

It is recommended to develop public policies for pre-university education infrastructure, which currently generates the highest volume of urban traffic in Romanian cities. The goal should be to support a transition to a high-quality, well-distributed local education system accessible to children independently from an early age.

Reconsidering and reducing the need for certain trips

Another major source of urban traffic is commuting to work. Following the COVID-19 pandemic, many professionals have adopted remote work, reduced work schedules, or hybrid models—partly from home, partly at the office. The demand for conventional office spaces has declined sharply, while co-working spaces have emerged as viable professional environments near residential areas. Online meetings, now routine, have significantly reduced the need for physical travel.

These **alternative working arrangements should be actively promoted and supported** wherever possible—both within the local business environment and across public administration and other institutions. Special attention should be paid to **mitigating the risks of social isolation**.

Many courier services have implemented **parcel locker systems (e.g., Easybox)**, enabling local delivery and pickup points, thus reducing traffic from individual home deliveries.

Community engagement and intersectional perspective

All relevant stakeholders—employers, employees, customers—should be **involved inclusively and iteratively** throughout the entire process of developing sustainable mobility measures. Inclusivity means **actively involving all groups**, including people of different ages, genders, backgrounds, (dis)abilities, and socioeconomic status, as well as intersectional cases (e.g., low-income elderly people, mothers with strollers, immigrant children). These policies should be shaped by **user experience** and input from those affected, including minimizing disruption during infrastructure works.

The independent mobility of elderly residents is encouraged by the presence of tall street trees and green public spaces, which help create **comfortable microclimates near residential areas.**

Integrating the time perspective

The transition to climate neutrality frequently involves **time-specific measures** aimed at reducing congestion and pollution, such as:

- Dynamic pricing based on time of day or day of the week for parking, taxi services, public transport, and congestion charges.
- Time- and zone-based vehicle access restrictions.
- Scheduling logistics and utility services outside peak traffic hours.
- Encouraging organizations to stagger work schedules so that start and end times avoid peak hours—some companies have long implemented this voluntarily.

Reducing commuting times and increasing active mobility grants people more time for activities that enhance their quality of life, including health and self-care, caring for others, recreation, socialization, cultural participation, and civic engagement. This additional time has **positive impacts on public health, productivity, and both personal and public budgets**.

Barcelona's municipal government introduced the **Barcelona Time Pact**, a citywide agreement promoting a more balanced daily schedule, enabling residents to live and organize their time in harmony with their needs and within a shared framework of urban coexistence.

Transdisciplinary and integrated approach

The modernization and development of transportation infrastructure must be approached through a **transdisciplinary process**, as part of integrated urban projects. This means ensuring complete planning and design by a multidisciplinary team of specialists and experts, addressing (but not limited to) the following:

- Urban design and landscape composition principles.
- The relationship between infrastructure and adjacent buildings/functions, including potential integration through expanded intervention areas.
- Green and blue infrastructure, habitat connectivity, soil quality, biodiversity, and microclimate.
- Stormwater management and soil absorption capacity.
- Protection and enhancement of built and natural heritage.
- Signage systems for intuitive spatial orientation.
- Analysis of airflow dynamics and the impact of built volumes, vegetation, or terrain on wind corridors and stagnant air zones.
- Public space user experience (UX design) and movement for all user types—both in everyday use and emergencies.

Integrated urban projects are best procured through design competitions held in accordance with the standards of the International Union of Architects—the only public procurement method that ensures selection of the best solution for complex projects.

Mirror Mission Cities Hub Romania

Possible Cities

Integrated toolkit for climate neutrality

Green infrastructure and nature-based solutions

Principles and tools for planning. NEB

Cristian Ioja
Răzvan Niță
Alexandru Ciobotă
Raluca Rusu
Thora Oskarsdóttir

4

Green infrastructure and nature-based solutions

Principles and tools for planning. NEB

Contents

Climate neutrality requires cities to conserve existing urban green infrastructure components, expand their area where deficits are identified (including by increasing urban permeable surfaces), and significantly enhance their multifunctionality.

Without healthy, sufficient, and functional urban green infrastructure, it is not feasible to achieve climate neutrality targets set by the EU.

The recycling of built spaces must become a common practice in cities, ensuring the inviolability of urban green infrastructure components (including permeable plots).

Urban greening must be ecologically appropriate (real contribution to improving urban environmental quality, carbon storage, and water management), socially oriented (focusing on citizens' health), and economically sustainable (maintenance costs aligned with the financial possibilities of the city).

The responsibility for conserving and expanding urban green infrastructure is both public and private.

1 Preamble: green infrastructures and climate neutrality

Climate neutrality is a target increasingly adopted by cities worldwide, playing a central role in the responsible management of the climate crisis at global, regional, and local scales.

To efficiently respond to these efforts, urban green infrastructure (UGI) must have a structure tailored to the biophysical and socioeconomic contexts of cities, be quantitatively sufficient, of adequate quality, accessible, and distributed equitably in spatial and social terms, and designed to maximize ecosystem services; integrating green infrastructure with other urban infrastructures is required to maintain urban quality of life and economic competitiveness.

Municipalities are responsible for ensuring that urban green infrastructure becomes a priority topic, included in spatial planning and territorial development processes (European Commission, 2019). Thus, urban biodiversity and ecological processes are key elements in mitigating and adapting to climate change.

In Romania, official statistics used by public administration (including official statistical records) commonly equate urban green infrastructure with urban green spaces. While forested areas, grasslands, wetlands, agricultural land, restored areas, or private green spaces within urban settings are frequently considered institutionally external or difficult to address by public authorities, they indeed form part of urban green infrastructure. Therefore, a conceptual clarification as well as a clear emphasis on the benefits provided by urban green infrastructure—as an overarching concept encompassing all urban nature categories—are required.

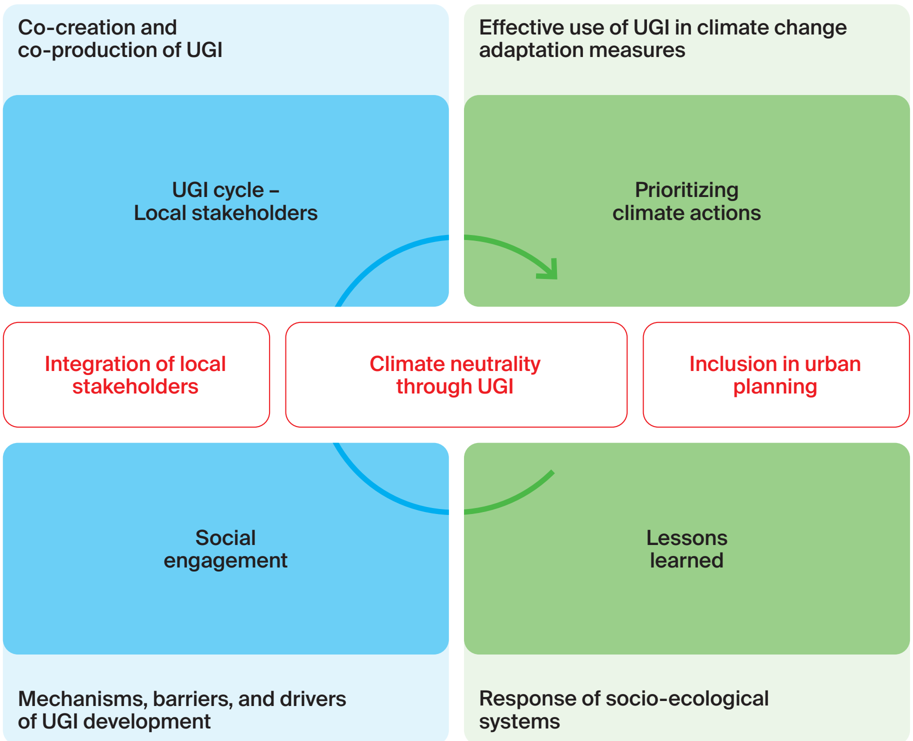


Fig. 1

Participatory development of UGI for climate neutrality

2 Defining urban green infrastructure

The European Commission (2013) defines green infrastructure as “a strategically planned network of natural and semi-natural elements, designed and managed to provide a wide variety of ecosystem services and to contribute to biodiversity protection, both in rural and urban environments” (European Commission, 2013; Escobedo et al., 2019).

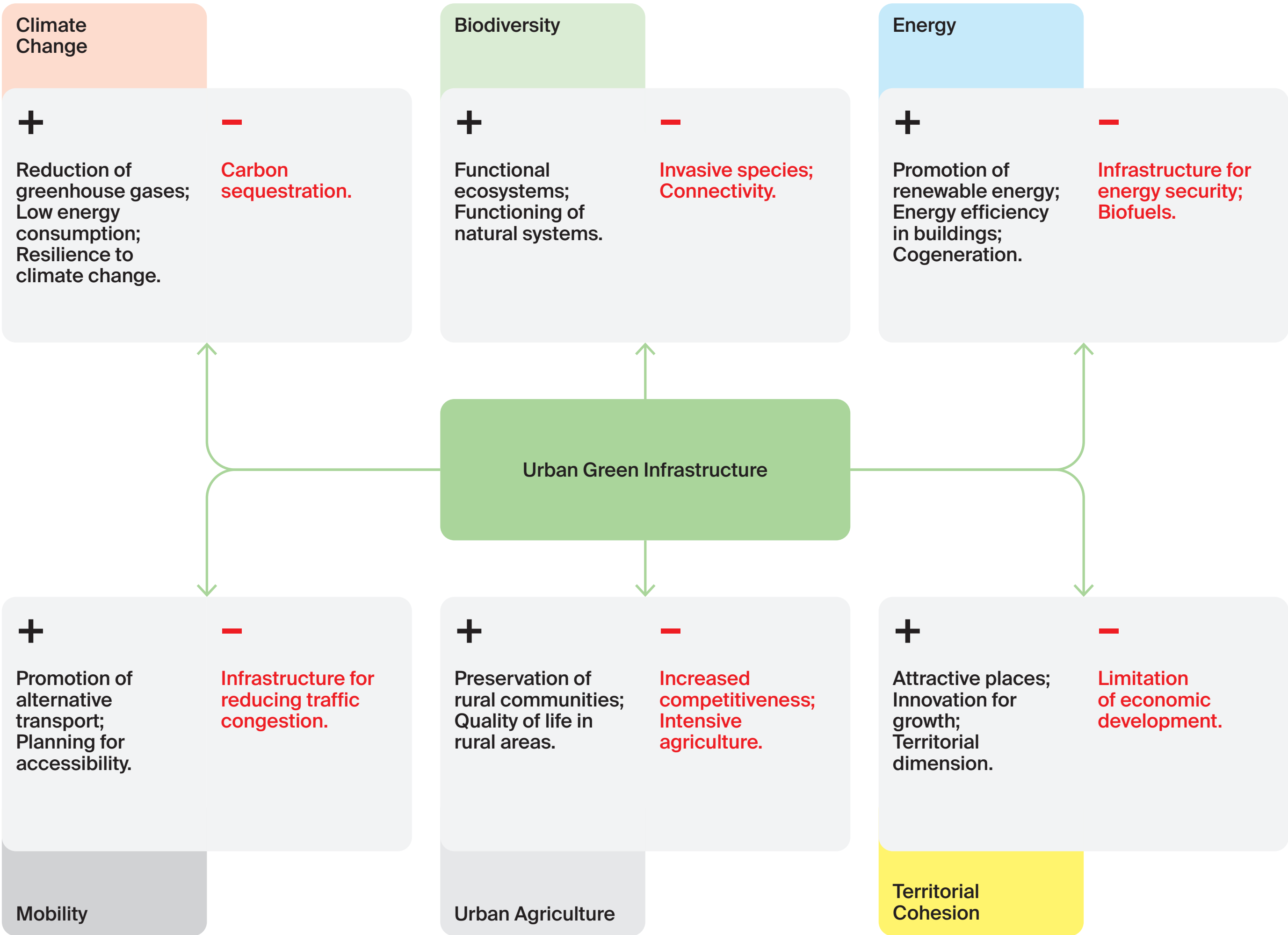


Fig. 2

Integration of UGI into various urban and territorial management practices

Urban green infrastructure (also known as green-blue infrastructure) is part of the regional green infrastructure, also referred to as ecological infrastructure. Thus, urban green infrastructure represents a strategically planned network within city boundaries, comprising natural and semi-natural ecosystems at various stages of conservation and restoration, designed to deliver a wide range of ecosystem services necessary to support human well-being and quality of life.

The concept goes beyond merely grouping all previously mentioned categories of urban nature under a new label; rather, it promotes an integrative vision of managing urban infrastructure components, enhancing urban sustainability and increasing its resilience to future challenges (e.g., climate change, pollution, reduction in water resource availability). Thus, urban green infrastructure aims at high connectivity between local and regional components (including natural areas outside the city), balanced multifunctionality, enhanced value of small green spaces and unused lands, and increased use of nature-based solutions. Moreover, a key objective is the unsealing and ecological restoration of degraded lands, facilitating biodiversity and improving ecosystem services (Lafortezza et al., 2013; Niță et al., 2018, Ioja et al., 2021).

Urban green infrastructure consists of:

a. Core areas, which are of major importance for biodiversity conservation and the provision of ecosystem services (e.g., protected natural areas, areas with functional natural ecosystems, aquatic areas, large public parks and gardens);
b. Corridors and stepping stones, which ensure connectivity between network elements (watercourses, ponds, shelterbelts, tree alignments, small green spaces);
c. Restored habitats, especially aimed at enhancing connectivity and network functions;
d. Engineered components, human-made to maintain an optimal level of connectivity and ecosystem functionality (aquatic areas, medium- and small-sized parks and gardens, agricultural lands, wildlife crossings, fish ladders, green roofs, green walls, permeable areas);
e. Buffer zones, which improve ecological quality and landscape permeability (zoos, arboretums, botanical gardens, agricultural lands);
f. Multifunctional areas, with multiple uses but high compatibility levels (Pauleit et al., 2017).

Urban green infrastructure can also be understood through various networks, which represent typical habitats used by species according to their needs, as follows:

— Green network, composed of medium and tall vegetation (green spaces, urban forests, isolated trees, etc.);
— Blue network, consisting of wetlands and aquatic areas (watercourses and canals, lakes, ponds, marshes, etc.);
— Yellow network, primarily represented by agricultural areas (agricultural mosaics, urban meadows and pastures, vineyards, orchards);
— Brown network, consisting of corridors and soil reservoirs (vacant lands with varying intensities of ecological succession processes);
— Black network, defined by areas devoid of artificial light, essential for the protection of nocturnal and luciferous species (unlit green spaces, trees with cavities, urban areas with adjustable lighting, construction attics, etc.).

3 State of urban green infrastructure in Romania

In Romania, the concept of 'urban green infrastructure' has gained increasing prominence, including in territorial and urban planning documentation developed in recent years. However, there is no consistent approach, nor has it been effectively integrated into current practice, due to a range of diverse factors. The forested, agricultural, and vacant lands associated with cities in Romania are not included in official statistics, despite their significant importance in providing ecosystem services.

According to data from the National Institute of Statistics, the area of green spaces in Romanian cities increased from 20,680 hectares in 1993 to 33,620 hectares in 2023. This increase in green space area seldom reflects real spatial growth, being primarily attributed to city boundary expansions, the inclusion of new areas reclassified as green spaces, past underestimations followed by more accurate current reporting, or the addition of categories previously not classified as green space (e.g., forests, agricultural lands). Therefore, when considering the urban area as it existed in 1993, without subsequent extensions, most cities have experienced a decrease in green spaces, averaging between 10% and 20%.

The green space per capita index at the city level averages 16.82 m² per inhabitant (ranging from 4 to 28 m² per inhabitant, ±5.87). The majority of cities in Romania (97%) report a green space per capita value below the national legal requirement of 26 m² per inhabitant. Spatial differences in the distribution of the green space per capita index in Romanian cities are justified by their geographic location in relation to relief units, historical regions, positioning relative to major transport axes, and the period when they were declared as urban administrative units (Badiu et al., 2016).

In addition to urban green spaces, the blue component of green infrastructure is often included, represented by urban waters, such as watercourses, lakes, canals, wetlands, delta areas, or coastal zones. With an average coverage of 3.25% of the area of administrative-territorial units, urban waters exhibit high variability among Romanian cities (Iojă et al., 2021).

An overview of the state of urban green infrastructure components in Romania reveals the following:

— Forests, agricultural lands, and vacant lands are poorly integrated into green infrastructure planning, being addressed institutionally but largely disconnected from urban life.
— From a statistical perspective, the per capita green space figure is artificially kept high, merely to simulate compliance with environmental legislation. Beyond the figures, the lack of adequate green space is a reality in many Romanian cities, impacting public health, quality of life, housing costs, air pollution levels, noise pollution, urban heat island expansion, and urban aesthetics.
— Public investments in green spaces often run counter to climate neutrality goals and user expectations (for example, prioritizing built and furnished functions over urban nature and biodiversity elements).
— Awareness of the benefits of urban green spaces among the public remains limited, resulting in minimal public response to threats to green areas.
— The conversion of urban green infrastructure into built and gray infrastructures is widespread. This practice is often disguised as "green spaces" on urban decks (e.g., underground parking), a common occurrence in recent urban developments in major cities.
— Preserving the green infrastructure's designated purpose remains a public responsibility, although practices of relocation and reduction are frequently observed in major cities.
— In the case of private investments in residential and office spaces through functional reconversion, urban planning indicators regarding green spaces are often not respected.
— Recent real estate developments have significantly exacerbated accessibility challenges related to quality green spaces (CCMESI, 2020).
— The yellow layer has been the primary victim of urban expansion, with cities losing significant permeable surfaces and natural soils.
— The brown layer is underestimated in terms of importance, with vacant lands often perceived as indicators of poor urban management.

4 Benefits of urban natural environment

Ecosystem services represent the benefits that human communities gain from the ecosystems they interact with (Millennium Ecosystem Assessment, 2005). In this context, it is essential to provide a brief overview of the ecosystem service categories and their contributions, correlated with urban green infrastructure. CICES (Haines-Young &

Potschin, 2018) identified three general categories of ecosystem services that are particularly relevant to urban green infrastructure:

a *Provisioning ecosystem services* are underrepresented in cities compared to surrounding areas, as most cities are predominantly focused on industrial production and services. However, services related to water management (including storage, circulation, and purification) and ornamental resources (such as plants that enhance landscape aesthetics) are of higher relevance and can be managed within cities.

Production	Functions of urban ecosystems
	Primary production, including community gardens and the cultivation of vegetables and fruits
	Raw materials and fuel, such as wood, compost, and textile fibers for various uses
	Ornamental resources, like flowers
	Surface and groundwater resources, both potable and non-potable (water reserves)

b *Regulating ecosystem services* are among the most vital for urban living. Within this category, urban green infrastructure contributes to the following: (i) Local climate regulation, particularly by lowering air temperature during heat waves through evapotranspiration and shading; (ii) Air quality regulation and pollutant filtration, including balancing gas concentrations and atmospheric humidity, as well as capturing suspended particles and pollutants from combustion processes and energy generation; (iii) Carbon absorption and storage; (iv) Mitigating and moderating natural hazards (such as floods, landslides, and storms); (v) Water cycle regulation; (vi) Soil erosion prevention and fertility maintenance (relevant in urban areas, particularly for maintaining the quality of green spaces); (vii) Pollination support; (viii) Ecosystem health maintenance through natural control of organism dispersal or genetic mutations.

Regulation	Functions of urban ecosystems
	Regulation of urban temperature (vegetation and water bodies reduce air temperature: water absorbs heat, trees offer shade and cool the air through evapotranspiration)
	Stormwater management (ecosystems help mitigate flooding, with rainwater being intercepted and absorbed by vegetation and soil)
	Pollution reduction (vegetation and microorganisms decrease water and soil pollution: plants and microorganisms purify water and remediate contaminated soils)
	Air quality regulation (vegetation reduces air pollutant concentrations: plants capture pollutants through leaf deposition, absorption, and accumulation in plant tissues)
	Mitigation of noise, visual, and odor pollution (trees, shrubs, and vegetated surfaces help reduce urban noise)
	Pollination (pollinators facilitate plant reproduction, promoting the development of flowers, fruits, and vegetables, and contributing to urban biodiversity)

c *Cultural ecosystem services* are the hardest to quantify, yet the most easily perceived by the general public. They encompass active and passive recreation, physical and mental health, as well as aesthetic and spiritual values.

Cultural	Functions of urban ecosystems
	Social connections (urban green spaces foster diverse social interactions and connections)
	Aesthetic values (people find and appreciate beauty in various aspects of nature)
	Recreation (urban green and blue spaces encourage outdoor activities)
	Education and science (urban ecosystems support nature-based learning)
	Heritage and culture (identity, sense of belonging, and spirituality)

Assessing urban ecosystem services is very important, as it requires understanding the existing supply, demand, and degree of utilization (*flow*) (Maes et al., 2013). Therefore, knowing the balance of ecosystem services is essential because any shortfall must be offset by gray infrastructure.

Fig. 3

Edipark — GreenIN Breiðholt un proiect parte din programul GreenInCities, orașul Reykjavík, în cadrul programului Horizon, coordsonator Institutul pentru Arhitectură Avansată din Catalonia (IAAC).

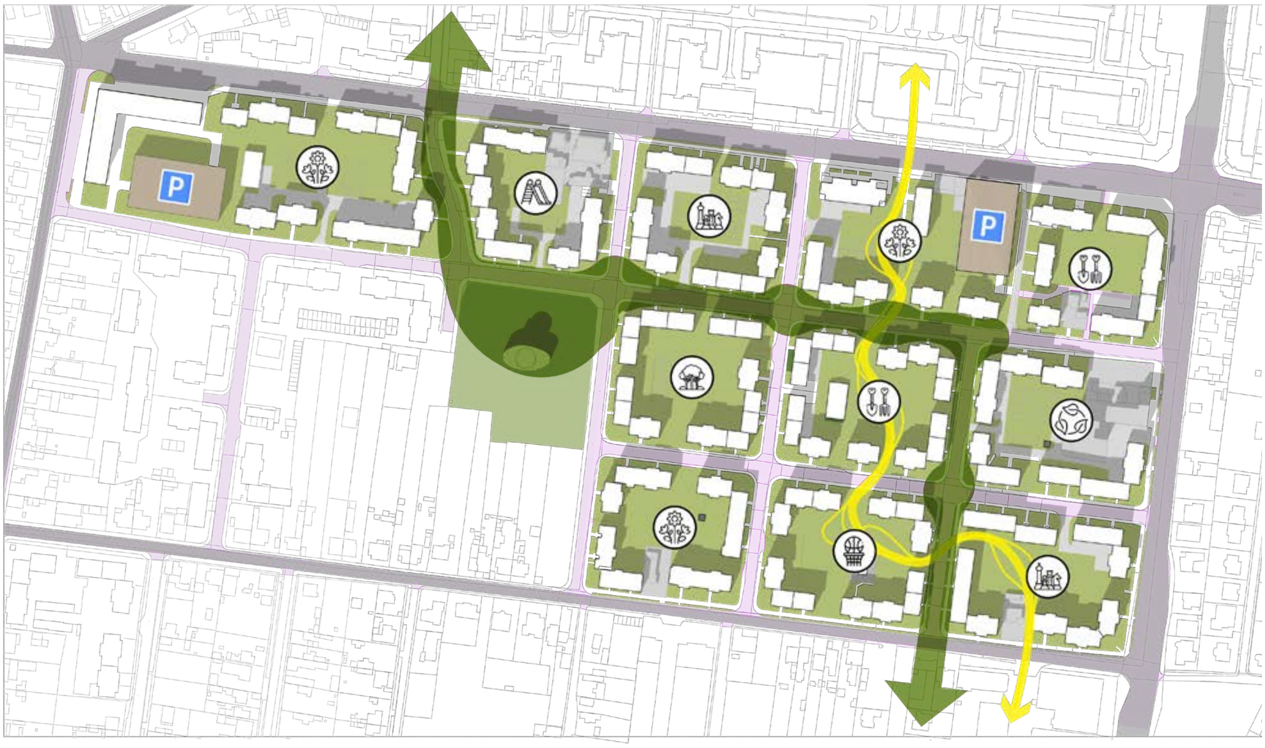


Fig. 4

Quantification of ecosystem services provided by urban green infrastructure in the Plavăț neighborhood, Timișoara. Multidisciplinary pilot project for urban regeneration, aimed at preparing the Financing Guide for Urban Revitalization and Regeneration, Priority 7 - Region for People, as part of the West Regional Program 2021-2027, West Regional Development Agency, 2021.

Nature Benefits Compared Scenarios for Stefan Plavat District in Timisoara.

Ecosystem Services Values[1]

Types of Ecosystem Services for the District	Current Situation	Scenario 1
	intervention area 98.306,37 m² total green areas 35.040,38 m² (36%)	intervention area 98.306,37 m² total green areas 59.010,68 m² (60%) multilevel car parking
Provisioning		
1 primary production (community gardens- fruits/ vegetables)	linear green areas with isolated groups of trees and community gardens	diverse green areas (e.g. community gardens, pocket park, linear green areas)- edible products
2 raw materials (compost and multiple use vegetal materials)	collected by local maintenance companyes with no multiple use (only for local heating system)	diverse green areas integrating compost and multiple use vegetal materials
3 Ornamental resources e.g. flowers	landscape composition low in ornamental resources	rich landscape design with high ornamental resources with support for pollinators
Regulating		
1 Air-quality maintenance: ecosystems contribute chemicals to and extract chemicals from the atmosphere	28 048m2 tree surface (80 % tree cover of the total green area surface), Carbon (C), PM10 sequestration	47 209 m2 tree surface (80 % tree cover of the total green area surface), Carbon (C), PM10 sequestration
2 Climate regulation e.g. land cover can affect local temperature and precipitation	29% tree covered of the total intervention area- 5° C cooler than open areas and 7% grass covered areas of the total intervention area - 1-2° C cooler than constructed areas*	48% tree covered of the total intervention area- 5° C cooler than open areas and 12% grass covered areas of the total intervention area- 1-2° C cooler than constructed areas*
3 Water purification/detoxification: ecosystems can be a source of water impurities but can also help to filter out/ decompose organic waste	poor filtration or decomposition processes	rain gardens with bioretention systems for the storm runoff of the blocks of flats (29 648 m2)
4 Bioremediation of waste i.e. removal of pollutants through storage, dilution, transformation and burial	poor bioremediation processes identified due to poor biodiversity and sealed surface	60% of rich in biodiversity green areas and dinamic/ intensified bioremediation processes
Cultural		
1 Social relations: ecosystems affect the types of social relations that are established	constructions fragmentation (parkings, private buildings s.o.) of the blocks of flats interior yards, poor social cohesion	reduction of construction fragmentation (parkings, private buildings, interior roads s.o.) obtaining high quality areas for social cohesion
2 Aesthetic values: many people find beauty in various aspects of ecosystems	poor ecosystem diversity generating poor aesthetic values, lack of maintenance	rich ecosystem diversity generating high aesthetic values, easy maintenance with low costs hired and good ecosystem conectivity
3 Recreation	poor recreation facilities, lack of play-grounds and sport facilities, poor pedestrian and velo mobility	high recreation facilities- playgrounds and sport facilities, good pedestrian and velo mobility

1

Eurostat, Joint Research Centre (JRC), Directorate General for Environment (ENV), Directorate General for Research and Innovation (RTD) and European Environment Agency (EEA), Accounting for ecosystems and their services in the European Union, 2021 edition.

*

U.S. Environmental Protection Agency, Trees and Vegetation in Reducing Urban Heat Islands: Compendium of Strategies (2008) https://www.epa.gov/heat-islands/heat-island-compendium

High

Medium

Low

Scenario 2	**Scenario 3**	Notes
intervention area 98.306,37 m^2 total green areas 51.705,50 m^2 (53%) ground and underground level car parking	intervention area 98.306,37 m^2 total green areas 51.777,70 m^2 (53 %) multilevel and underground level car parking	
diverse green areas (e.g. community gardens, pocket park, linear green areas)- edible products	diverse green areas (e.g. community gardens, pocket park, linear green areas)- edible products	The design process will integrate small community gardens according to the EU objective "from farm to fork"
diverse green areas integrating compost and multiple use vegetal materials	diverse green areas integrating compost and multiple use vegetal materials	
rich landscape design with high ornamental resources with support for pollinators	rich landscape design with high ornamental resources with support for pollinators	
41 364 m2 tree surface (80 % tree cover of the total green area surface), Carbon (C), PM10 sequestration	41 422 m2 tree surface (80 % tree cover of the total green area surface), Carbon (C), PM10 sequestration	The table presents aproximate calculations for carbon captation/ retention and mentions the ratio for PM10 caption. More air quality indicators will be developed during the design process.
42% tree covered of the total intervention area- 5° C cooler than open areas and 10% grass covered areas of the total intervention area- 1-2° C cooler than constructed areas*	42% tree covered of the total intervention area- 5° C cooler than open areas and 10% grass covered areas of the total intervention area- 1- 2° C cooler than constructed areas*	The table presents aproximate calculations for the microclimat optimization reported to tree cover. More datas will be developed during the design process.
rain gardens with bioretention systems for the storm runoff of the blocks of flats (29 648 m2)	rain gardens with bioretention systems for the storm runoff of the blocks of flats (29 648 m2)	Multiple options are available, which will be detailed during the design process, eg. Small rain gardens in every yard or few large rain gardens in some of the yards
53% of rich in biodiversity green areas and dinamic/ intensified bioremediation processes	53% of rich in biodiversity green areas and dinamic/ intensified bioremediation processes	
reduction of construction fragmentation (parkings, private buildings, interior roads s.o.) obtaining good quality areas for social cohesion	medium construction fragmentation (parkings, private buildings, perimetral roads s.o.) with good quality areas for social cohesion	
rich ecosystem diversity generating high aesthetic values, easy maintenance with low costs hired	rich ecosystem diversity generating high aesthetic values, easy maintenance with low costs hired, medium ecosystem conectivity	The aestetic aspects will be developed during the participatory design process.
high recreation facilities- playgrounds and sport facilities, good pedestrian and velo mobility	high recreation facilities- playgrounds and sport facilities, good pedestrian and velo mobility	The recreation facilities will be developed during the participatory design process.

5 Urban green infrastructure planning

5.1 Urban green infrastructure planning tools

Urban green infrastructure is one of the planned components of the city, just as important as 'hard' and social infrastructure. In this regard, the integrated administration and management of urban green infrastructure, aligned with public policies, provide local administrative units (LAUs) with specific planning tools that are important to present within this guide. The planning tools for urban green infrastructure, as outlined in national and European legislation, are as follows:

I **Field data collection stage / active database:**

1 **Local Register of Green Spaces**, mandatory according to *Law no. 24/2007*:

— The Local Register of Green Spaces is a comprehensive tool for inventorying green spaces within urban areas, by creating a set of data, information, and plans related to the identification of lands defined as green spaces and those degraded, which could potentially be rehabilitated as green spaces. It also includes the assessment of vegetation viability, its characteristics, and associated quantitative and qualitative indicators (Romanian Landscape Architects Association, 2017), Fig.4.

— The Local Register of Green Spaces is established as a database and is updated whenever changes occur "Verification and updating of the Local Register of Green Spaces within urban areas shall be carried out continuously, according to the changes observed on the ground regarding green spaces." (according to art. 1 and art. 16 of Order no. 1.549 of December 4, 2008).

2 **Audit of the surface area, quality, and accessibility of green spaces**, mandatory until 2011 according to *Law no. 24/2007*.

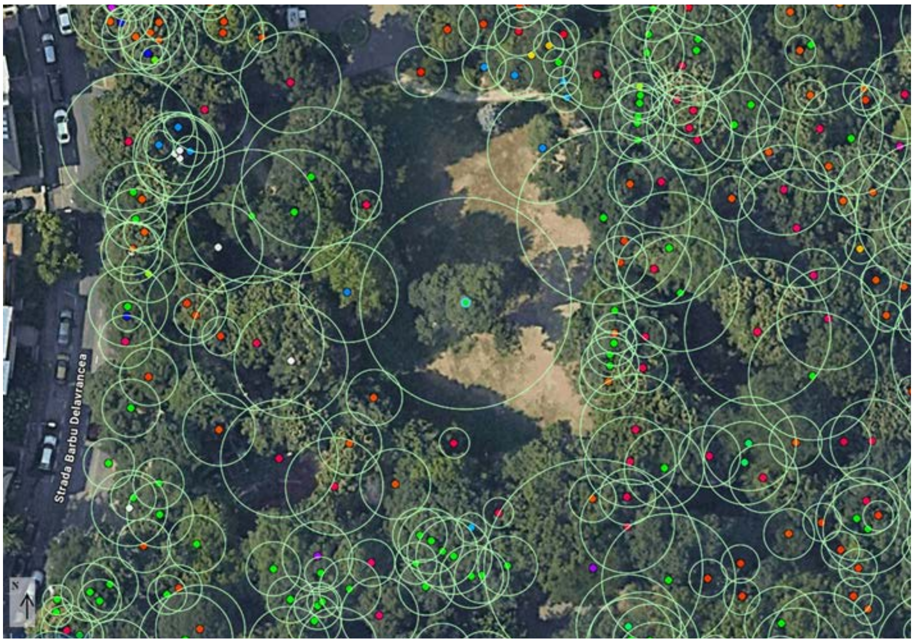


Fig. 5

Green Space Register for Kiseleff Park, Bucharest. Project coordinated by landscape architect Dr. Diana Culescu, Romanian Landscape Architects Association, Bucharest Territorial Branch, and selected within the Raiffeisen Communities program, an NGO accelerator for sustainability, initiated by Raiffeisen Bank Romania, with support from the Association for Community Relations.

II Planning and integration stage with urban planning documents and territorial or local landscape plans:

1 **Strategy and action plan for the conservation and development of the green space network**, mandatory until 2011, according to *Law no. 24/2007*:

— *The strategy for conserving and developing the green space network* is a planning tool aimed at "ensuring balanced distribution in relation to the specific characteristics of the reference territorial unit, as well as creating green spaces by transforming unproductive land, other land categories, and applying alternative methods" (according to art. 10, (2) of *Law no. 24/2007*).

2 **Urban Greening Plan,** recommended within the *EU Biodiversity Strategy for 2030, correlated with the EU Soil Strategy for 2030*:

— The Urban Greening Plan serves as the general framework that defines, formalizes, and outlines the commitments of the local administrative unit (LAU) to promote and protect biodiversity and urban greening (*Urban Greening Plans, Guidance for cities to help prepare an Urban Greening Plan, EC, 2021*).

— The Urban Greening Plan should be integrated into the urban planning process and the long-term strategy for the future development of the urban area, aligned with other strategic plans such as those for urban development, mobility, construction, water management, energy, climate change mitigation and adaptation, air and soil quality, waste management, and noise reduction (*Urban Greening Plans, Guidance for cities to help prepare an Urban Greening Plan, EC, 2021*).

— The Urban Greening Plan must be developed by the end of 2021 for European cities with at least 20,000 inhabitants (*EU Biodiversity Strategy for 2030, p.15*).

— The Urban Greening Plan will integrate the "land take hierarchy" (*EU Soil Strategy for 2030, p.11*).

III Design stage:

1 **A landscape study** is mandatory for investment projects related to green and landscaped areas, according to Annex 4 and Annex 5 of *Government Decision 907/2016*.

2 **The building permit documentation** (DTAC) is mandatory, following the procedure stipulated by Law no. 50/1991, republished, and its methodological norms.

— The standard content of the DTAC is defined by Government Decision 907/2016.

— For existing investment projects involving the rehabilitation or restoration of green spaces, the standard content of the documentation for intervention works requires technical expertise according to Law 177/2015 - amending and supplementing Law 10/1995 on construction quality, and where applicable, Law no. 422/2001 - on the protection of historical monuments, republished, with subsequent amendments, and Order 2495/2010 - approving the Methodological Norms regarding the certification of specialists, experts, and technical inspectors in the field of historical monument protection (Romanian Landscape Architects Association, 2017).

3 **Proiect de organizare a execuției lucrărilor (POE)**
For works affecting green infrastructure, the Work Execution Organization Plan (POE) must include mandatory measures to protect the integrity and viability of urban ecosystems (according to Annex 9, Chapter III of Government Decision 907/2016).

4 **Specific landscaping project**
The specific landscaping project must be prepared by specialists in the fields of landscape architecture, urban planning, horticulture, and forestry (Art.11 (2), Law no. 24/2007, for urban planning specialists correlated with the Regulation from July 29, 2010, regarding the organization and functioning of the Urban Planners Register of Romania, art.16 (5)).

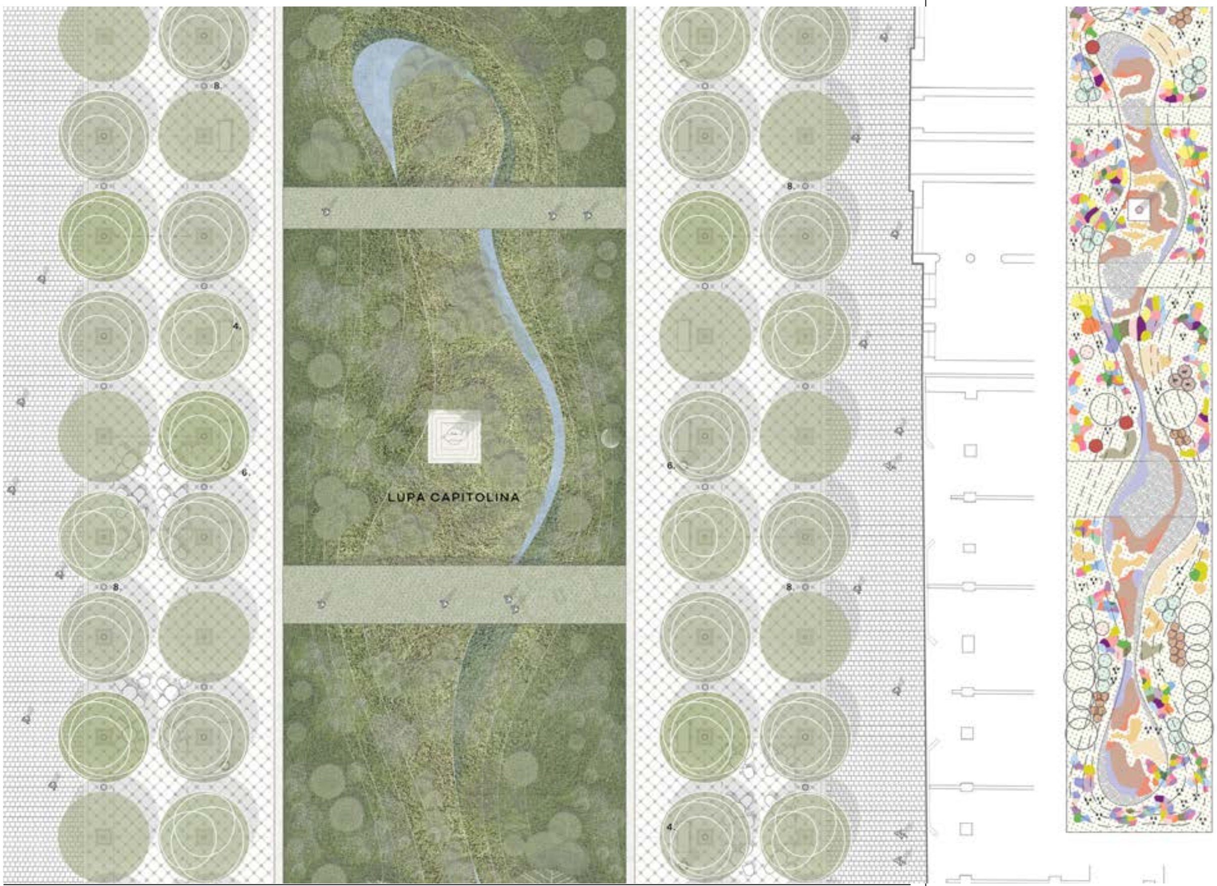


Fig. 6

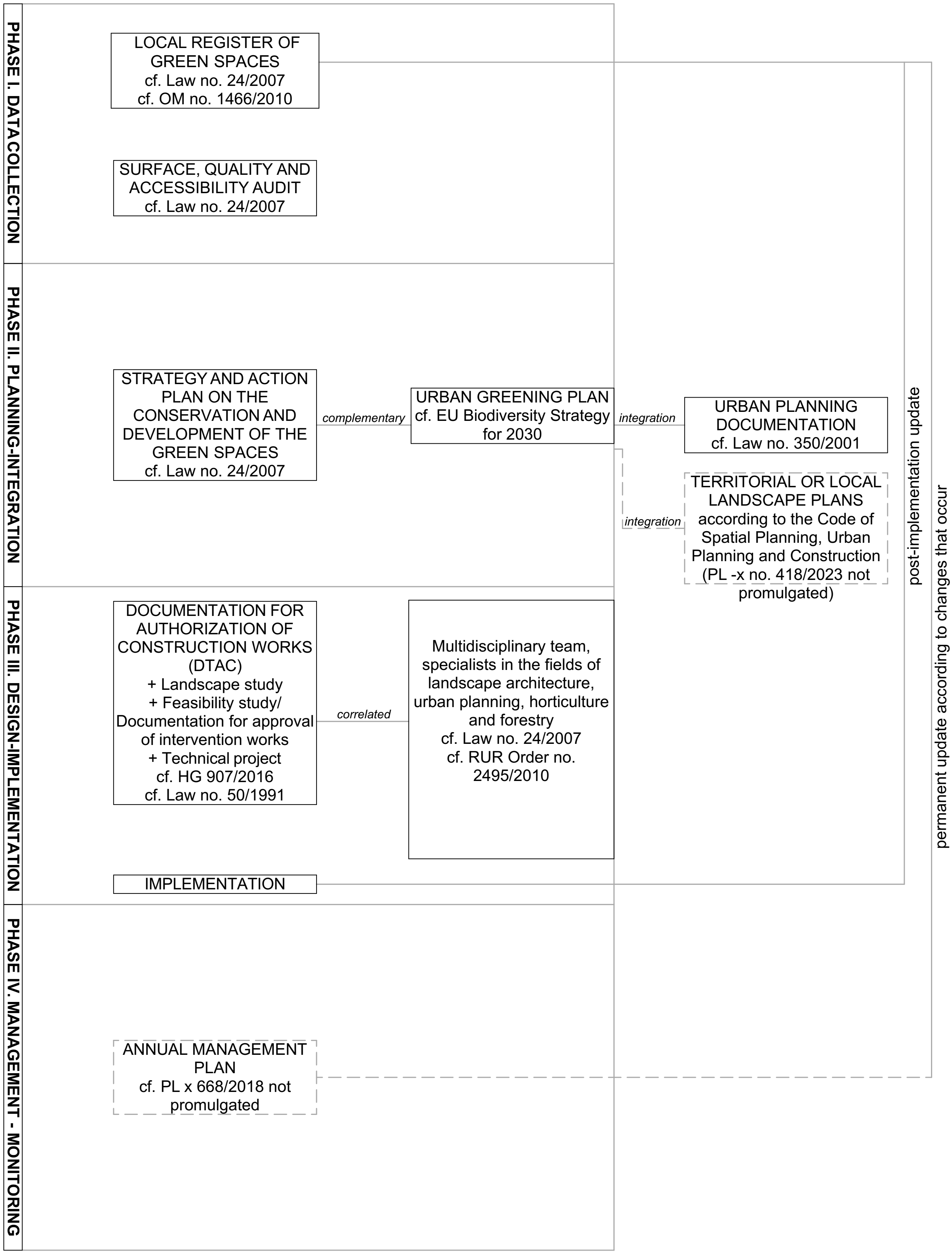
International Solution Competition "Development and Modernization of Opera Square (Victory Square) and Streets in the Cetate Area", Timișoara Municipality. Main authors: arch. Radu Golumba (STUDIO ARCA), arch. Șerban Sturdza (PRODID) Co-authors: arch. Mihaela Rusuleț, arch. Luminița Pascu, arch. Daniel Ursu, arch. Alexandra Stan, arch. Lucian Cărăbaș, arch. Andrei Simonescu, arch. Ligia Gherman, arch. Cristian Moțiu, arch. Doina Sturdza, arch. Dan Cioclu, arch. Ioana Cioclu, arch. Mika Nilich, arch. Ovidiu Serghe, arch. Daria Petrașcu, arch. Mihnea Tudor, arch. Ruxandra Vasile. Architecture collaborators: arch. Felix Pantalici, arch. Florin Gherman, arch. Claudiu Oprița, arch. Alexandru Barbu, stud. arch. Adela Mustață, stud. arch. Alexandru Tudoroiu. Specialty collaborators: landscape arch. Nicolas Triboi, landscape arch. Andrei Condoroș, eng. Cornel Farcaș, eng. Sergiu Tămaș

IV Management and monitoring stage:

1 **Annual vegetation management plan**, as outlined in the draft legislative amendment to Law no. *24/2007* (PL. x 668/2018, not enacted)

— *The annual vegetation management plan* is a specialized document that sets out the measures, actions, and activities to be implemented following the completion of green space development. Its purpose is to maintain the viability and functionality of green spaces, while ensuring the benefits they provide to the locality and, by extension, to the community.

— Activities carried out under the annual vegetation management plan are updated in real time within the *Local Green Space Register*.



**The scheme presents the legally regulated phases and tools required for an ambitious planning process, with maximum results for the Program M100. We recommend following these steps also for cities with ambitious urban greening plans.*

Fig. 7

Diagram illustrating the stages and best practice tools in the green infrastructure planning process.

5.2 Principles of urban green infrastructure planning and management

Urban green infrastructure planning and management must consider a set of principles that distinguish it from other existing approaches. Specialized literature identifies the following principles associated with urban green infrastructure:

— **Connectivity.** Connectivity is a key feature of landscape structure, crucial for species-landscape interactions. It includes both a structural dimension (the landscape's capacity to facilitate organism movement between components) and a functional dimension (the landscape's ability to maintain continuity of ecosystem services). Connectivity seeks to establish a well-integrated network of components that benefit both city residents and plant and animal species.

— **Multifunctionality.** Multifunctionality aims to maximize the ecosystem services provided by urban green infrastructure components. Urban green infrastructure should deliver diverse social, ecological, and economic functions. Multifunctionality not only fosters diverse functions and enhanced synergies within components but also enhances the efficiency of these spaces, particularly in urban areas where land is scarce.

— **Multi-scale approach.** Thanks to its flexibility and adaptability, urban green infrastructure can be planned at multiple scales, from building level (e.g., green roofs and green walls) to regional, national, and continental levels, encompassing landscape interactions and connections with broader natural areas.

— **Integration.** This principle primarily refers to the integration of green infrastructure networks with other urban systems, commonly known as gray infrastructure.

Fig. 9

The role of imagination in the co-design process at GreenFeel (Healthy Places), a workshop led by Dr. Landscape Architect Raluca Rusu and Dr. Landscape Architect Alexandru Ciobotă, 2019.

Fig. 8

Dunboyne Road, Linden Demesne – The Natural Quarry Park. Authors: Cunnane Stratton Reynolds, Landscape Architect Diana Codrean, Landscape Architect Alastair Ferrar. Client: Cairn Homes

— **Diversity.** Urban green infrastructure emphasizes the diversity of components, regardless of size, quality, or ownership, recognizing their essential role.
— **Applicability.** Urban green infrastructure should be tailored to the biophysical and socio-economic context to prevent excessive or unnecessary investments.
— **Governance.** Governance emphasizes collaboration between governmental actors and citizens throughout the urban green infrastructure planning process.
— **Continuity.** Urban green infrastructure should ensure continuity in planning and management to maintain long-term viability. Green infrastructure plans should incorporate ongoing monitoring systems and regular progress reports on urban greening initiatives.

5.3 Integrated Approaches Aligned with the Vision of the New European Bauhaus

5.3.1 Urban Biodiversity in Achieving Climate Neutrality

Urban green infrastructure planning aims to achieve healthy ecosystems and promote nature-based solutions as its strategic objectives. Healthy ecosystems are reflected in the diversity and richness of species, relying on the protection, restoration, and enhancement of urban biodiversity. In this context, urban biodiversity is a key goal of the European Green Deal, playing a cross-cutting role in urban policies.

Urban biodiversity encompasses the variability of living organisms, from genes and species to ecosystems within urban environments (Convention on Biological Diversity (COP), 2010). Urban biodiversity can be found in natural, semi-natural, designed, or restored ecosystems, in sewage networks, underground galleries, on rooftops, in small cracks of buildings, in residences, or in other types of buildings (Breuste et al, 2023). Thus, cities are far from sterile; they are environments where biodiversity is present in various forms, ranging from those entirely dependent on human intervention to those independent of it, and in the most unexpected places, from remnants of natural ecosystems to human-made spaces.

The potential of ecosystems to sequester carbon is closely tied to their biodiversity. Natural ecosystems can store large amounts of carbon through organisms that absorb it from the atmosphere and deposit it for the long term in various parts of the plant (stems, roots, etc.) (Weiskopf et al, 2024).

Urban ecosystems represent socio-ecological systems where most people live. These are distinct ecosystems, largely artificial, and include various other types of ecosystems (e.g., forests, lakes, agricultural zones on urban peripheries), strongly influenced by human activities (MAES, 2020).

When it comes to species diversity, large cities can rival natural areas, offering a range of spaces for biodiversity, including rivers, shores, meadows, forests, parks, community and private gardens, ditches, ponds, buildings of various heights and densities, and abandoned sites where nature can thrive. Unlike other landscapes (such as rural areas), where biodiversity is declining due to intensive practices and monoculture, cities provide a network of diverse spatial structures that foster biodiversiy (Biodiversity | Urban Green-blue Grids). Therefore, cities become refuges for biodiversity, especially if the surrounding non-urban landscape is altered by agriculture, forestry work, or other intensive human uses (Knapp et al, 2021). Hence, considering the role of cities as reservoirs of nature, conservation and facilitation of biodiversity become objectives in the planning process of urban green infrastructure.

Urban green infrastructure planning must set strategic objectives regarding the enhancement and facilitation of biodiversity in the urban environment; more details in the chapter on Urban Planning. Below are some examples, not claiming to be exhaustive:

— Practicing regenerative planning and design based on principles, materials, and techniques that promote the restoration and revitalization of natural systems, including soil protection and regeneration, etc.;

— Including multiple ecological layers and mixes of native plant species in the design process, from grassland to locally sourced tree stands, aligned with the fact that these species are adapted to local ecosystems and host a variety of beings, Fig. 9;

— A holistic approach to urban ecosystems, e.g., biotic and abiotic components, compared to a more focused approach concentrating only on certain parts of green infrastructure;

— Ensuring connectivity through solutions such as green corridors, which allow species to move between habitats, Fig. 10;

— Improving and restoring ecosystems and various types of habitats in terms of size, space availability, and connectivity between them;

— Including components that replicate natural systems, such as rain gardens, green roofs, and walls, which contribute to stormwater management, improve water quality, and provide habitats for species;

— Enhancing biodiversity to ensure ecosystem services, aiming to increase the well-being of both society and nature, Fig. 11;

— Conserving the health of the soil microbiome.

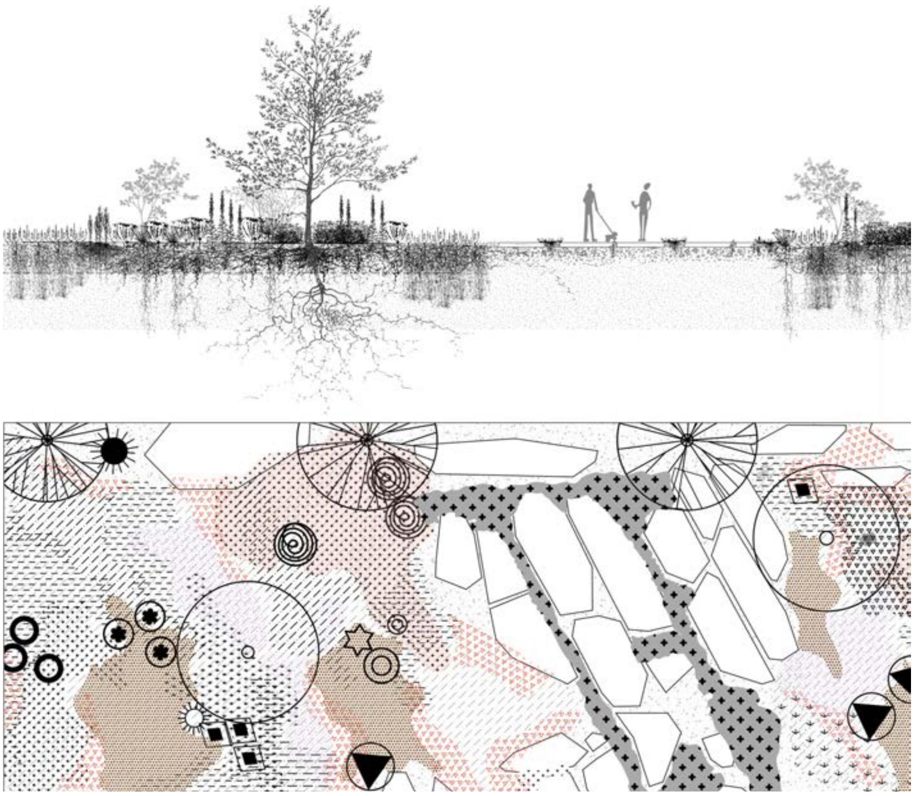


Fig. 10

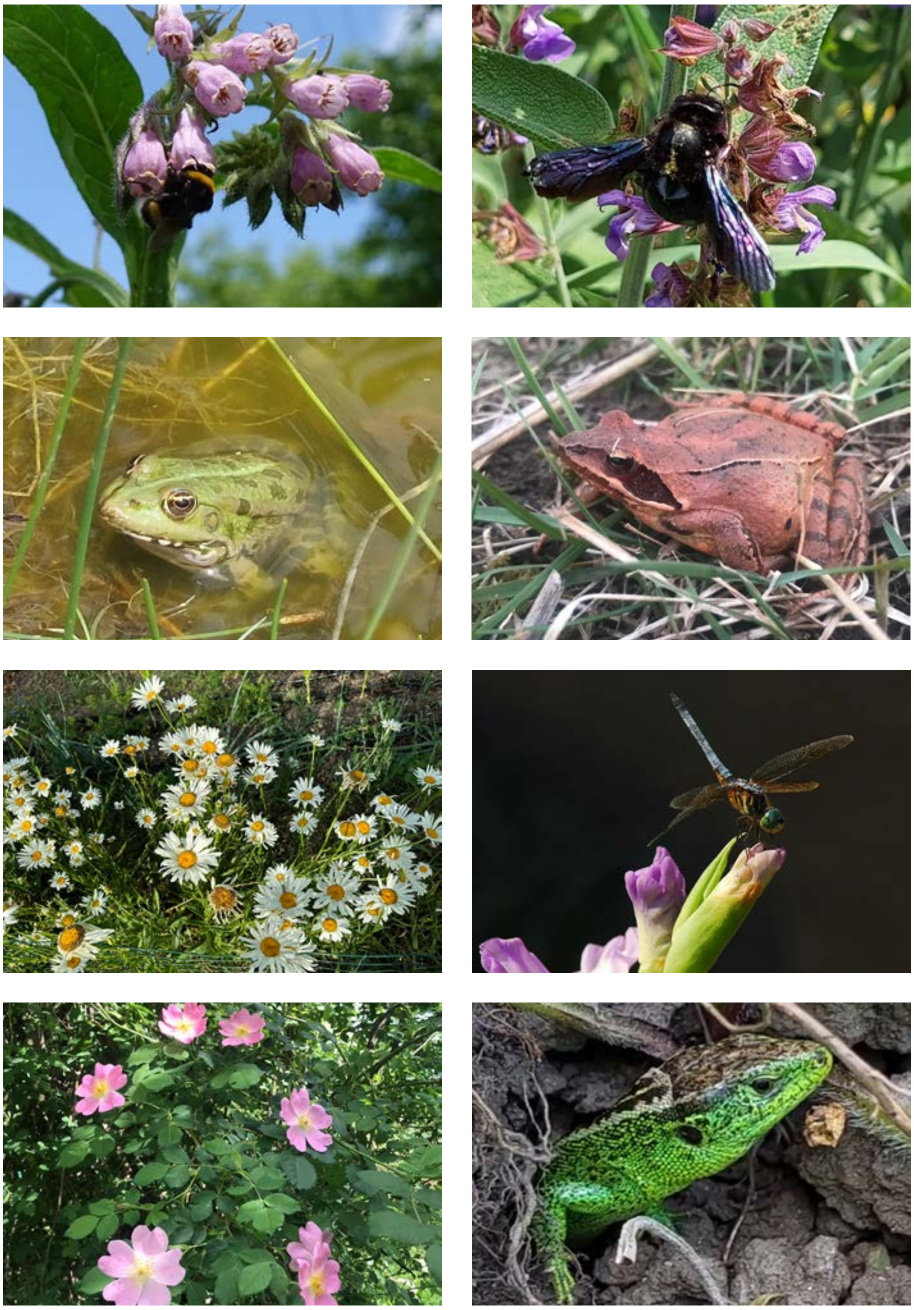
Multiple Ecological Layers. International Solutions Competition "RULMENTUL, BRAȘOV", Lead Authors: ATELIER MASS (Silviu Aldea, Camelia Sisak, Tamás Sisak) + NEW ENVIRONMENTS (Giacomo Gallo, Robert Younger) Co-author: SAH (Ana Horhat), BLU.works (Jacopo Gennari Feslikenian) Architecture Collaborators: Violeta Frișan, Robert Vasiluț, Roxana Udrescu, Cristian Duda, Vlad Birtaș, Andreea Ștefănescu (Atelier MASS), Abhinand Krishnakumar Menon (BLU.works) Specialization Collaborators: Felicia Radoviciu, Teodora Pascu, Ivona Svinți-Nechita (landscaping), Teodora Constantinescu, Oana Paraschiv (urban planning), Bogdan Simionescu (visuals), 2024.

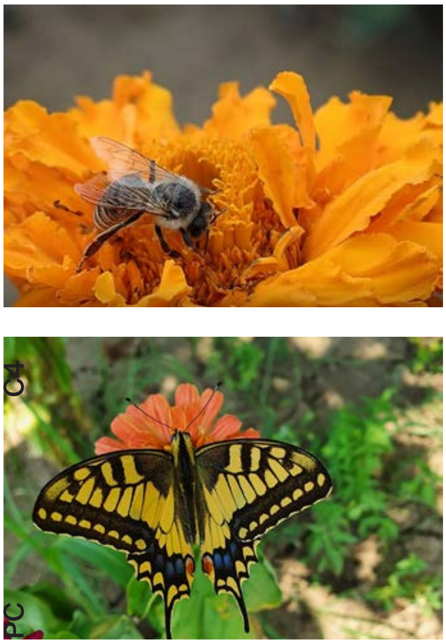
Fig. 11

Oradea in Bloom - Perennial Mix. Authors: Cadro Landscape Studio, Landscape Architect Diana Codrean, Landscape Engineer Timea Simon, Client: Municipality of Oradea, 2023.

Fig. 12

Biodiversity at GreenFeel Timişoara, 2024.





5.3.2 Circular Economy and Climate Neutrality

Circular economy principles should be incorporated into the planning of urban green infrastructure (IFLA, 2021).

a. **The Inner Circle** – Urban green infrastructure planning should focus on minimizing changes. Priority should be given to renovation and reuse of materials to conserve energy, water, labor, and other resources. The core of this principle lies in conserving existing site elements, such as vegetation, local habitats, soils, bodies of water, and both fully and partially paved surfaces, etc. Fig. 12.

b. **Long-term Circularity** — The more durable a structure or material, the fewer natural resources are needed over time. Long-term circularity is ensured through design and construction methods that facilitate easy maintenance, partial replacement, and eventual disassembly and recycling. Long-term circularity involves strategies that prolong the lifespan of urban green infrastructure components and minimize the resources needed for maintenance.

c. **Cascading Use** — By minimal reuse or renovation, materials and built elements can extend their lifespan, even when repurposed in other projects. This principle ensures that materials and goods remain in circulation, even when remodeled or refurbished, thereby reducing the extraction of new resources and minimizing the overall ecological footprint.

d. **Pure Circles** — The more a material maintains its purity and quality, the easier it is to reuse compared to processed materials or alloys. Pure materials often have a higher resale value, which tends to increase over time.

Fig. 13

Historic Garden, "Dimitrie Brândză" Botanical Garden, Bucharest. Authors: Mona Petre, Andreea Machidon, Petronela Viforeanu, Alina Adăscaliței. The project is supported by the IKEA Urban Environment Fund, funded by IKEA Romania and managed by the Bucharest Community Foundation, 2007. Photograph by @Mihai Petrescu Puica.

5.3.3 Nature-based Solutions

Nature-based solutions are inspired by, supported by, or mimicked from nature. They are designed to address a wide range of societal challenges in an adaptable way, using resources efficiently while delivering economic, social, and environmental benefits (Davies & Lafortezza, 2019). They differ from conventional engineering approaches because they are multifunctional, adaptable to local contexts, and help enhance and conserve natural capital, thereby increasing the resilience of landscapes.

A key aspect of nature-based solutions is recognizing nature's role in addressing significant societal challenges (Raymond et al., 2017). These solutions support the maintenance, development, and restoration of ecosystems as responses to various societal challenges, including climate resilience, water management, coastal protection, green space management, urban biodiversity, air quality, urban regeneration, participatory planning, governance, equity, social cohesion, public health, economic opportunities, and job creation.

Klimatek (2016) classifies nature-based solutions into six categories, based on the components they aim to improve:

— *Buildings* (green roofs, green walls, rainwater collectors, solutions in community gardens, greening spaces between buildings);
— *Public spaces* (urban furniture, permeable pavements, comfortable urban spaces, areas with modified microclimates, subdivided gardens, urban parks and gardens, restoration of abandoned land);
— *Aquatic ecosystems and drainage systems* (sustainable urban drainage systems, restoration of ponds and lakes, renaturation of rivers and their banks);
— *Linear transport infrastructure* (greening of streets, permeable pavements, greening of linear transport routes);
— *Natural areas and management of low-density construction zones* (protected natural areas, wetlands, peri-urban parks, rural area management);
— *Coastal zones* (dune restoration, beach regeneration, restoration of coastal wetlands, creation of artificial reefs).

Among the green solutions with high implementation potential in European cities, several representative examples have been selected and grouped into multiple categories.

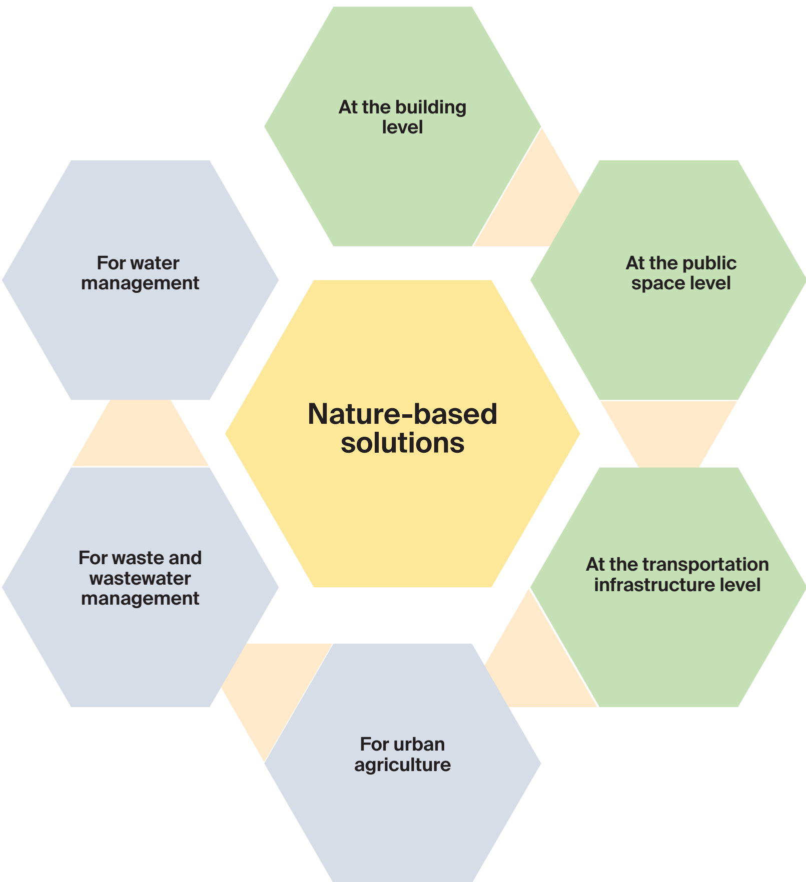


Fig. 14

Types of Applications for Nature-based Solutions

Typologies of Nature-based Solutions (according to Iojă et al., 2021)

a. Nature-based Solutions Promoted at the Building Level

Green roofs are solutions that involve installing vegetation on the roofs of buildings in urban areas. They provide significant benefits in cities with high building density, where they can help reduce electricity consumption for temperature control in both cold and warm seasons. Green roofs can also enhance a city's resilience to climate change by reducing the urban heat island effect and lowering the resources required for energy production through temperature regulation in buildings.

Similar to green roofs, *rooftop orchards are setups on buildings* where residents or users can produce food. In addition to this direct benefit, rooftop orchards act as carbon capture spaces and reduce rainwater runoff. Like green roofs, they are particularly suited for cities with high building density.

Solar rooftops are a green solution that can be locally implemented on buildings in cities with high electricity consumption. They help increase electricity production from renewable sources.

Additionally, to reduce flood risks, rainwater harvesting roofs can be used. These roofs collect rainwater, which can be reused for various urban management activities (e.g., cleaning, maintaining and managing green spaces, etc.). This type of green solution contributes to water management challenges and reduces surface runoff as well as the urban heat island effect.

Green facades and vertical gardens are effective solutions for urban areas with high building density and limited space for green areas. Vegetation can be placed on the building walls, directly contributing to improved urban aesthetics, regulating indoor temperatures, and reducing resource consumption for electricity production.

Community courtyards are green solutions that can be implemented in residential buildings, within the interior courtyard. Implementing community courtyards is an efficient solution in urban environments with high building density and limited space for growing green areas. These courtyards can serve recreational purposes, act as noise barriers from traffic, or host gardening activities for residents. Some of the main challenges addressed by this solution include adaptation to climate change effects, improving public health, and increasing social cohesion.

b. Nature-based Solutions Promoted at the Public Space Level

Permeable pavements can replace traditional asphalt, improving rainwater infiltration and preventing flooding. They can also be useful for reducing the urban heat island effect in cities where very high temperatures are recorded in the warmer season.

Allotment gardens serve a similar purpose to local community gardens but are not limited to the interior courtyard of a building and can be made accessible to the public. They are similar to rooftop orchards but can support a more diversified range of crops, contributing to food production for the local population.

Renatured abandoned areas can be green solutions that convert abandoned land, former industrial sites, or vacant lots into green spaces, either for recreation or to address environmental issues associated with climate change or natural risks (e.g., flooding). Furthermore, by developing these spaces, potential issues related to security and public safety can be addressed, as vacant lots often attract stray dogs and homeless individuals.

Urban micro-climates are setups in the urban environment that directly contribute to mitigating the effects of climate change (extreme temperatures, floods, strong UV radiation) and provide spaces for relaxation. Micro-climates can be created as vegetated areas or urban green spaces.

Green street furniture refers to the integration of green solutions in the planning and design of resting and recreational areas that complement transport infrastructure or public open spaces. Examples include shaded areas with climbing species or socializing zones that incorporate green spaces or elements made from materials like wood or stone. In addition to enhancing the aesthetic of the landscape, these elements help regulate the hydrological cycle, provide shade, reduce surface heating, moderate the microclimate, and improve air quality.

Greening public squares involves reconfiguring public spaces to introduce vegetation elements. The primary reasons behind these transformations are ensuring climate comfort and converting these spaces into high-importance recreational areas in urban settings.

Urban parks and forests are likely the most recognized and widely implemented green solutions in cities. They offer a wide variety of ecosystem services, including support, provisioning, regulation, and cultural services. It is important to note that the diversity, quantity, and quality of these services depend directly on the way these spaces are designed and managed.

c. Nature-based Solutions for Water Management

Sustainable urban drainage systems are useful solutions for cities with high precipitation. They help manage stormwater runoff, especially in areas with a high density of impermeable surfaces. These systems consist of networks of surface channels and vegetation associations that improve the natural infiltration of water into the soil, as well as underground infiltration and storage systems. Sustainable urban drainage systems contribute to a more natural water cycle in urban environments, reducing the effects of flooding or lowering the frequency of such events, and preventing water pollution by easing the pressure on conventional drainage networks.

Renatured river areas refer to the removal of artificial sections of rivers and their re-meandering. Renatured river areas, by reactivating natural floodplain zones, help reduce the effects of flooding on grey infrastructure. Moreover, they clearly improve urban landscape aesthetics while also providing recreational spaces.

Controlled flood plains are naturally designed spaces along rivers to minimize the effects of flooding, especially in cases of very high precipitation. The benefits of implementing such a green solution are reflected both economically (reduction or elimination of property damage during floods, lower water treatment costs, increased land value in the area) and socially (recreation spaces) and environmentally (regulation of the hydrological cycle).

Creating or developing lakes or wetlands is an extremely useful solution for regulating the urban water cycle, moderating the climate, and providing recreational zones.

Rain gardens are designed to reduce the amount of pollutants in stormwater from impermeable surfaces and promote infiltration. Through technical modifications to soil characteristics and the use of specific plant species, rain gardens contribute to the regulation of the hydrological cycle.

d. Nature-based Solutions for Linear Transport Infrastructure

Greening streets refers to all actions aimed at introducing vegetation into the design of urban transport infrastructure – planting street alignments, creating green islands, planting grass along tram lines, using permeable pavements, and establishing gardens in nearby buildings, etc. The main benefits include reducing air pollution due to the filtration capacity of vegetation (related to the species planted, the maturity level of the vegetation, the width of the alignments, etc.), reducing noise levels, moderating the climate, and encouraging the use of alternative transport.

Greening high-capacity transport infrastructure involves, in addition to the actions mentioned earlier, integrating vegetation into the design of associated elements (such as parking lots and bridges) and protection zones for infrastructure, thus creating green corridors.

e. Nature-based Solutions for Urban Agriculture

Recent studies have shown that the creation of "food-autonomous cities" can be a green solution supporting sustainable urban development. One of the key principles behind this approach is using public space for food production, which has multiple social, economic, and environmental co-benefits. This green solution should be understood as a mosaic of sub-solutions, such as urban farms, community gardens, residential gardens, organic farms, cultivated rooftops, rooftop greenhouses, vertical farming, etc. Some of these solutions can be implemented in the urban environment, while others are suited to peri-urban areas.

Rooftop gardens have the same characteristics and benefits as green roofs, with the added possibility of physical activity through gardening, opportunities for social interaction, and economic benefits from the products obtained.

Rooftop greenhouses are systems that incorporate urban agriculture into existing or new buildings and involve interconnection with the supporting buildings regarding energy, water, and carbon dioxide flows. Their purpose is to create a favorable environment for certain plant species to thrive year-round. They produce larger quantities of products than rooftop gardens.

Vertical farming (indoor farming) is a relatively recent green solution that uses modern technologies to achieve rich harvests on small land areas. Most vertical farming systems are located within buildings, in recycled containers or even in mining tunnels, with the controlled environment contributing to high yields. Disadvantages of this solution include high costs and a large amount of energy used, which can cause pollution if renewable sources are not utilized.

The creation of food-autonomous cities relies on using public space for growing various types of vegetables. Andernach, a pilot city for food autonomy, used a wide range of spaces to grow vegetables, including protection zones near the historical fortress in the city. In addition to the numerous economic (free food for the population, job creation), social (social cohesion, educational spaces in nature, and physical activities), and environmental (climate moderation, water cycle regulation) benefits, food production in cities, especially large ones, faces disadvantages, such as air and soil pollution, particularly with heavy metals and other toxic pollutants that can transfer into food.

6 Targets and Indicators for Urban Ecosystem/Urban Green Infrastructure Restoration

6.1 European and National Targets Revelant to Urban Green Infrastructure

European Policies

EU Regulation on Nature Restoration (2024/1991)

Targets	2030	> 2031
Urban ecosystem restoration in line with the provisions of Art. 8, 13*		
Urban green space (sqm) (M)	No reduction in surface area compared to 2024 levels Target coverage of 45% in urban centers and densely populated areas (Art. 8 (1))	An upward trend to be measured every 6 years (Art. 8 (2))
Urban tree canopy coverage (sqm) (M)	No reduction compared to 2024 levels Target coverage of 10% in urban centers and densely populated areas (Art. 8 (1))	An upward trend to be measured every 6 years (Art. 8 (3))
Trees	Planting additional trees (in line with the EU-level target of at least 3 billion trees) while respecting ecological principles, including ensuring species diversity and multi-age diversity. Priority should be given to native tree species, except in very specific cases and conditions where non-native species adapted to the local soil, climate, and ecological context contribute to increased climate change resilience. Tree planting measures aim to improve ecological connectivity through sustainable afforestation, reforestation, and urban green space expansion. (Art. 13)	
Terrestrial, coastal, and freshwater ecosystem restoration in line with the provisions of Art. 4 *		
Marine ecosystem restoration in line with the provisions of Art. 5 *		
Restoration of natural connectivity of rivers and natural functions of associated floodplains in line with the provisions of Art. 9 *		
Restoration of pollinator populations in line with the provisions of Art. 10 *		
Agricultural ecosystem restoration in line with the provisions of Art. 11 *		
Forest ecosystem restoration in line with the provisions of Art. 12 *		

EU Soil Strategy for 2030**

Targets	2030	2050
Net land take (M)	Reduction of net land take Land take hierarchy in Urban Greening Plans, which prioritizes the reuse and recycling of quality urban land and soils, phasing out financial incentives that contradict this hierarchy, such as local tax benefits for transforming agricultural or natural land into built environments.	Reduction to 0 (zero) net land take

Urban biodiversity – In the absence of specific indicators for urban ecosystems in European policies, multidisciplinary teams will establish and measure these indicators for each urban center and agglomeration. Starting from the list of biodiversity indicators for forest, agricultural, and water ecosystems, examples of measured indicators, without being limited to these, include:

- Fallen deadwood (m^3/ha)
- Multi-age tree stands
- Forest connectivity
- Species diversity
- Proportion of native species

Examples of urban ecosystem restoration measures (point 31 from Annex VII, EU Regulation on Nature Restoration)

Expanding urban green spaces with ecological characteristics, such as parks, trees and forest strips, green roofs, wildflower meadows, gardens, urban horticulture, tree-lined streets, urban meadows and hedgerows, ponds, and watercourses, taking into account, among other aspects, species diversity, native species, local conditions, and climate change resilience.

National Policies - OUG 114/2007

Targets	2013
Urban green space sqm/inhabitant (M)	26 sqm/inhabitant (Art. II (1))

M - indicator subject to monitoring according to Art. 20 (1), b. of the EU Regulation on Nature Restoration (2024/1991).

* If the listed ecosystems are part of the urban green-blue infrastructure.

** Lands and soils are fragile and represent limited resources, subject to increasing demand for space: urban expansion and soil sealing consume nature and transform valuable ecosystems into concrete deserts.

6.2 Indicators for evaluating urban green infrastructure

Urban green infrastructure provides a range of environmental, social, and economic benefits. To effectively evaluate these benefits, approaches can be either qualitative (assessing recreational spaces and social benefits) or quantitative (measuring ecological and economic outcomes). One of the most recent methods focuses on quantifying urban ecosystem services, offering a measurable value that makes management easier for decision-makers.

By quantifying the ecosystem services of urban green infrastructure, the benefits become more tangible and manageable, supporting informed decision-making processes

Indicators for evaluating urban green infrastructure

Evaluation type	**Dimensiunea urmărită**	**Indicator examples**
IVU coverage	IVU quantity	Area of urban forests (ha)
		Area of urban agricultural land (ha)
		Area of urban green spaces (ha)
		Area of urban aquatic spaces (ha)
		Area of vacant land with restored vegetation (ha)
		Managed area for conserving ecosystem services (ha)
		Area of protected natural spaces (ha)
		Proportion of permeable surfaces (%)
	IVU quality metrics	Total shaded area (m^2)
		Annual count of dead trees
	IVU connectivity indicators	Total Core Area (TCA)
		Euclidean Nearest-Neighbor Distance (ENN)
IVU performance metrics	Ecological value of IVU	Increase in property value (Euro/sqm)
		Annual job creation (no./year)
	Economic impact of IVU	Creșterea valorii spațiului de locuit (Eu/mp)
		Numărul de locuri de muncă (nr/an)
	Social value of IVU	Distribuția spațială a alergătorilor și bicicliștilor (numărul de alergători și cicliști/oră/km)
		Enhanced physical and mental well-being of users

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Best practices related to urban green infrastructure

Green solution

Edipark-Greenin Breiðholt

Location	Vesturberg, Breiðholt, Reykjavík, Island
Stakeholders involved	National partners include the City of Reykjavík, Fjölbrautaskólinn í Breiðholti, and Fab Lab Reykjavík. Experts involved: Dr. Ævar Harðarsson (urban planning), Þórólfur Jónsson (nature and parks), Guðrún Hrefna Guðmundsdóttir, FB director, Óskar Dýrmundur Ólafsson, executive director of Suðurmiðstöð
Implementation period	2024-2028
Type of action	Enhancing urban green spaces to promote well-being, social development, sustainability education, and civic engagement.
Challenges addressed	Urban regeneration, increasing climate change adaptability through green urban transformations.
General description of the investment	The participation of the City of Reykjavík in the European GreenInCities project, part of the Horizon program. This 48-month project involves 30 legal entities, including 11 cities. GreenInCities is coordinated by the Institute for Advanced Architecture of Catalonia (IAAC), Spain. The project focuses on gardening as a method for social integration and collaboration. Its objective is to establish grower groups composed of students and residents of Breiðholt who will use the community garden. The proximity to homes and schools facilitates its use as an educational and community space.
Nature's role	Encouraging community involvement in green space care, leisure activities, and organic food production, while supporting pollination.
Benefits	The project strengthens sustainability education through lessons on ecosystems, soil quality, and urban agriculture. The garden is also designed as a recreational space for city residents, providing a welcoming environment for both people and wildlife, including birds and bees.

Fig. 15

Edipark - GreenIN Breiðholt, a project within the GreenInCities program

Green solution

Natur-Park Sudgeland

Location	Schoneberg, Berlin, Germania (16,7 ha)
Stakeholders involved	City of Berlin – project initiator, Grün Berlin – coordinating state company, Deutsche Bahn – land donor, Allianz Environmental Foundation – funder, Odious – designer
Implementation period	1995-2000, 2008-2009
Type of action	Restoration, protection, conservation (landscape conservation area, urban nature park)
Challenges addressed	Urban regeneration, biodiversity conservation, contamination
General description of the investment	The project aimed to transform a former railway depot, closed in 1952, into a natural area with both tree and herbaceous vegetation. It offers opportunities for unique nature experiences and suitable habitats for various plant and wildlife species. Trails, bird observatories, modern art installations, and other amenities were developed. The remaining buildings, including the Brückenmeisterei and the water tower, are used for educational activities and experimental artist spaces.
Nature's role	Partial restoration of natural forest processes.
Benefits	Increased appeal for recreational and leisure activities among Berlin residents; enhanced biodiversity conservation value; creation of nature experience areas, particularly beneficial for young and elderly people; expanded spaces for creative activities; permeable surfaces; role in moderating urban climate and biogeochemical processes.

Fig. 16

Natur-Park Südgelände (Berlin) – ecological restoration area

Green solution

Tempelhofer Feld

Location	Berlin, Germania (355 ha)
Stakeholders involved	City of Berlin – project initiator, Grün Berlin – coordinating state company, BASE – designer
Implementation period	2008-2010
Type of action	Restoration, protection, conservation, management (landscape conservation area, urban park)
Challenges addressed	Urban regeneration, biodiversity conservation
General description of the investment	The project aimed to convert a former airport, closed in 1998, into a recreational area. Part of the old airport area was designated for biodiversity conservation by creating suitable bird habitats. The runways were opened for cycling and other non-motorized activities; bird observatories were built; picnic and beach areas were organized. The remaining buildings, including the terminal and hangars, are used for educational activities, concerts, ceremonies, and fairs.
Nature's role	Enhancing natural processes of herbaceous vegetation expansion to allow water infiltration.
Benefits	Increased attractiveness for recreational activities among Berlin residents; enhanced biodiversity conservation measures; designated nature experience areas accessible to all age groups; permeable surface; role in moderating urban climate and biogeochemical processes; contribution to carbon retention.

Fig. 17

Tempelhofer Feld (Berlin) – a former airport transformed into a conservation and recreation area

Green solution

Isar River Plan

Fig. 18

Isar Plan (Munich) – the reconstructed Isar River bed used for recreation

Location	Munich, Germany
Stakeholders involved	Bavarian State Government, City of Munich
Implementation period	2010-2015
Type of action	Restoration, protection, management
Challenges addressed	Flood protection
General description of the investment	The project aimed at flood management and the restoration of an 8 km river section of the Isar, which had been canalized. It was initiated after floods in 1999, 2005, and 2013 that significantly affected southern Germany. The project focused on increasing the retention capacity of the Isar floodplain, improving biodiversity conservation potential, and enhancing the recreational value of the riverbanks. The Isar was restored over an 8 km section, widening the floodplain from 50 to 90 meters, replacing concrete with sands and gravels in the riverbed, and reconnecting the river through fish ladder installations, while also providing various recreational facilities.
Nature's role	Restoring the natural flow regime of the Isar to increase its capacity to handle high discharges.
Benefits	Improved flood resilience; restoration of longitudinal connectivity of the watercourse; water quality improvement; increased biodiversity conservation value; providing nature experience areas accessible to all age groups; urban climate moderation and biogeochemical processes; carbon retention contribution.

Green solution

Prinzessinnengarten

Fig. 19

Prinzessinnengarten – community garden and restaurant

Location	Berlin, Germany
Stakeholders involved	City of Berlin – project initiator, Nomadisch Grün NGO – administrator
Implementation period	2009
Type of action	Restoration, management, creation, addition
Challenges addressed	Urban regeneration, social cohesion.
General description of the investment	The garden area had been unused for 60 years. In 2009, citizens removed approximately two tons of waste from a 6000 m^2 surface, and in July 2009, the Nomadisch Grün NGO placed the first 100 planted pots. The plants are grown in recycled boxes, tetra packs, and rice bags, making the garden fully mobile. The first harvest was collected in August 2009, and in September 2009, the first four beehives were installed. The area includes play facilities for children. In 2010, a garden café opened, and 300 more pots were placed. In winter, the garden is relocated to the market on Eisenbahnstrasse.
Nature's role	Organic food production and pollination.
Benefits	Food production, social cohesion, increased attractiveness for recreational activities accessible to nearby residents; creating a space for urban agriculture practices.

Green solution

Rio Madrid Rio

Location	Madrid, Spain
Stakeholders involved	Madrid City Council – project initiator, Burgos & Garrido / Porras La Casta / Rubio A.Sala / West 8 urban design & landscape architecture – design
Implementation period	2007-2015
Type of action	Restoration, management, expansion
Challenges addressed	Public health and quality of life, urban regeneration, air quality, climate risks such as urban heat island effects and extreme temperatures.
General description of the investment	Madrid Rio is an urban regeneration project that transformed an unused section of the former M-30 highway, which was closed and replaced with an underground passage, into a network of parks along the Manzanares River. The expansion of green areas was complemented by the development of sports facilities (sports fields, running tracks) and the enhancement of historical and architectural landmarks (Puerta del Rey, Puente de Toledo, Matadero Madrid). The project also created relaxation areas, playgrounds for children, observation points, and bird platforms.
Nature's role	Increasing the surface of semi-natural spaces within the city of Madrid and restoring the river ecosystems of the Manzanares River.
Benefits	Connecting the poorer neighborhoods in southern Madrid with the city center; developing infrastructure to support cultural, sports, and recreational activities; promoting sustainable transport by creating cycling paths; creating a healthy living environment for residents by reducing air pollution associated with decreased traffic emissions; enhancing the area's attractiveness through the valorization of monuments.

Fig. 20

Parc Urban Madrid Rio

Green solution

Bosco Verticale Milano

Location	Milan, Italy
Stakeholders involved	City of Milan, Lombardy Regional Administration, Architect Stefano Boeri, local NGOs
Implementation period	2014-2017
Type of action	Creation of a new building with integrated green solutions.
Challenges addressed	Urban regeneration, urbanization, severe pollution, impermeable surfaces.
General description of the investment	Bosco Verticale is part of the urban regeneration project in the Porta Nuova district, featuring a residential and business complex with green solutions. The project consists of several residential buildings with heights of 76 and 110 meters, incorporating 900 trees (ranging from 3 to 9 meters in height) and over 20,000 plants (shrubs and grasses), arranged according to the orientation of the facades. A nearby park features constructed wetlands.
Nature's role	Carbon sequestration, air purification, climate moderation.
Benefits	Transforming the neighborhood's image, creating jobs in the green economy, supporting biodiversity, carbon storage, high energy efficiency of the building, and climate moderation.

Fig. 21

Bosco Verticale and constructed wetland in Milan

Green solution

Warta River Development Strategy in Poznan 2012-2030

Fig. 22

Smart river management of the Warta River in Poznan (Poland)

Location	Poznan, Poland
Stakeholders involved	Poznan Municipality, local residents, KuiperCompagnons, Royal HaskoningDHV, SwedeCenter
Implementation period	2012 - 2030
Type of action	Restoration of old river branches, currently silted up; sustainable riverbed management to prevent flooding.
Challenges addressed	Flood protection, restoration of aquatic habitats
General description of the investment	The development strategy encompasses around 70 projects aimed at creating islands, establishing new river branches of the Warta, constructing a port, revitalizing riverbanks, and connecting green spaces and playgrounds with the river's floodplain. The strategy is structured around six key themes: connectivity (road and pedestrian), safety, housing and employment (residential and public spaces), tourism and recreation (including artificial beaches), heritage, landscape, and nature.
Nature's role	Restoring the hydrological cycle and enhancing the area's attractiveness.
Benefits	Flood protection, improving quality of life and area attractiveness, increasing ecological value through more diverse and intense ecosystem services, connecting green spaces to create a cohesive urban green infrastructure, enhancing the value of adjacent areas, revitalizing nearby spaces, and boosting recreational potential.

Green solution

Văcărești Nature Park

Fig. 23

Văcărești Nature Park (Romania)

Location	Bucharest, Romania
Stakeholders involved	Ministry of Environment, Bucharest City Hall, Vacaresti Park NGO
Implementation period	After 2014
Type of action	Conservation
Challenges addressed	Neglect, biodiversity conservation, providing nature experiences for the residents of Bucharest
General description of the investment	The project aimed to designate the Vacaresti area as a natural park. In 2016, the Ministry of Environment declared the Vacaresti Nature Park over an area of 183 hectares, with the purpose of conserving over 100 species of aquatic birds, mammals, amphibians, reptiles, and fish that have found a suitable habitat here. Additionally, the area is intended to offer nature experiences for Bucharest residents. Unresolved issues still exist concerning sanitation, safety, accessibility, and attractiveness.
Nature's role	Natural succession processes have encouraged vegetation growth while also partially restoring water cycles and other biogeochemical processes.
Benefits	Climate regulation, carbon sequestration, habitat creation, effective stormwater management, improved air quality, and enhanced opportunities for nature-based recreation for Bucharest residents.

Green solution

Healthy Places—Timișoara

Location	Timișoara, Romania Green Feel, a 3-hectare periurban plot, privately owned but open to the public UVT Urban Garden, a public courtyard attached to the West University of Timișoara building, designed by architect Hans Fakelmann
Stakeholders involved	Studio Peisaj, TerraPia, Cristina Potra-Mureșan, Valentin Mureșan, Timișoara Community Foundation, West University of Timișoara
Implementation period	2019-2022
Type of action	The project revitalized two locations in Timișoara, one periurban and one central, transforming them into genuine platforms for knowledge exchange, human interaction, and harmonious coexistence with nature.
Challenges addressed	Providing an alternative to mainstream urban development practices (highly specialized, top-down, aggressive) and addressing the need for community-oriented, inclusive, and biodiverse places that facilitate connection, knowledge sharing, and inspiration drawn from nature, local history, traditions, and diverse individual experiences.
General description of the investment	The project activated two community gardens within the city, which have since become spaces for dialogue, experimentation in line with sustainability principles, and platforms for disseminating local practical knowledge. A variety of nature-inspired solutions were adopted through a participatory approach to reshape these places, rediscovering their beauty through the diversity of needs they address and aspirations they cultivate. Reversible interventions demonstrated how communities can maintain and adapt nearby places to their own needs, fostering a sense of belonging and involvement. This community consists of researchers, gardeners, entrepreneurs, artists, and people from various backgrounds and ethnicities, whose personal stories and memories enrich both locations on a daily basis. The model created through this project serves as an educational platform that can be scaled to other regional locations. Healthy Places was selected as a finalist for the New European Bauhaus (NEB) Awards, European Commission, 2021.
Nature's role	Reconnecting with nature, reclaiming a sense of belonging
Benefits	Integrating natural resources into the co-design process ensures the fulfillment of daily needs, facilitates emotional connections, activates the memory of place, and enriches dialogue based on inclusion, tolerance, and cooperation. The activated places become "nurseries" of nature-based know-how, relying on accessible natural raw materials and inspiring transformations of the urban environment into the landscapes of the future. Rural practices were integrated into the design of these spaces to showcase sustainable, centuries-old ways of living in close relationship with the surrounding environment, challenging communities to reflect on current lifestyle habits.

Fig. 24

Beekeeping workshop for children, knowledge transfer between human and non-human communities, GreenFeel Timișoara, 2024

Mirror Mission
Cities Hub Romania

Possible Cities

Integrated toolkit
for climate neutrality

Waste management and circular economy

7R — General context and the construction field
Trends and emerging technologies

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5

Waste management and circular economy

7R - General context and the construction field

Trends and emerging technologies

Contents

1 Waste management and the circular economy

Waste accounts for 5% of global greenhouse gas (GHG) emissions. Improper waste disposal affects public health and biodiversity by polluting the soil, water, and air. Population growth and density, raising living standards and evolving consumption habits intensify this negative impact.

The conventional economic model relies on extracting raw resources from nature, followed by production and waste disposal. Most of the waste take exponentially longer periods to decompose in nature than the rate at which is produced. This linear economic model has proven to be extremely harmful to life - both human and ecological.

Circularity is a principle rooted in nature, where any element no longer needed by one organism becomes a resource for other organisms. The idea of the circular economy is inspired by the nature's material cycle, aiming to minimize environmental impact. The core principle is to reconfigure value chains in such a way as to create a waste-resource continuum, similar to the natural ecosystems.

Transforming the economic model requires both technological transformations - to allow for the collection and transformation of waste into resources for reconfigured or new production lines - and systemic changes in processes, behaviors and attitudes on a broad scale. It also involves implementing monitoring, evaluation and reporting techniques

The waste management system benefits from the smart city concept through digitization and IoT, streamlining processes for all stakeholders and enabling real-time reporting of results. This is vital for demonstrating the effectiveness of the efforts made.

Integrating circularity into the economic model is often illustrated by the 7Rs:

— **Redesign** — (re)designing systems, services and products at every stage of production and consumption to eliminate waste and optimize resource use. At an individual level - reconsidering our choices, needs, wants, and how we satisfy them;
— **Reduce** — reducing the need for ressource extraction, production, and purchasing, reducing the amount of waste generated, especially non-biodegradable substances;
— **Re-use** — choosing sustainable products that can be used for longer periods in their original purpose, maximizing usage over time and/or number users, etc. Adaptive re-use is integrated into rehabilitation and conversion processes;
— **Repair** — prolonging an object's lifespan through measures such as maintenance, keeping it in good working condition, assembling or replacing parts when necessary etc.;
— **Rehabilitation and Conversion** — extending the service life by adapting to new standards and/or new functions and/or uses. This includes adaptive reuse and, to some extent, the concept of upcycling;
— **Recycling** — non-biodegradable materials are disassembled and sorted, then reassembled into new, higher value items (upcycling) or processed into raw material for new products (recycling);
— **Recovery** — using waste as fuel for energy generation.

The circularity principle applies to individuals and organizations across all sectors of activity.

Domeniul Construcțiilor

Issues relating to the maintenance, renovation, rehabilitation and conversion of builings are addressed in detail in the chapter Built Environment. In this chapter, the sections dedicated to the construction sector will primarily focus on the management of construction and demolition waste (CDW).

Approximately 40% of all waste comes from construction and demolition activities, and resource extraction for the construction sector disrupts ecosystems through excessive deforestation and excavation. Therefore, environmental policies and legislation consistently address resource and waste management associated with the sector.

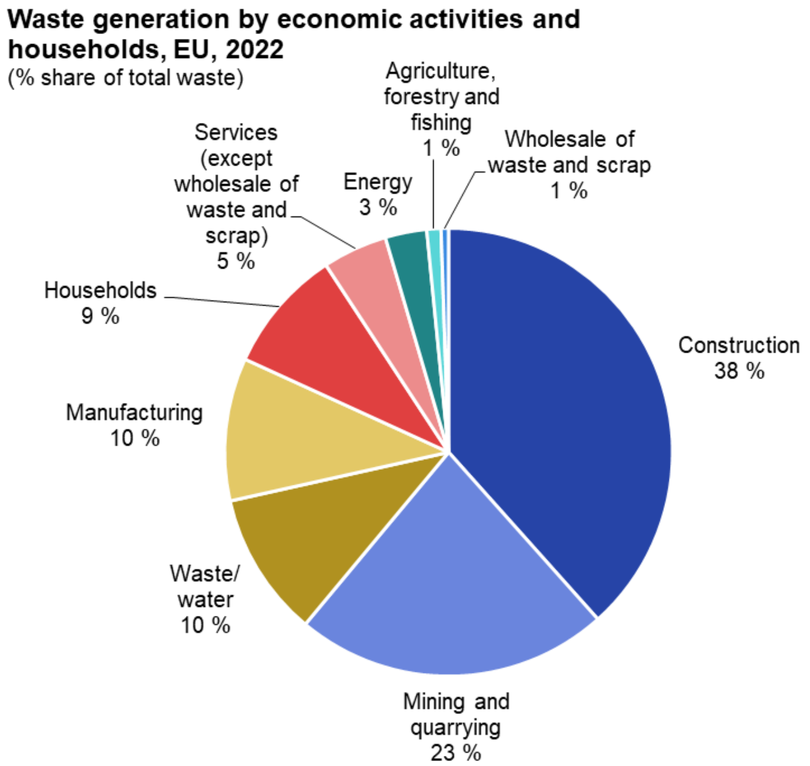

Fig.1

Waste generation by economic activities and households, EU, 2022 (shares of total waste) Services (excluding waste management) 5%; Households 9%; Manufacturing 10%; Wastewater 10%; Mining and quarrying 23%; Construction sector 38%; Waste management 1%; Agriculture, forestry, fishing 1%; Energy 3%.
Source: Eurostat - https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics, accessed 10.03.2025, translated into Romanian by the author.

The same general waste management logic applies to construction waste, following the priority order of the 7Rs:

— Rethinking the necessity of building and design approach of constructions.
— Reducing the need to build, the generation of waste, and the consumption of natural resources.
— Re-using existing buildings, i.e. certain materials and construction elements.
— Repairing buildings, installations and related equipment.
— Rehabilitating and converting existing constructions and their components.
— Recycling construction materials.
— Recovering energy through the combustion of certain types of construction and demolition waste (CDW)

2 Current Status

2.1 Legislative Framework

The Global Alliance on Circular Economy and Resource Efficiency (GACERE), launched in February 2021 at the Fifth Session of the United Nations Environment Assembly (UNEA-5.1), is a global alliance of governments committed to collaborating and supporting a just transition to a circular economy.

At the EU level, an extensive framework has been developed, which include:

— **The Circular Economy Package**, targeting the integrated management of resources across several sectors of activity.
— **The European Green Deal**, with the vision of making Europe the first climate-neutral continent, sets out several goals, including:
  — Adopting a circular and climate-neutral economy by 2050
  — halting pollution and biodiversity loss
  — promoting a fair, healthy and environmentally friendly food system
— **The Circular Economy Action Plan** operationalizes the Green Deal through the development of sustainable product policy, eco-design, and green public procurement (GPP).
— **The European Circular Economy Stakeholder Platform -** https://circulareconomy.europa.eu/platform/en, in Romania: https://rocesp.ro/
— **The Urban Agenda Partnership on Circular Economy**, which strengthens the urban dimension of the topic

At the national level, the main legal acts regulating the field are:

— Emergency Ordinance No. 92 of August 19, 2021, on waste management - https://legislatie.just.ro/Public/DetaliiDocument/245846
— Law No 132/2010 on selective waste collection in public institutions - https://legislatie.just.ro/Public/DetaliiDocument/120275
— Order no. 2.436 of September 20, 2023, approving the Guide on Specific Waste Regulations, as a result of implementing project SIPOCA 394/116097 - https://legislatie.just.ro/public/DetaliiDocument/274884
— Law no. 101 of April 25, 2006 (republished), on the sanitation service of municipalities
— Law no. 51 of March 8, 2006, on community public utilities services
— Law No 69 of April 25, 2016 on green public procurement https://legislatie.just.ro/Public/DetaliiDocumentAfis/177918
— Government Decision no. 1.172 of 2022, approving the National Strategy on Circular Economy - https://legislatie.just.ro/Public/DetaliiDocumentAfis/259668

These are complemented by over 100 other pieces of legislation regulating more specifically the local sanitation service, extended producer responsibility, the management and transfer of different types of waste, financing mechanisms, and more.

Construction Sector

Construction-specific legislation is addressed in the chapter on the Built Environment. The following specifically refers to the legislation concerning construction and demolition waste.

European Directive 2008/98/EC set the target of recycling at least 70% of construction and demolition waste (CDW) by 2020.

EU Regulation 2020/852 introduced the Do No Significant Harm (DNSH) principle, according to which public projects funded by EU funds or other public sources must demonstrate that they do not significantly harm the environment.

Romanian legislation requires the separate collection of waste at the source, and economic operators are required to contract authorized companies for proper management. In order to ensure traceability, environmental legislation of maintaining **a waste management registry for all waste-generating companies**, covering the entire value chain.

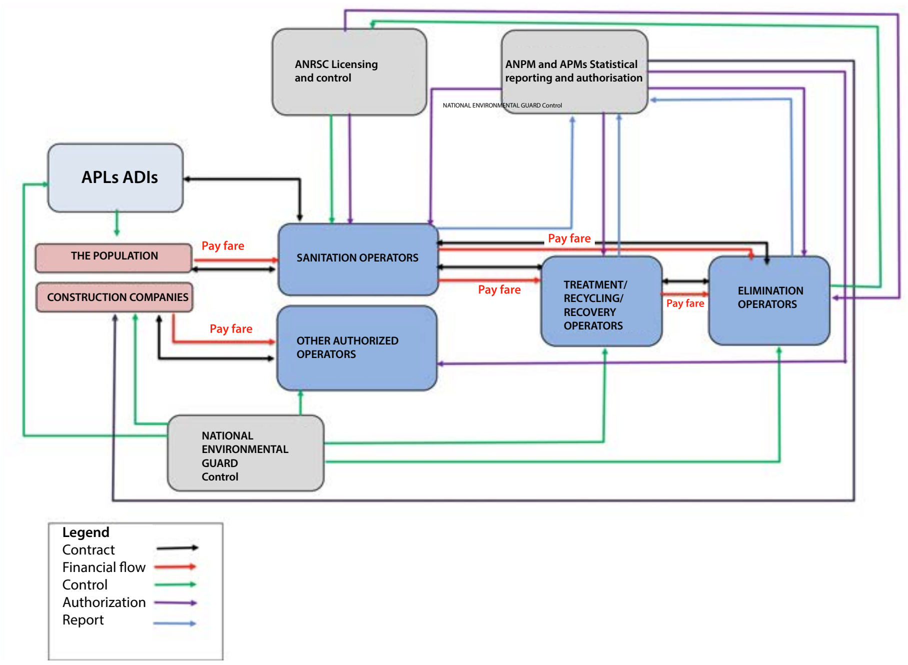

Fig. 2

Current construction and demolition waste management scheme
Source: National Waste Management Plan, 2017 (Figure II-33)

2.2 Practice

The field of waste management and circular economy is relatively new on the public agenda and therefore faces a number of barriers in implementation:

— resistance to change and inertia of existing systems;
— lack of coordination between different actors and sectors;
— technological and infrastructure challenges;
— legislative and regulatory barriers.

Large companies, in general, conduct regular audits focused on specific issues they whish or have a duty to monitor to maximize performance. Some of them implement waste management and circularity systems, such as ISO 14001, ISO 59010, and ISO 59020.

All of these efforts directly or indirectly involve the company's employees and companies in their value chain, which is why, particularly but not exclusively, large companies run sustainability training programs for their employees.

For example, Carrefour in partnership with the SNRB Association has initiated a training program for its employees in Romania on the separate handling and collection of batteries and the management of battery fires.

Administrative, business, NGO and academic initiatives are beginning to converge in Iași County. Several local administrations are implementing separate collection systems at different levels of maturity, but the degree of circularity is extremely low, although in the last 5 years some of them have developed programs to educate and raise public awareness on waste management. Universities offer training programs focused on circular economy, and a number of companies in the county have adopted circular practices, using renewable resources such as straw (Agreenergy Construct), flax, hemp, and wool (Green Collection), repair and recovery (Wise Fashion), upcycling (AllGreen), etc.

"Eco-Schools" and "Green Week" are educational programs taking place in public schools across the country to develop a culture of sustainability among new generations. NGOs such as the De-a arhitectura propose activities and provide educational resources for this purpose.

These programs address sustainable development in many aspects, including waste (avoidance) generation and management.

The RetuRo program was launched on November 30, 2023, nationwide, consisting of a return guarantee scheme for reusable plastic, metal, and glass packaging. In 2024, a return rate for marked packaging of approximately 55% was expected. These are directed to recyclers, not for reuse.

Construction Sector

The current situation in the field of construction regarding the quality of constructions, building permits, energy performance, and interventions on the built heritage is addressed in the Built Environment chapter. The following specifically refers to the current practice of managing construction and demolition waste.

According to the data from the National Environmental Protection Agency under the Ministry of Environment, the average recycling rate of construction and demolition waste (CDW) is about 48% for the period 2010-2022. This value results from the sum of the quantities reported by the managers of CDW crushing station and operators in the field, which were used in road infrastructure, relative to the total amounnt of CDW reported by all operators in the construction sector. Construction and demolition waste (including excavated soil from contaminated sites) is classified under item 17 in Annex 3 of the "Guide on Specific Waste Regulations [...]", approved by Order 2436 of September 20, 2023.

Currently, the disposal of special construction waste is carried out in municipal landfills or in nature, as there are no specialized landfills.

At the national level, there are 34 facilities for crushing CDW, with a total estimated capacity of about 3 million tons per year. These facilities can transform concrete and bricks into materials that may have a later use, generally as aggregates, which is a limited application of the circular economy principle. Thus, the majority of CDW ends up in road infrastructure.

In other words, although there are old buildings whose masonry contains stone and brick in good condition that can be reused, in the absence of a concrete recovery plan, these materials will not be reused in the construction of a new building, as the European Union aims. They will be used, at best, as support for road infrastructure and embankments.

The distribution of crushing facilities is uneven, which increases transportation costs, generates pollution, and slows down the adoption of recycling practices. The lack or insufficiency of collection centers and processors well-distributed across the territory will continue to allow the illegal dumping of CDW. In both rural and urban areas, there are frequent cases of illegally abandoned construction waste, contributing to environmental pollution and the underreporting of officially recorded quantities.

Monitoring the amount of CDW is quite a difficult process and requires the existence of intermediaries to carry out both staged demolition/

dismantling and pre-collection for the purpose of processing these materials with the intention of reuse.

However, there are isolated initiatives that bring certain products resulting from demolitions back to the market, such as valuable materials from dismantled traditional buildings (roof tiles, bricks, stone, timber trusses or beams). Marketed as "reclaimed bricks" or "second-hand," these pieces are cleaned, sorted and can be reused in construction through online sales platforms. Material recovery is a relatively widespread practice, especially in rural areas where there is no clear record of demolitions, and in urban areas, where such materials are not recorded as waste (they are part of construction rubble). These historical construction materials (fish-scale tiles, traditional bricks, valuable wooden boards or beams) are then sold on online platforms and used for construction projects funded exclusively by private sources.

Although most of heritage buildings would require the use of traditional materials to meet with the standards for interventions on architecturally and historically valuable buildings, construction materials resulting from CDW are not permitted in public works in Romania.

Romanian cities lack proper infrastructure for the recycling the CDW materials. However, some economic operators or individuals have been identified who engage in activities related to the recovery of CDW, such as collection, sorting, cleaning and reintroducing these materials to the market. The absence of regulations has led to the emergence and expansion of an informal system for reusing CDW, highligthing the need to create infrastructure that meets the needs of both communities and the market (e.g., collection centers where selected materials can be brought for reuse).

Currently, an organizational structure is being developed at the initiative of the National Heritage Institute, bringing together four pilot centres and providing support for the implementation of Investment I.4 - Circular Economy and Increasing Energy Efficiency of Historic Buildings, part of Component C5 - Renovation Wave within the National Recovery and Resilience Plan (NRRP). This includes measure I4.c: Supporting the circular economy by creating a pilot centre for the collection and reuse of historic construction materials from legal demolitions, with a completion deadline set for 2026.

Private initiatives in this field include:

- 112recuperare.ro (Bucharest), an online platform for the recovery and reuse of materials resulting from the legal demolition of historic houses, that could be reused or integrated into other constructions – such as bricks, window frames, façade details, fences, and ornaments. The initiative is supported by the Romanian Order of Architects through the Architecture Stamp (Timbrul de Arhitectură).
- Bricked.ro (Cluj-Napoca) offers services for the recovery, restoration, and reuse of old bricks.
- The Recycling Map is a participatory platform initiated by Viitor Plus, which aims to map circular economy spots in Romania, including those in the construction sector.
- Offers and requests for traditional construction materials in good condition (which are not accepted under legislation governing public investments) are posted and accessed on general online platforms for buying, selling, and exchanging products and services.

3 Waste Management and the Circular Economy

The transition to a circular economy presents both challenges and opportunities. It requires a systemic approach, technological innovation, innovation in business and governance models, and changes in values, attitudes, and behaviors.

For the most effective application of the circularity principle, it is recommended to follow the 7Rs in order, coherently and convergently, thus generating a higher cumulative impact:

1. **Redesign / Rethink**
2. **Reduce**
3. **Reuse**
4. **Repair**
5. **Renovate and convert**
6. **Recycle**
7. **Recover**

Several initiatives developed at both national and international level are dedicated to promoting the circular economy and supporting administrations that are committed to such goals. Custom initiatives can be innovative and tailored to specific contexts, but they typically require more time and resources to develop.

3.1 Redesign / Rethink

Rethinking how we operate, our business and governance model, and reevaluating purchasing and consumption habits at both individual and organizational levels are at the core of the circularity cycle. This involves redesigning procedures and processes, as well as managing products and their components throughout their entire life cycle.

In the business environment, this redesign can manifest through:

— Rethinking the business model, the supply chain, and the impact on customer mindset through key marketing messages, analyzing the quantity and quality of waste generated by the company, as well as the overall environmental impact.

— Designing durable products, which come with long-term warranties, sometimes even lifetime guarantees. A special case is the classic durability model, which integrates timeless qualities, where product durability becomes a core value of aa company.

— Designing for extended product life by modularizing components and standardizing them so they can be repaired, upgraded, and disassembled - this implies creating a market for spare parts.

— Designing for optimal recycling, to ensure the closure of the circular loop (minimizing composite materials, using recycled and recyclable materials). Examples include:
  — Fairphone – a modular smartphone, easily repairable and upgradeable by the user.
  — Adidas Futurecrat.Loop - fully recyclable sports shoes made from a single material.

— The product-as-a-service business model provides usage rights instead of ownership. Renting and lending are classic forms of transfer of usage rights transfer, commonly applied to real estate, automobiles, and increansingly to bicycles, scooters, etc. The model has expanded to other occaasionnally used products such as household appliances, tires, lighting systems, clothing of different styles and for different occasions, tools, utensils and more. Philips offers lighting as a service, billing customers for light itself. The company has every interest in creating sustainable products, as it retains ownership of the bulbs, fixtures, and other equipment, and is responsible for their maintenance and upgrades. This model significantly reduces resource consumption.

- Extending product value through company commitments to take-back and refurbish used products.
- Industrial symbiosis and resource value extension by connecting companies that generate or collect waste with companies that recycle and transform it into new products.

At the local government level, rethinking the role of the municipality – how they organize and carry out activities, regulates and delivers services to the community, activities, regulate and deliver services to the community, and plan procurement and investment—lays the foundation for coherent and converging future measures. Municipalities can apply the same principles as the business sector, adapted to their specific context. For example:

- Rethinking the local systems they can influence, such as the food system, education system, energy systems, and water supply and management systems. One example is theMilan Urban Food Policy Pact, a global partnership of cities committed committed to building sustainable, inclusive, and resilient urban food systems that integrate circularity principles.
- Service design and direct procurement with a focus on durability criteria and optimization for repair, upgrades, disassembly, and/or recycling (Green Public Procurement - GPP).
- Creating or supporting infrastructure that facilitates access to occasionally or short-term used products, thus reducing the need for individual purchases. For example:
  - Mobility sharing schemes: bike-sharing, car-sharing;
  - Community centers with equipment and toys for young children, where parents and caregivers can spend time with their children;
  - Rental or makerspace centers for DIY equipment.
- Introducing regulations or incentives to encourage collective solutions instead over individual ones, which often lead to higher resource consumption and increase waste. For example:
  - Shared building or complex-level heating systems, or connecting to the central heating grid instead of using individual apartment boilers;
  - Promoting the use of public or shared transport over private cars.

Construction Sector

"The greenest building is the one that already exists," especially in terms of construction material resource efficiency. Local administrations can adopt circularity policies in the construction sector by promoting the prioritization of the 7Rs in order, aiming to minimize construction and demolition waste (CDW): reuse, renovation, conversion, etc..

The first step toward circularity is rethinking the need for building in the first place, followed by reconsidering design approaches and construction techniques. Designing buildings for maximum potential of disassembly and reassembly or recycling, and for adaptability to various functions, are just a few strategies that help save resources and reduce CDW generation.

Furthermore, building design can and should integrate CDW as much as possible through reuse or recycling. For this, the best available techniques for selective demolition and sorting are essential, as they facilitate the extraction of high-quality materials and allow for the safe removal and handling of hazardous substances.

Examples of CDW reuse include:

- Concrete and industrial bricks can be crushed and reused as aggregates
- Traditional bricks and tiles can be reused in restoration works
- Wood can be recycled or used for bioenergy
- Metals should be collected and sent for recycling
- Insulation materials and plastics, depending on their composition, can be recycled or incinerated for energy recovery.

Landfilling CDW should be the last resort.

3.2 Reducing Waste Generation

Reducing waste generation also means rethinking consumption needs, especially for single-use products.

Municipalities can implement a range of measures to reduce waste generation, such as:

— Digitizing the municipality and its subordinate services;
— Applying a Zero Waste criterion when organizing their own activities and events, as well as public events in general;
— Reducing the need for individual purchases by establishing regulations and incentives for collective solutions over individual ones, such as product-as-a-service business models: shared mobility systems, makerspaces, etc.
  Community tool libraries lend or rent tools and equipment based on an annual membership subscription.

They can also develop campaigns in partnership with other stakeholders to promote responsible purchasing and consumption behavior. For exemple:

— "Zero Waste Week" - an international campaign that challenges individuals and communities each year to experience a zero-waste week. In 2020, it had 56 million participants across 76 countries.
— "Zero Waste Christmas"– The Renovation and Recycling Agency of Oslo regularly shares waste reduction and management tips, second-hand markets, and giveaways on its social media. At Christmas, it posts advice on reducing food waste, avoiding unwanted or unnecessary gifts, choosing sustainable wrapping, and more.
— "Plastic Free July" – a global initiative that challenges people to avoid single-use plastics for a month, inspiring over 140 million participants in 190 countries in 2021.

Construction Sector

Reducing CDW is facilitated by:

— Choosing to carry out activities online or in existing spaces whenever possible.
— Promoting phased and selective demolitions to enable the safe removal and handling of materials, and to facilitate high-quality reuse and recycling by selectivly removing materials and establishing sorting systems.
— Creating or supporting the developpement of a collection infrastructure recovery of CDW and refusing their disposal in municipal landfills.
— Implementing an effective monitoring and sanctioning system to prevent the illegal dumping of CDW in the environement.

3.3 Re-use

A fundamental principle of reuse is durability—the ability of a product to remain in good physical and functional condition for as many uses and for as long as possible. Durability is a potential that can be maximized through the intensive use of the product.

From the perspective of climate neutrality, it is always preferable to produce and purchase durable products, but also to use them to their full potential. Therefore, especially for products used occasionally—but not exclusively—they can be shared within a small group (couple or family) or a larger community (cooperatives, etc.) to make the most of their durability. This minimizes resource consumption and waste generation, which would otherwise result from the multiplication of rarely used, isolated items.

To create a sustainable system of sharing and/or transfer, collaboration between consumers and producers is essential, often requiring support from central and local authorities.

Local governments can support the maximization of reuse by:

- facilitating the development of sharing, lending or rental contexts, as well as product-as-a-service models;
- encouraging the development of exchange and donation platforms. Enabling product transfers within a limited area reduces the environmental impact of transportation and packaging while strengthening local communities. Examples of such platforms include:
  - Social shops, where donated products are sold at very low prices.
  - Donation collection systems - in many places in Romania there are collection points, sometimes using containers, for textiles, toys and footwear.
    Oslo's small voluntary recycling centers include second-hand zones where a wide range of items can be donated and taken, including dishes and other fragile objects.

Fig. 3

Recycling Tent Grønmo, Source: https://www.facebook.com/kildesorteringioslo
Credit: Municipality of Oslo (with permission)

  - Organizing swap events in communities. Cities like San Francisco regularly host clothing, book, and other item exchange events.
  - Too Good To Go is an app aimed at preventing food waste by connecting restaurants and stores with potential consumers.
  - Freecycle is a global platform that makes it easy to donate items that are no longer needed. In Romania, there are multiple local or regional online communities with the same goal.
- Second-hand markets (and shops). Priority should be given to supporting local goods transfer initiatives to minimize transportation, storage, and packaging.
  - In Romania, "old goods" markets for children are a tradition inherited from the Saxons in some towns, where in the fall and spring children can sell their old bicycles, clothes, and toys.
  - The municipality of Ljubliana (Slovenia) opened reuse centers that contributed to a 59% reduction in waste sent to landfills between 2004 and 2014.
- Reusable packaging and containers systems
  - The return system launched nationwide in Romania on November 30, 2023, includes plastic, metal and glass packaging marked with a return guarantee. By 2024, the return rate was about 55%, with most of these items being sent to recyclers, not for reuse. Some improvements to the system can be facilitated at a local level.

In Germany, the return system covers 98% of beverage bottles and has led to a reuse rate of 97.9%.
- Zero Waste events propose eliminating waste production, mainly by using reusable products, minimizing waste, and recycling it.
- Furoshiki is a traditional Japanese practice of wrapping objects, including gifts, with a high-quality, attractive, and reusable cloth. This practice is promoted in campaigns like Zero Waste Christmas, part of a mindset-shifting effort.

— Public procurement that include re-use criteria.

Repair Café Ixelles (2013), at the Elzenhof community center in Ixelles, CC author PhilippeCPhoto, source: flickr.com

Construction Sector

Firstly, maintaining existing buildings to extend their lifespan in good physical and operational condition, as well as their adaptive reuse, are priority approaches for the transition to climate neutrality. This aspect is extensively addressed in the chapter on the Built Environment.

Secondly, high-quality reuse and recycling are facilitated by promoting staged and selective demolitions to allow for the safe removal and handling of materials, as well as the establishment of sorting systems.

Material banks can be established at the municipal level or in large post-industrial regeneration areas. Promoting the priority use of materials recovered from construction and projects that have successfully integrated them contributes significantly to changing mentalities and accelerating change.

3.4 Repair

Extending the lifespan of products through maintenance and repair can be supported by local administrations by:

— Supporting local businesses that provide repair services: cobbler, tailoring, electronics, and household appliances, etc.

— Supporting the development and maintenance of "makerspace" centers, possibly within dual campuses where available. These centers can offer access and assistance to the public during certain times.

Repair Café is a concept present in 35 countries with over 2000 locations, where volunteers help repair items. iFixit offers free electronics repair guides for electronic products.

Fig. 5

Repair Café Ixelles (2013), at the Elzenhof community center in Ixelles, CC author PhilippeCPhoto, source: flickr.com

— Campaigns promoting repairs

— Public procurement that include remanufacturing and refurbishment criteria.

Caterpillar's Cat Reman program collects used components from heavy machinery and restores them to original specifications. The energy savings compared to producing new components is 85%.

Construction Sector

Maintenance interventions on existing buildings are extensively discussed in the **Built Environment** chapter.

3.5 Rehabilitation and Conversion

Unlike recycling, this stage addresses limited interventions to adapt to new standards and uses, while maintaining the integrity of the structure and its components.

The measures indicated in chapter 3.4. Repair also apply in this chapter, with an emphasis on rehabilitation and conversion, including adaptive reuse, where the creative and innovative component plays a major role.

Examples of conversions through adaptive reuse or upcycling to offer a "second life" to items:

- Li-ion batteries from electric vehicles or those powering electric scooters and bicycles can be used for energy storage systems for data storage (an IBM and BMW initiative) or for external chargers for cell phones, tablets, or laptops (Ecovip, Romania).
- Furniture and fittings incorporating used tires, pallets, recovered woodwork parts, barrels, and various other containers.
- New products made from used objects (reconstruction) or from leftover materials from production (stock ends).

Construction Sector

Interventions on existing buildings are extensively covered in the Built Environment chapter.

The concept of “upcycling” is also adopted in the construction and design sector, using:

- elements from deconstructed buildings, such as woodwork from various materials, large tubes, columns, beams, and prefabricated reinforced concrete floor elements, etc;
- material stock ends such as ceramic tiles and various types of panels;
- prefabricated panels that integrate materials recovered from construction and demolition, such as bricks, wood pieces, etc.
- Products from other industries: cargo containers, rubber mats, plastic or glass bottles, crates, etc.

Special attention must be given to hazardous waste when converting industrial spaces for other functions. These are identified and classified according to legislation based on toxicity, flammability, corrosivity, and reactivity. There are specific regulations regarding methods of safe collection and storage, handling and transportation, processing, and neutralization. The most common hazardous industrial waste includes used solvents, used oils, batteries, and medical waste.

The Emscher Generation Project (Germany) is a model of post-industrial regeneration. After 100 years of intensive mining and metallurgical industrial expansion, the river valley management cooperative, Emschergenossenschaft, launched one of the most extensive river restoration programs in Europe. The program highlighted the major impact of water management on ecological and social transformation in an area of 865 km², with 353 km of waterways and 2.2 million inhabitants. The ZUGABE cooperation model is offered by Emschergenossenschaft to support of other interested municipalities

Fig. 6

Images before (left) and after (right) restoration of a watercourse in the Aplerbeck neighborhood of Dortmund, Credit: EGLV (Gerner et. al, 2018)

Fig. 7

Images of the industrial site before (left) and after (right) the restoration of the Emscher River, the creation of the Phoenix Lake and the surrounding mixed neighborhood, Credit: City of Dortmund, EGLV (Gerner et. al, 2018)

3.6 Recycling

Some of the products and materials that can no longer be reused, repaired or converted for use in other purposes than their original ones, can be reintroduced into the circuit through recycling. Recycling involves a more in-depth processing at the fiber and/or substance level.

The recycling process is very specific to different types of substances, which is why it is crucial that materials are properly separated for different types of processing. A highly precise separation would be extremely complicated and impossible to assign to the population. Therefore, in municipal waste collection, a pre-selection is made based on major categories of materials:

— Paper and cardboard
— Plastics and metals
— Glass
— Bio-waste / compostable
— Residual
— Textile
— Electrical, electronics and household appliances
— Construction and demolition waste.

UAn effective recycling system involves the whole community and must ensure the collection, recycling, and reintroduction of recycled material into production to ensure the economic viability of the entire process.

A. An efficient **collection system** is the first step for efficient recycling, but also for adaptive reuse and upcycling on a large scale. The collection system includes:

— Creating a highly accessible infrastructure for selective collection accessible to all, with:
  - collection points in public places for passersby;
  - collection points in public places for residents, accessed via card or mobile app;
  - waste management centers operated by residents, NGOs, or social businesses;
  - Source separation systems (door-to-door);
  - Voluntary Contribution Centers (VCC) accessible for free via card or mobile app;
  - On-demand collection through a mobile app, similar to ride-sharing platforms, for special waste: batteries, CDW, furniture, etc. Some types of waste can be collected in prepaid boxes and sent with an AWB generated by the app. The system may include a reward scheme through raffles or other benefits.

Common collection systems should be planned from the urban design phase to be harmoniously integrated into the urban landscape. Sanitation services should predominantly operate at night, using silent, non-polluting equipment.

Commercial, industrial, and production areas require dedicated waste management spaces, equipped with minimal treatment equipment, such as compactors or press-containers, to reduce waste volume and optimize transport to recyclers.

In Oslo, there are three categories of voluntary collection centers: small, medium, and large. The size of the centers determines the types of products and materials collected and the quantity accepted. Residents bring various types of household-generated waste free of charge based on an identification number. Functional objects can also be brought and displayed in a second-hand area. Materials and items collected at these centers can be taken by other residents or partner organizations.

https://www.oslo.kommune.no/english/waste-and-recycling/recycling-stations/#toc-2

The International Business District in Songdo, South Korea, has developed a fully automated waste management system that uses IoT. Waste is evacuated from high-rise buildings through ducts to bins with sensors, which are connected to a network of pneumatic pipes that automatically sort the waste and transport it through underground tunnels to a collection station.

Source info: Training Materials for Implementing Smart Cities in Asia and the Pacific for Inclusive, Resilient, and Sustainable Societies 2022 - United Nations Centre for Regional Development (UNCRD)

FEPRA and Mobexpert have created a partnership whereby Mobexpert customers can deliver old furniture when purchasing new items, with the old furniture being collected and directed for refurbishment or recycling through FEPRA.

— stimulating buy-back initiatives;
— Efforts to educate and inform the public about proper selective collection through campaigns aimed at the general public, educational programs in schools, training programs in companies, institutions, and other organizations;
— Establishing incentives for proper and efficient selective collection, as well as penalties for non-compliance. The "pay-as-you-throw" system has been highly successful in cities like Zurich, but without complementary monitoring measures and strict sanctions for improper waste disposal, it may lead to increased pollution.

B. Efficiently distributed **recycling centers** designed functionally and efficiently, with adequate processing capacity and minimal environmental impact. It is recommended to integrate educational and demonstration facilities in recycling centers to strengthen public education and awareness campaigns through demonstrative visits and immersive experiencess.

C. **Reintroducing recycled material into production** by promoting the development of products made from recycled substances and adapting company production lines to use recycled raw materials. It is recommended to create spaces for meetings and dialogue among stakeholders who can close the loop of the circular economy, turning waste into raw material for new products.

"Plastic Road is a Dutch initiative for constructing roads using recycled plastic. It aims to reduce plastic waste, create more durable roads that are resistant to extreme weather conditions, and enable faster installation compared to traditional methods. Japan's national electronics recycling program has surpassed a 70% recycling rate, and precious and rare metals from electronic waste are successfully recovered. The program included holding producers accountable, a recycling fee built into the product cost, and an extensive infrastructure.

Composting is a natural process of recycling organic waste. In agriculture and landscaping, it has several beneficial effects:

- Loosens the soil and improves permeability, with better water retention.
- Increases biodiversity and the nutritional qualities of the soil, maintaining a balanced pH.
- Reduces dependency on chemical fertilizers.
- Applying compost as mulch helps conserve moisture and suppress weeds.
- Incorporating compost into degraded soils helps rehabilitate urban green spaces.

Composting can be done at the individual, community, or large-scale level, which is why many municipalities are developing policies to promote composting. These include:

- Incentives to implement composting systems.
- Regulations regarding the separate collection of organic waste.
- Certification programs for quality compost.

San Francisco promotes home composting, by providing free equipment and training for residents. The city has an 80% waste diversion rate.

Milan (Italy) has implemented large-scale separate collection of organic waste by distributing containers and biodegradable bags to each household, with frequent collection (twice a week) to reduce odors, and intensive education and awareness campaigns. Results: over 100 kg of organic waste per person per year collected, and a 20% reduction in residual waste.

Construction Sector

The collection system for non-hazardous construction should be developed and efficiently distributed across the territory. It is recommended to establish construction and demolition waste (CDW) collection centers:

- if there is no such collection center within of 15 km radius.
- if there is no transfer station within a 35 km radius that also handles waste from construction works.

This will encourage increased treatment capacity for operators operators involved in CDW management for recycling and reuse.

3.7 Recuperare

Products that cannot be directed to the options presented above (7R), can be recovered for energy production, a field that is continuously developing and innovating. Currently, the most commonly used technologies are:

- Incineration with energy recovery

  Amager Bakke (Copenhagen), also known as Copenhill, is a facility with a waste processing capacity of 400,000 tons/year, producing electricity for 50,000 households and heating 120,000. The construction has become a volumetric urban landmark and a social gathering point due to its 82-meter climbing wall and rooftop garden, which turns into a ski slope during the winter season.
- Anaerobic digestion and biogas production

  Sweden has developed 200 biogas plants across the country through a dedicated program. 65% of the biogas produced is used as fuel for vehicles. CO2 emissions are thus reduced by more than 500,000 tons/year.
- Pyrolysis and gasification

Construction Sector

Non-recyclable wood and plastic waste are used as alternative fuel in cement factories. This process focuses on the co-processing of waste in cement factories, with the benefits of reducing the use of fossil fuels, minimizing waste sent to landfills, and providing an economic solution for managing residual waste.

4 Emerging Trends and Technologies

Circularity requires integrated and systemic approaches. Local authorities can facilitate the creation of symbiotic ecosystems in partnership with with utility companies, private companies, universities, research institutions, etc.

Kalundborg Symbiosis (Denmark) is an example of a successful industrial ecosystem where a thermal power plant supplies residual steam to a refinery and a pharmaceutical factory, ash to cement production, and treated wastewater to industrial processes. Companies in the ecosystem have together reduced their CO2 emissions by 635,000 tons/year and achieved savings of approximately 24 million euros/year.

Eco-Industrial Park Händelö (Sweden) is a symbiotic industrial park with regional relevance. It integrates several industries that exchange resources and energy, significantly reducing CO2 emissions and resource consumption.

Emerging trends in waste management:

— Digitalization and automation of processes. Blockchain technology and smart contracts are being developed to increase waste traceability and transaction transparency between actors in the system. The concept of a digital product passport is under development at the European policy level and being tested in pilot projects by various companies. Blockchain-based recycling certification is expected to increase trust in the recycling system.
— Growing importance of the sharing economy and circular business models.
— Development of new biodegradable and compostable materials.
— Integration of circular design principles in education and professional practice

Emerging technologies and future prospects for waste management:

— Artificial Intelligence (AI)-based sorting technologies.
— Sludge and wastewater treatment technologies:
  — nanofiltration and reverse osmosis membranes to remove contaminants at the molecular level.
  — Ceramic membranes resistant to clogging for industrial wastewater treatment.
— Advanced materials and nanotechnologies for waste treatment and recovery;
— Technologies to capture and utilize carbon from waste;
— Innovations in renewable energy from waste

As a result, the transition to a circular economy presents both significant challenges and opportunities for innovation and development, based on collaborative, transdisciplinary approaches and the involvement of stakeholders.

5 Monitoring, Evaluation, and Reporting (MER)

The circular economy is a sustainable economic model that aims to keep materials and products in the economy for as long as possible through reuse, conversion, recycling, or recovery. The effectiveness of the transition measures toward a circular economy requires continuous monitoring and evaluation, starting from the baseline and in relation to the established objectives.

The European Eco-innovation Index is a way to assess and compare the performance of countries at the European level regarding resource efficiency, eco-innovation, and socio-economic outcomes. The chart below shows that, although Romania is on an upward trend in 2024 compared to the previous year, it is a country that requires more involvement to reach the European average in terms of eco-innovation performance evaluation. European Eco-innovation Index EIS interactive tool 2024 | Research and Innovation.

Companies and communities can create economic value in the transition to climate neutrality. This is demonstrated by numerous experiences of design innovation, cross-sector collaboration and connecting circular supply chains.

Continuous monitoring and evaluation are critical to adjusting, optimizing and strengthening these efforts. Measuring and transparently reporting the impact of these initiatives demonstrates the benefits of the circular economy and encourages widespread adoption of these practices. This requires:

— Defining key performance indicators (KPIs) for waste management;
— Implementation of data collection and analysis systems;
— Using IoT technologies for real-time monitoring - traceability;
— Transparent and accessible performance reporting.

Local administrations can promote circularity through public procurement that includes circularity performance criteria, assessed using standardized systems such as:

— Circulytics, a circularity assessment tool developed by the Ellen MacArthur Foundation. It includes aspects like circular design, sourcing, and resource recovery;
— The Global Reporting Initiative (GRI) provides standards for sustainability reporting, including aspects related to circular economy;
— Integrated Reporting `<IR>`: Encourages companies to report how they create long-term value, including through circular practices;
— ISO 59020 - measurement and evaluation of performance from a circularity perspective.

Impact assessment systems for communities' environmental performance are presented in detail in the **Digitization and Urban Data chapter**.

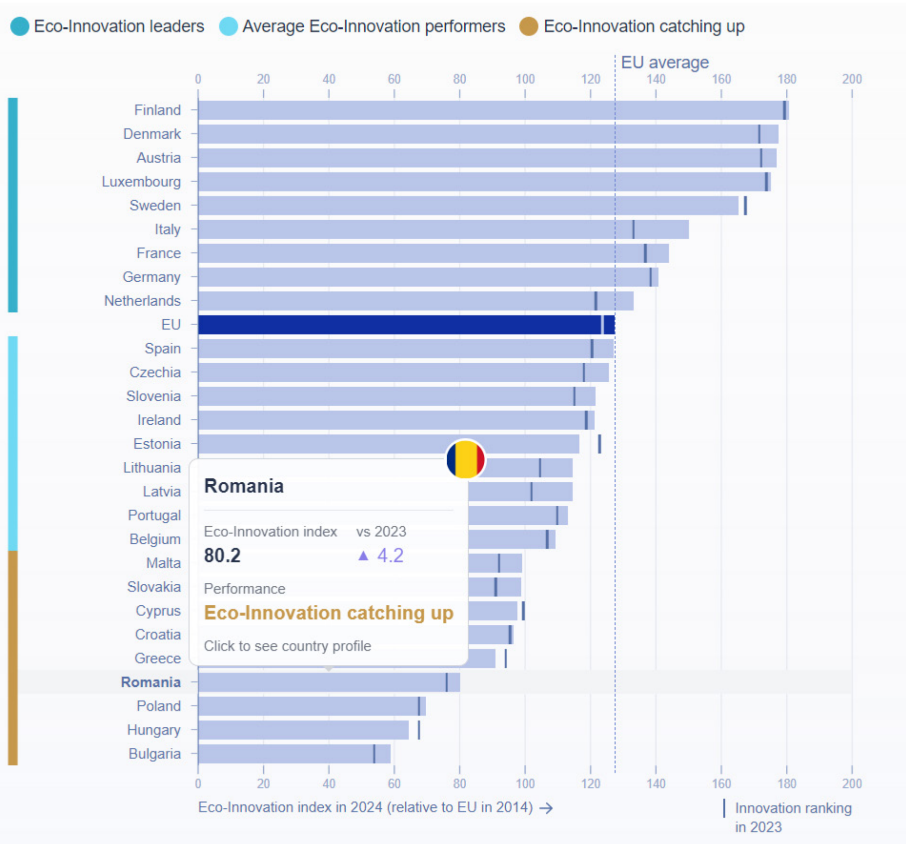

Fig. 8

Eco-Innovation Index 2024 raportat la 2014, Comisia Europeană

Construction Sector

Some international certifications for sustainable buildings and communities integrate circularity assessments. More details are available in the Built Environment chapter.

Monitoring and evaluating the performance of CDW management requires clear methodologies, specific techniques and digital tools to collect data, analyze progress and adjust strategies.

Methodologies for Measuring Outcomes
Proper monitoring of the total quantities generated, as well as the recycling rate in both public and private sectors, is crucial. Mapping material and waste flows allows for material optimization to reduce waste and helps improve waste traceability and regulatory compliance. In this way, reporting systems can be improved by implementing efficient data collection and reporting mechanisms for CDW waste generation and management. This ensures the accuracy of national and European statistics, which is essential in combating illegal practices.

Life Cycle Assessment (LCA)
The real environmental impact is reported over the entire life cycle for any material or product, including for construction materials. A series of studies assess this impact, considering resource consumption, energy requirements, and generated emissions, as well as CO2 storage capacity..

Digitizing Waste Traceability
Prevention and sanctioning measures for improper construction waste management can be applied and reinforced with the existence of a digital system for real-time waste flow monitoring, accessible to authorities and companies in the construction sector.

In terms of performance indicators to measure the progress and effectiveness of the measures implemented, they are grouped into 4 categories: **quantitative**, **qualitative**, **traceability** and **economic**.

Quantitative Indicators (measurable in tons or percentage)
- Recycling and reuse rate of waste (minimum 70% according to Directive 2008/98/EC).
- Total amount of waste generated (tons/year) - key indicator for prevention measures.
- Percentage of waste disposed of in landfills to be reduced through recycling and reuse
- Amount of recycled materials used in new construction (tons/year).

Qualitative Indicators (measure efficiency and impact of measures)
- Level of compliance with national and European legislation;
- Number of projects implementing selective demolition;
- Degree of awarness and training of the professional and operational personnel.

Traceability and Control Indicators
- Percentage of waste shipped by authorized operators with elimination of illegal practices
- Number of violations/fines imposed;
- Digitalizing waste traceability, by implementing an electronic system for monitoring waste flow.
- Establishment of adequate infrastructure, properly distributed:
  - Number of crushing installations for CDW ;
  - Number of CDW recycling stations, by material type;
  - Number of municipal landfills, whether owned by local authorities such as city halls or county councils, and operated either directly or through private company concession.
  - Number of centers for collecting non-hazardous construction waste for preparation for reintegration into the economic

circuit, such as bricks, tiles, wooden joinery, wood structures, stone, etc..

Economic Indicators (costs and financial benefits)
- Savings achieved through recycling and reuse (€/year), and increased use of recycled materials to reduce construction cost;
- Waste management cost per ton (€/ton), to encourage investment in sustainable solutions;
- Revenues from the sale of recycled materials (€/year), and regulation of an existing market that significantly underperforms its economic potential, encouraging companies to adopt circular economy models.

6 Recommendations for Public Policies

Vision for a Zero-Waste Society and a Fully Circular Economy

Beyond environmental benefits, the transition to a circular economy generates vast economic opportunities: new industries, new professions, emerging technologies, and an improved quality of life. The community's adoption of an ambitious vision in this regard accelerates the transition to climate neutrality and the manifestation of its benefits.

Amsterdam (The Netherlands) has set a vision for a fully circular economy city by 2050, establishing three priority action areas:
- Construction: Use of recycled materials and designing for disassembly.
- Biomass and food: Valorsation of organic waste and reduction of food waste.
- Consumer products: Promoting repair and reuse.

As part of this strategy, a number of initiatives have been developed, such as:
- De Ceuvel: a circular business park built on a decontaminated industrial site.
- Repair Cafe: Network of community workshops for repairing objects.

Integrated and Systemic Approach

The effective approach to waste management and the circular economy can only be systemic, transdisciplinary, and trans-sectoral. It involves understanding the root causes of issues and their effects, identifying stakeholders, values, and societal rules, behaviors and mentalities, and the benefits that maintain the current state and hinder change. Setting a new vision involves reframing these values, rules, behaviors, and mentalities, identifying and promoting new benefits, partnering with those who share the vision, and taking responsibility for promoting and implementing it.

Isolated actions have little value and impact.

Stakeholder Involvement and Public-Private Partnerships

Addressing waste management and the circular economy effectively requires the identification and participation of all stakeholders.

Changing mindsets, engaging the community, and governance models for stakeholder involvement are covered extensively in the **Participatory Governance** chapter, while public-private partnership are covered in the **Administrative Tools** chapter.

Specifically, large events such as music and film festivals are valuable opportunities for educating and raising awareness among the public in an enjoyable manner. There are significant experiences in Romania in this regard, involving various forms of art, interactive activities (creative workshops, games, and informative screens), monitoring and displaying real-time results to visualize immediate impact, celebrating outcomes, and offering prizes.

Funding Waste Management and Circular Economy Projects

- Green bonds issued by municipalities to finance green infrastructure projects;
- Economic incentives for emerging and/or performing circular economy projects;
- Crowdfunding through online platforms to finance community circularity projects;
- Public-Private Partnerships (PPP) for the development and operation of waste management systems.
- Participatory budgeting.

Circular and Zero-Waste Public Procurement
It is recommended to request technical specifications regarding performance standards for sustainability, reuse, repair, recycling, and recovery. More on the subject of green public procurement can be found in the **Administrative tools** chapter.

Digitization and Transparency
Product traceability, the transparency of their journey, and transactions can be ensured through the integration of blockchain technology. Reporting results in this way improves the process and increases citizens' trust in the collection and recovery system, stimulating the reinforcement of individual efforts and community-level initiatives for the long-term adoption of new behaviors.

Construction Sector

Dedicated Criteria for Investment in Construction - Public Procurement
During procurement procedures, technical specifications will be requested to comply with performance standards for sustainability, repair, and recycling. Methodologies for sorting, collecting, pre-treatment, processing, preparation for reuse, recycling, and recovery of waste from construction works can also be requested and appropriately scored.

These operations are carried out at the location where the construction and demolition waste (CDW) is generated and are primarily used for construction and finishing activities on-site or in a recycling/recovery unit for interventions on public buildings or projects funded through public investments, in accordance with Government Decision 907/2016.

Procurement procedures may integrate specifications and selection criteria that target the capacity of renewable energy production equipment (photovoltaic systems, heat pumps) to limit waste generation, as well as their potential for recycling and repair, noise reduction measures, dust control, and pollutant emissions during construction or maintenance works.

Accountability for Private Investments
For private investments, in order to issue Demolition and Construction Permits, Local Public Authorities (LPA) may require appropriate scoring of the criteria mentioned earlier for public procurement.

Implementation of a Financial Guarantee
A financial guarantee will be established to cover the costs of managing waste from construction works, which will be refunded after the completion of the works, according to the completion certificate.

Information and Promotion
Information and promotion campaigns regarding the proper management of construction waste should ensure that residents are informed through appropriate means about the waste management system for construction waste within localities, alongside other legal obligations and responsibilities.

The transition to climate-neutral cities requires a concerted effort from all involved actors. By adopting sustainable practices and utilizing technology, we can build a future where cities are cleaner, healthier, and more resilient to climate change.

Useful Additional Resources - International Best Practices

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Mirror Mission
Cities Hub Romania

Possible Cities

Integrated toolkit
for climate neutrality

Urban planning

Effective spatial planning — metropolitan coordination
Operational tools

Claudia Pamfil
Eugen Pănescu
Bjarne Uldal

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Urban planning

Effective spatial planning — metropolitan coordination. Operational tools

Contents

1. Urban planning

1.1 The importance of planning

The sectoral targets aimed at reducing emissions and transitioning cities to become climate neutral cannot be achieved on an ad hoc basis, but only through a careful planning process. More so as all these efforts are about using resources wisely and reducing waste and inefficiency, a continuous process of reviewing developments, assessing the extent to which set targets are being met, adjusting decisions and (re)phasing measures to keep progress on track is needed. Many of the objectives are interrelated and can be addressed through coordinated measures, so planning is more necessary to identify synergies and streamline the effort.

A paradigm shift towards a planning and governance framework more conducive to the design and implementation of urban policies for sustainable development has been needed for some time, and cities have been working towards this. With even more challenges stemming from climate change, but also from poverty, social segregation, ageing and growing vulnerable groups, as well as from the deteriorating state of infrastructure and old housing stock, priorities for action need to be well chosen based on a comparison of feasible alternatives in terms of institutional and financial capacity. For active and successful management of these situations, planning needs to complement 'classic' methods with agile management tools, using methods for simultaneously calculating the economic, social and environmental effects of planning. The dynamism of planning supplemented in this way will not only enable a more precise and rapid response to the increased challenges, but also the ability of local administrations to negotiate in an informed way with private development, whose interests will not align as quickly with the expected level of responsibility.

Urban planning aligns strategic objectives with financing and implementation mechanisms at the territorial and organizational levels. To ensure the balanced development and transformation of cities on the Green Transition, local public authorities establish goals, tasks and responsibilities in advance through participatory and iterative planning processes. Based, on the one hand, on the analysis of what has already happened, which requires a monitoring system and capacity, and, on the other hand, on the forecasting of future trends, resources and impacts, planning processes are continuous and combine technical and scientific aspects with community needs and ambitions.

Beyond providing a coherent framework for decision-making and more efficient use of resources, planning processes can, if effectively managed in all aspects by local authorities, also bring intrinsic benefits in terms of administrative capacity development[1]: obtaining information in a systematic way on economic, social and territorial dynamics, on the interests of different actors, clarifying the direction of the outlook and setting priorities for action, increased accountability and higher organizational performance, efficiency in fulfilling roles, improved cooperation and teamwork, and increased competence of the persons in the specialist services involved and of local elected representatives. The chapter 'Administrative tools' details these types of tools.

Irrespective of the type or scope of planning, be it economic, spatial, sectoral, climate change mitigation and adaptation, disaster preparedness, organizational, etc., all processes and instruments ultimately aim to make the best long-term decisions, so it is recommended that actions and measures result from a strategic, transparent and objective approach.

1

Adapted from Bryson, J., M., 2002, Strategic planning for public and non-profit organizations, Ed. Mast, 2002.

1.2 Planning levels, linkages and reflecting the transition to climate neutrality

The range of plans that provide the process of urban and territorial administration varies from comprehensive and integrated strategic development plans to local regulations and operational procedures. Although these plans do not follow a clearly imposed hierarchical order in terms of chronology and subordination, they are ordered according to the perspective addressed (strategic, programmatic/tactical or operational) and the size of the geographical space they can influence.

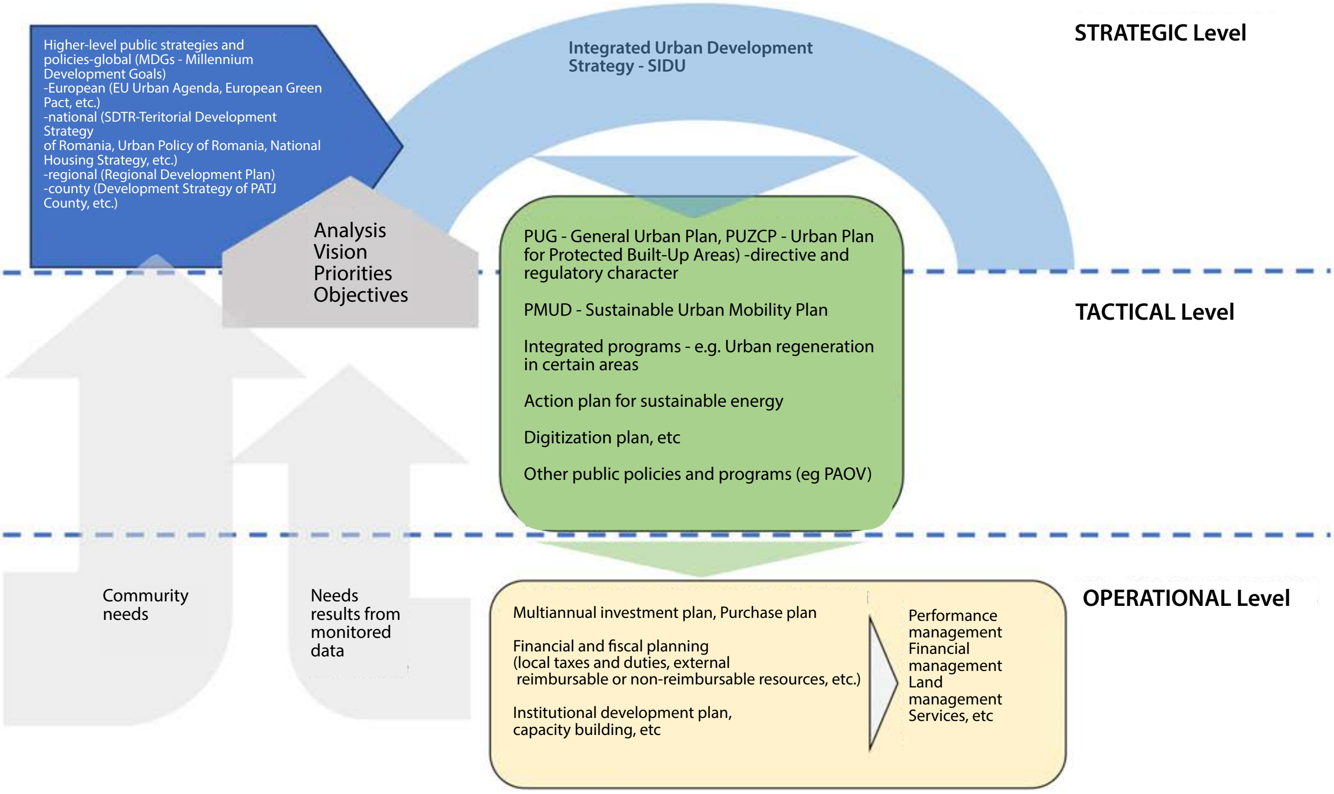

Fig. 1

Simplified scheme of levels and relationships between planning documents, source author

National, zonal and county spatial planning plans have a strategic perspective that aims to translate integrated sectoral priorities established at that level through consultative processes (through national, regional policies or sectoral strategies) into the territory. The General Urban Plan has both a development steering and regulatory role, establishing operational and building rules for coordinating urban development, sometimes detailed in Zonal and Detailed Urban Plans. In theory, these urban development plans should territorially implement local development strategies, which in turn would (also) reflect higher level strategic documents and sectoral strategies.

It is important to recognize the elements that make spatial planning not always effective and do not always produce the expected impact[2]:

— In many strategic and urban plans there is a lack of linkage between vision (what the plan envisages as the ideal future), objectives and actions (how the vision will be achieved), and their linkage to available resources
— Urban development plans do not cover the entire territory they aim to influence or impact - the legal application of urban development plans is limited to the TAU although urban expansion often manifests itself beyond administrative boundaries in

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As analyzed by the Romanian Urban Policy: https://www.mdlpa.ro/pages/elaborarepoliticiurbanesipoca711 peri-urban areas, and urban development plans initiated by the private sector are often limited to the initiator's plot although they induce changes that need to be dealt with on a larger scale, both in terms of public facilities and circulation, and in terms of coherence;

— Private developers can strongly influence urban developments, which requires local governments to play an important role in balancing private and public interests and to maintain a focus on the long-term investment horizon of infrastructure and public facilities when short-term gains are more visible and risk producing imbalances

— Public information and consultation processes required by legal procedures are usually delegated to private providers of strategic or urban planning services and often do not involve citizens in a meaningful way.

To fit planning objectives and measures related to climate change mitigation and adaptation and the transition to climate neutrality into existing planning processes and documents, or to strengthen them by (re)estimating the impacts of proposals and setting more precise targets and measures, it is necessary to analyse and assess existing plans and the linkages between them. Through such analysis, possible shortcomings in the planning documents can be identified, such as:

— provisions with a high degree of irrelevance because they were drafted a long time ago or because they were designed exclusively by external experts and were based on mechanical assessments without being adapted to local conditions;

— discretionary/random forecasts, which were not based on evidence (documented data, developments and trends, forecasts, studied phenomena and needs);

— contradictory provisions or inconsistent measures;

— unambitious provisions on the transition to climate neutrality.

Reflecting the urgency and scale of the challenges, planning for climate action should be rigorous and more ambitious than only a few years ago, also considering the very important proportion that cities need to contribute to the global emission reduction target and national commitments. Also, given that recent information now shows much clearer changes in weather patterns leading to unprecedented extreme events, urban planning needs to prepare cities for the impacts of such changes through mitigation or resilience-building measures. Keeping in place measures that ignore these emergencies or are too ineffective is therefore extremely dangerous.

It is also imperative that climate action is linked to planning tools, both for direct effects and to increase the integration of the understanding of how cities work, with benefits for all categories involved in these processes: administrative, political, community, technical and educational.

This analysis should not be limited only to strategic documents or urban development plans with their related regulations, but also to some procedures and rules that may be inconsistent with the objectives of the transition to climate neutrality, for example outdated parking regulations that instead of discouraging the use of the car to the destination and providing a maximum number of parking spaces that cannot be exceeded, stipulate the obligation to provide at least a (too generous) number of parking spaces (depending on the built area). These local adaptation instruments are already being used successfully not only abroad but also in Romania.

In support of decreasing the inertia for change in the administration, some unwritten rules embedded in the tradition of some departments should be identified that could prevent the implementation of climate transition measures, either inflexible approaches to exemptions or incentives, fear of strictly enforcing some provisions in planning documents or a preference to avoid estimating (or requiring the estimation of) the impacts of proposals, or attitudes that would make it difficult to monitor progress transparently.

In analysing the extent to which local planning or policy documents respond to the need for climate action, it will probably be necessary to focus initially on only a small number of measures, due to limited resources and urgency. In this case it should be kept in mind that emissions can be mitigated in three fundamental ways: efficiency improvements, technological innovations and demand mitigation solutions[3]. While all three pathways offer potential reductions in energy consumption, **demand mitigation** solutions allow for immediate reductions without the need to wait for the deployment or development of new technologies.

Therefore, to identify what needs to be corrected or improved, answers to questions such as:

— Do spatial plans at territorial level apply the integrated development strategy?
— Do the urban development plans and sectoral programs/plans (air quality, waste management, energy efficiency, as appropriate) respond to the objectives and measures set out in the National Integrated Urban Development Strategy for Resilient, Green, Inclusive and Competitive Cities 2022-2035 - Romania's Urban Policy?
— Does the actual planning set ensure coordination at metropolitan scale, functional area or relevant territorial areas (e.g. river basins)?
— Do urban plans:
    — promote lower emissions, by reducing demand for the use of high-emission vehicles?
    — contain measures/regulations limiting urban sprawl?
    — encourage adaptive re-use of existing built-up areas at the expense of vacant land?
    — promote a compact and energy-efficient urban structure while reducing traffic demand?
    — promote the creation/expansion of blue-green infrastructure and nature-based solutions?
    — restrict building in at-risk areas?
    — identify climate vulnerabilities and contain mitigation measures?
    — set out requirements and measures for efficient water and wastewater management (to cope with or mitigate the risks of floods, droughts and heat waves)?
    — regulate the protection and restoration of permeable areas/soils and the maintenance or restoration of urban ecosystem functions?
    — demarcate urban regeneration and restructuring areas and formulates the program themes for these plans?
— Are urban development plans permanently accompanied by detailed action plans, with responsibilities and resources allocated according to the specificities of the local government and community partners?
— Did the implementation of the plans lead to the achievement of the desired effects and objectives? How do we measure this?

1.2.1 Steps for building effective spatial planning

Planning provides the framework for decision-making by forecasting future resources and planning their use. This framework needs to be predictable, coordinated and coherent. Given the "global" nature of spatial planning and the "integrative" nature of urban planning, there is a clear need for coordination between the decision-making sectors that have an impact on the territory, so that decisions are in line with the community's objectives and ambitions and make the most efficient use of resources.

Recommendations on creating a conducive planning framework:

a) Design long-term and medium-term strategies with common objectives of general interest:
— Link spatial planning with development strategies in order to apply strategic visions to land management through achievable objectives; urban development plans should be based on a clear

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Creutzig, F. & Roy, J. Towards demand-side solutions for mitigating climate change., 2024: https://iopscience.iop.org/article/10.1088/1748-9326/ad33d3/pdf development strategy and, in order to allow synergies and effective coordination, they should be developed or updated almost simultaneously, in the following close sequence: local development strategy (integrated, sustainable) - mobility strategy, energy efficiency strategy, climate change mitigation and adaptation strategy (other sectoral plans) - UDP including spatial development strategy, zoning and land use regulation;

— Make plans easily accessible and understandable, with clear delineation of roles and responsibilities in implementation;

— develop flexible but predictable plans so that they can adapt to new circumstances and respond to changing dynamics without wasting resources and therefore avoid the proliferation of a multitude of strategies and plans;

— Plan land use and physical development in close correlation and coordination with other departments and areas (environment, transportation, investment, social welfare, culture, etc);

— Establish action plans (related to urban planning documents and climate policies) and projects based on realistic (and cautious) resource estimates and through a complementarity of local funds (including new sources, state budget and non-reimbursable funds) to promote strategic priorities.

b) Elaboration of sectoral policies and urban plans at appropriate territorial scales:

— Increase in-house technical capacity (through training programs and exchange of experience) in conducting territorial analyses and cooperation between departments (investment, programs, finance, communication) and with neighbouring TAOs;

— ensure the relevance of plans at an appropriate scale and set them within an appropriate and realistic timeframe;

— Establish partnerships between neighbouring administrative units to collaborate, set common objectives and coordinate the planning of joint efforts and actions, so that the UDP (territorial development strategy, zoning, urban planning regulation and action plan) is based on sound metropolitan-scale analysis and forecasts and implements the peri-urban/metropolitan zonal territorial development strategy and national urban policy objectives;

c) Background studies and research to support zoning proposals, regulations (land use and permit conditions) and actions:

— ensure the updating and access (all internal departments, but also investors and their specialists) to an urban database, including cadastral and GIS data, thus enabling continuous territorial analysis and a more strategic use of unused, under-utilized, polluted, etc. plots, utilities, green infrastructure, etc;

— ensure that baseline studies do not duplicate those carried out for higher level documents or strategies, but complement them with specific prospective and consultative analyses, bringing appropriate correlations and territorial perspectives, providing a range of alternative proposals that can be debated to choose the optimal one based on the estimated impacts;

d) Ownership of plans by decision-makers through a framework of dialog and accountability, involving citizens, the private sector and elected councillors in the analysis of long-term opportunities and impacts:

— Create procedures and habits for practicing transparency, encouraging community information and consultation, taking into account the needs of different stakeholders, and promoting the broader public interest in a process informed by data, analysis and continuous dialog;

— Make open data available to the public, including spatial data, strategic documents and commissioned studies, zoning and land-use regulations, building permits, investments, public procurement, budgets, and supplement this information with explanatory brochures that present the information in a way that is easy for citizens to understand;

— Require adequate reasoning for any proposal, analyse alternatives and ex-ante impact assessments with the provision of this information to citizens and incorporate their views; for example, treat proposals for initiating PUZs by the private sector in a transparent way, allowing the public to easily understand how the proposals have evolved, how decisions have been made and allow for proper appeal procedures to be carried out as early as possible in the process;

— Provide regular feedback to stakeholders in a consistent and transparent way, explain whether decisions have been made through necessary trade-offs based on evidence, and use any opportunities for consultation to build trust.

e) Develop digital tools for checking and negotiating design themes and final design and development and urban design project routes and variants. These tools already exist and could become a widespread good practice within the administration and technical verification commissions, but especially for project promoters, to understand the correlation between desires and climate impacts, but also to understand and present quality elements to future users and public opinion in the processes of public participation and consultation in urban development.

2 Metropolitan coordination

Among the most impactful changes for urban planning in recent decades is the growth of the area in which people live their lives, with communities of work and interest (culture, health, education), networks of friends, customers and suppliers, shops, leisure facilities, etc. that extend far beyond the administrative boundaries of the locality of residence. More recently, technology has brought about changes in work and living behaviours, and the period of the pandemic[4], the various digital platforms enabling remote working and home search[5], and the growing concern for work-life balance[6] have accentuated trends towards flexible working, with implications for urban planning.

Economic change has also meant that goods production has been replaced by knowledge- and service-based sectors which, relying mainly on access to skilled labour, have a polarizing effect. These sectors tend to cluster in specialized centres with strong links and complementary relationships within natural economic zones. Thus, the scale at which economic exchange and living patterns currently operate corresponds to the catchment areas of large service centres, major hospitals, leisure facilities or higher education institutions, depending also on the physical structure of the wider natural area and cultural specificities. The development of cities (polarizing centres) depends on attracting and retaining well-educated people, and this depends on providing a high-quality living and working environment. Thus, economic relations and flows of goods and people do not stop at the administrative boundary, they do not follow the 'lines' of local authority boundaries on a map. Territorial administrative units are not isolated entities, but parts of wider territories where economic and social interdependencies relevant to housing, services and mobility are manifested and need to be reflected in the planning and governance structure.

Comparative studies of cities in Romania and Europe have been able to reveal both local dysfunctions and the potential for development, which is much higher in situations where metropolitan coordination is a common practice and uses technical and political-administrative management tools with quantifiable socio-economic effects, such as *Project Fusilli* developed with the support of the World Bank[7].

In the last decade in Romania, the population in the first ring around the county municipalities has increased by 20.8%, at the same time as the demographic decline of urban centres[8]. The fact that the built footprint of Romanian localities has increased by about 719.1 km2, of which 39% within cities and 67% in their first peri-urban ring[9], indicates the presence

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https://ec.europa.eu/eurostat/databrowser/view/lfsa_ehomp__custom_12158505/

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https://www.cidob.org/en/publications/housing-digital-age-trends-and-implications

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7

https://urbanizehub.com/wp-content/uploads/2023/12/Project-Fusilli-A-simple-recipe-for-clever-metropolitan-planning.pdf

8

2009-2019 data presented by Romania's Urban Policy

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according to the Corine Land Cover data for the period 2006 - 2018, cited by MDLPA in the explanatory memorandum to the draft law on metropolitan areas, 2022 of the phenomenon of uncontrolled urban sprawl, manifested mainly around dynamic urban cities.

> „Forms of sprawl often come at odds with the principles of sustainable, compact and well-connected development, with a **lack of pro-active planning and coordination at the metropolitan level leading to a disconnect between housing, employment, major services and recreational areas**. Development on the outskirts of cities is often fragmented and mono-functional, with the planning process neglecting the planning of the built and social infrastructure necessary for quality housing and service with neighbourhood amenities within the community. The metropolitan approach in expanding urban areas requires the territorial coordination of spatial planning, mobility, technical and social infrastructure and public services to ensure sustainable development, reduce excessive land consumption but also to increase the quality of life in all areas of development, requiring also an integrated financial effort, or dedicated funding lines for these peri-urban areas."[10]

Although there are valuable and even pioneering experiences with associative structures dedicated to integrated inter-community development in the cities participating in the M100 approach, recent analyses presented at[11] have shown that in Romania metropolitan cooperation is still rather insufficiently promoted and mandated from the central level through incentives and implementation mechanisms, including operational mechanisms for land transfer and new plotting, but that there is great potential for planning and policy integration and budgeting at the metropolitan scale. And until such additional measures are introduced in central level provisions, the partnership approach in metropolitan areas can be emphasized by harnessing the complementarity of administrative units and integrated (re)planning at this scale to streamline emission reduction and climate neutrality efforts. It is expected that the understanding of the overarching purpose will generate the necessary political support at the level of the metropolitan administrations.

The administrative-territorial units in a metropolitan territory or functional urban area already collaborate through various institutional arrangements (inter-community development associations, including administrative consortia) or specific contractual partnerships for a particular program or public service, but it has proven necessary to plan strategically and territorially at this scale through highly qualified, multidisciplinary professional capacity (urban planners, urban economics specialists, mobility specialists, sociologists, landscape architects, utility and environmental systems engineers, hydrology specialists, documentalists, geographers, geographers, lawyers, database GIS and modelling specialists, communication specialists, etc.) to also develop and maintain integrated information systems, monitoring indicators and territorial analysis (baseline studies for urban plans and policies), forums for dialogue and public-private partnerships for complex urban operations - i.e. metropolitan urban planning agencies. The creation of such agencies can facilitate a coherent, faster and more efficient decision-making process and ensure the right conditions (financial and avoiding political instability or interference) to attract specialists[12].

2.1 Recommended measures / How?

In the context of rapid urbanization and population growth in peri-urban areas, as well as economic change and the flexibilization of work, and bearing in mind that urban centres and their areas of influence are not only economic drivers but also major consumers of natural resources and carbon emitters, it is necessary to **synchronize urban development strategies, spatial development plans** and **general**

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Explanatory memorandum to the draft law on metropolitan areas, 2022

11

Metrex Conference, Bucharest, October 23-25, 2024: https://www.eurometrex.org/events/metrex-autumn-conference/

12

See also chapter Administrative tools

urban development plans at metropolitan (or urban functional area) level, and to link up the subsequent sectoral plans (PMUD, PAASC, PICA, PAED, etc.)

It is recommended that metropolitan-wide synchronization should promote as priorities areas that are visibly beneficial and relatively easy to sustain at the metropolitan level, such as:

— integrated water resources management to cope with water scarcity and droughts by encouraging increased use of reclaimed water and alternative sources (industrial, agricultural and residential) and by making consumption more efficient;
— effective drainage infrastructure, wetland protection and urban cooling systems to reduce the risks of flooding and extreme temperatures;
— creating or developing green space infrastructure and interconnected ecological corridors;
— Integrated mobility and metropolitan transportation system;
— waste management and the circular economy
— re-industrialization, especially in strategic areas;
— integrated and efficient regional energy system (e.g. joint photovoltaic parks and smart grids);
— coordination of public health services
— efficient land use and frugal consumption of land ("no net land take until 2050"[13]), in correlation with the provision of affordable housing and public facilities;
— social inclusion and poverty reduction
— crisis preparedness, response and management.

Through an assessment made by an inter-jurisdictional and multidisciplinary group on a metropolitan scale (representatives of local monitoring committees, joint technical commissions), the following aspects need to be checked and corrected:

— the existence of objectives that are too fragmented and leave gaps, so that other important metropolitan-scale development objectives are missing;
— targets (values of indicators proposed to be achieved) incomplete or partial in relation to the ambition of the objectives at metropolitan (sometimes also at TAU) scale, imprecise or without establishing a process for achievement - identification of difficulties associated with the measurement and ownership of data/indicators and the extent to which indicators fail to capture some essential elements of the achievement of objectives (see chapter on data analysis);
— imposing unnecessary burdens on localities that are unrealistic, with short and long-term objectives that are not aligned in the same direction;
— uncoordinated decisions and procedures, including fiscal decisions and procedures, which do not support or even contradict metropolitan-scale objectives (e.g. peri-urban local governments setting lower property taxes, cancelling out the effect of fiscal instruments used in the urban pole);
— projects that have been planned or are already being implemented without taking into account the (wider) territorial pool of beneficiaries and economy of scale;
— the lack or insufficiency of organizational, legal and/or financial measures to ensure the implementation of metropolitan approaches.

They are recommended as follows:

— Improving monitoring at metropolitan level by updating the composition of the monitoring and evaluation body to include representatives of the various categories of stakeholders and social groups, establishing regular monitoring sessions and even updating the monitoring committee's functions and working and reporting procedures;
— The availability of good quality data on a metropolitan scale is necessary for the use of specific indicators that monitor progress

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According to the measures related to the territorial sustainability objective of the Romanian Urban Policy: https://www.mdlpa.ro/pages/elaborarepoliticiurbanesipoca711

towards targets and objectives through metropolitan, regional (and national) information systems;
- strengthening a monitoring and evaluation platform of the process at metropolitan scale, which will also promote collective reflection of all stakeholders;
- accompany the medium- and long-term strategic plans (SIDU, PATJ, PUG) by a single and continuously (adjusted) metropolitan action plan, with concrete actions for one year and indicative actions for the next three years, with annual reporting, evaluation and adjustment (made public);
- drawing up, debating and adopting decisions and subsequent acts necessary for the implementation of programmes or projects on a metropolitan scale - establishing tasks, organizational procedures, legal and/or financial measures;
- The resumption of foresight activities (e.g. horizon scanning and scenario exercises) could be integrated into the administration's routine in order to keep long-term challenges visibly on the agenda;
- specific instruments to stimulate private sector and civil society actors to contribute to transition processes by taking initiatives, innovating their services and products and establishing innovative partnerships.

2.2 Success stories of metropolitan collaboration

The Paris Metropolitan Area (Île-de-France) has implemented an **integrated public transport plan**, which includes buses, trams and metro, interconnected between cities and towns throughout the region. The transport authority (Île-de-France Mobilités) is working with municipalities to develop routes and infrastructure to ensure seamless mobility between cities, reducing congestion and promoting public transport instead of private cars.

Metropolitan Toronto, where local authorities have developed **a common strategy for planning sustainable urban development**. This includes common regulations on land use, protecting the environment and ensuring housing affordability for all income groups. Urban regeneration projects are coordinated to avoid chaotic development, and energy efficiency initiatives are implemented uniformly across the metropolitan area.

The Stockholm region has created a **common energy system** for the whole region, integrating renewable energy sources and promoting energy efficiency.

The Barcelona Metropolitan Area has developed a **system of ecological corridors**, interconnecting the city's parks and green areas with the surrounding localities to enhance biodiversity and reduce air pollution. Projects to rehabilitate former industrial sites or unused areas have been developed in a collaborative way, ensuring that ecological and recreational benefits extend beyond Barcelona's administrative boundaries throughout the metropolitan region.

The Vienna Metropolitan Area has implemented an **integrated waste collection system**, including recycling and composting programs, which are coordinated at regional level.

In the London Metropolitan Region, integrated planning is reflected in **shared infrastructure projects** such as **Crossrail**, a rail system that connects different parts of the region, including business, housing and suburban neighborhoods. Spatial planning has also been designed to ensure a balance between new housing development and the protection of green spaces, creating a balanced long-term urban development.

Copenhagen, Denmark, in collaboration with neighboring municipalities developed and implemented the Cloudburst Management Plan[14] after being taken by surprise by the so-called "thousand-year storm" in 2011. The plan consisted of 300 **green and gray infrastructure projects** over a 20-year period, ranging from tunnels that channel rainwater to wastewater treatment plants, "*blue-green*" streets and squares, and permeable pavements that allow rainwater to seep directly into the ground.

The Milan metropolitan area has implemented the SISTEMA program, focused on **integrated flood and stormwater risk management** through the construction of retention basins to reduce flows to the urban sewerage network. the development of a digital monitoring system to predict heavy rainfall and manage water flows. the integration of nature-based solutions on the rehabilitation of small rivers around the city.

In many European metropolitan areas, local governments are working together to harmonize land-use regulations so that development is coherent across the metropolitan area:

— **The Berlin-Brandenburg Metropolitan Region** has a **common zoning plan** that allows for the development of suburban territory in a way that supports population growth and real estate market expansion, but without compromising natural resources and environmental quality.

— **The Hamburg Metropolitan Region** (Metropolregion Hamburg), comprising the city of Hamburg and 20 districts in three Länder (Hamburg, Schleswig-Holstein and Lower Saxony) has created **a common framework for spatial planning** regulating land use, economic development and environmental protection, common land use plans to prevent urban sprawl, protect sensitive natural areas and promote the development of coordinated secondary urban centers to avoid congestion in Hamburg and to stimulate balanced development throughout the metropolitan region.

— **The Greater Manchester Combined Authority** (UK), the joint governance body of the Greater Manchester metropolitan area made up of 10 local authorities, developed a joint strategic plan called the **Greater Manchester Spatial Framework** in 2016. This plan was then revised from 2016-2022 and came into effect in March 2024 called "**Places for Everyone**", which includes land allocation for housing, infrastructure and other development, common land use regulations and uniform rules for green space protection and urban regeneration.

— **The Lyon Metropolitan Area (France)** (Métropole de Lyon), one of the most advanced forms of metropolitan governance in France, includes 59 municipalities and functions as a unified entity to manage urban development and zoning. Métropole de Lyon has aimed for compact urban development that reduces land consumption and carbon emissions by developing a **Local Urban Development and Habitat Plan (PLU-H)**, which harmonizes zoning regulations for all municipalities in the region, integrates urban mobility policies with spatial planning to efficiently connect peri-urban areas with the urban center, and protects ecological corridors by setting clear limits on urban sprawl. PLU-H is available at three complementary territorial levels:
    — Metropolitan level, which is the strategic framework for urban agglomeration.
    — the scale of the nine river basins, an inter-municipal scale between the metropolitan area and each commune, which makes it possible to articulate the general strategy with the finer scale of local development;

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https://interlace-hub.com/cloudburst-management-plan-copenhagen

— the scale of each of Lyon's 59 communes and 9 boroughs, which is the relevant scale for quality of life, and which is responsible for fine-scale urban planning choices.

3 Planning as an integrating environment

Opportunities for action towards climate neutrality involve integrating strategies to reduce greenhouse gas emissions, mitigate and be resilient to climate change and support sustainable and inclusive development in an integrated manner into land-use planning by promoting the following:

- **compact cities and neighborhoods:**
  - Transit-Oriented Development (TOD) - planning high-density housing and commercial areas near public transportation nodes to reduce automobile dependence and emissions;
  - Encouraging development in built-up areas - adaptive reuse of existing buildings, conversion of brownfield sites to minimize land consumption, restructuring of areas with low quality of life and a tendency towards social segregation or ghettoization;
  - Mixed-use zoning - reducing commuting distances by encouraging developments where housing, businesses and public facilities are integrated, creating neighbourhood centres, ensuring equitable distribution of schools;
  - reconsidering the location of shopping centres adjacent to intermodal nodes, discouraging the location of large supermarkets or hypermarkets (with their associated extensive parking areas) in central areas and neighbourhoods
  - Priority for pedestrian streets and cycle lanes to promote low-carbon mobility;
- **Sustainable mobility and public transport:**
  - Prioritizing public transport - expanding surface transit, subway and light rail systems and providing intermodal hubs and regulations that encourage development near stations to reduce the use of private cars and encourage the use of public transport;
  - active mobility infrastructure - a coherent and extensive network of cycle lanes, pedestrian-friendly streets and low-emission (car-free) zones; a modal shift from cars to active travel or public transport has the potential to reduce energy demand considerably, cost-effectively achieving emission reductions in the short term[15], bringing also benefits in terms of reduced air pollution, more space for public spaces, cycle and pedestrian paths, parks or planted areas;
  - electrification of transport - electric vehicle charging networks and promotion of zero-emission vehicles.
  - optimizing logistics - supporting sustainable freight transport, last-mile delivery hubs and low-emission zones.
- **Blue-green infrastructure and nature-based solutions:**
  - Urban green networked green spaces - expanding parks, connecting parks with green trails, tree canopies, planted squares and permeable public spaces, encouraging green roofs, etc to absorb CO_2, reduce urban heat islands and improve air quality;
  - Ensuring the distribution and characteristics of areas planted with trees in the vicinity of dwellings, according to the 3-30-300 rule[16];
  - Rivers, wetlands and riparian buffers - protecting and restoring wetlands to enhance flood resilience and carbon sequestration; maintaining or restoring, where appropriate, urban ecosystem functions (rivers, floodplains, forests and surrounding wetlands) that can support biodiversity and connect diverse habitats across the city;

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Brand, C. et al, The climate change mitigation effects of daily active travel in cities, 2021: https://ora.ox.ac.uk/objects/uuid:ca8015aa-75d1-4dd6-b28c-5729b402b7f4/files/rkp78gg91d

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the 3-30-300 rule, proposed by Cecil Konijnendijk, co-director of the Nature Based Solutions Institute: and already applied in many cities: every citizen should be able to see at least three mature trees from their home, have a 30% tree canopy cover/canopy cover in their neighborhood and live no more than 300m from a park. https://nbsi.eu/the-3-30-300-rule/

— Reforestation and afforestation, including urban forests - establishing conservation easements and protected areas to prevent deforestation and habitat loss, expanding forests and creating urban forests to sequester carbon, lower temperatures and improve biodiversity;

— **zoning and regulations:**
  — restricting development in high-risk areas - preventing construction in flood-prone areas and areas prone to vegetation fires;
  — Cool and permeable surfaces - encouraging urban vegetation and permeable pavements and reflective roofs, for heat stress mitigation and stormwater management - with the establishment of indicators/benchmarks (which may also form the basis for differentiated charges or financial incentives for projects that reduce the impact on sewerage networks through the use of green infrastructure);
  — NzeB/ZeB climate-resilient building standards - a requirement to use energy-efficient and low-carbon materials, natural ventilation and lighting systems, and passive design to increase resilience and reduce emissions;
  — retrofitting existing buildings - stimulating deep energy renovations.

— **water management:**
  — integrated water resources management - ensuring sustainable use of water resources by incorporating climate projections into planning;
  — integrating stormwater retention and reuse systems - planning and regulating separate (extensions of) stormwater networks that can be directed to infiltration solutions, green infrastructure, rain gardens or water bodies without passing through treatment plants, reducing pollution and drinking water consumption and preventing urban flooding;
  — efficient use of water in urban design - stimulating water-efficient landscaping, greywater reuse and smart irrigation systems;
  — urban planning regulations that require new developments to include stormwater management infrastructure, such as underground or reservoir retention areas;

— **integrating renewable energy:**
  — Energy efficient land use - aligning urban planning with district heating, smart grids, microgrids and energy-sharing communities;
  — Solar and wind energy zoning - designating areas for renewable energy projects, such as solar farms and wind turbines, to reduce dependence on fossil fuels;

— **circular economy and waste management:**
  — use of land for circular economy centres - allocation of space for recycling, composting and materials recovery centres;
  — brownfield redevelopment - converting abandoned or contaminated sites into sustainable developments preferable to the use of greenfield land (which can, for example, become green spaces with lower acquisition costs);
  — Zero waste policies - integrating the transformation of waste into energy or reusable materials.

Last but not least, all these measures need to be accompanied by well-organized monitoring and management of implementation and diversified funding[17], through capacity building both in terms of training of specialists and decision-makers, and through the use of GIS databases, climate modelling applications and digital twins[18], preferably through the establishment of urban planning agencies that incorporate all the necessary competences in a single flexible entity[19]. Planning processes also need to include, in addition to cooperation at the metropolitan scale and with all administrative levels, the involvement[20] of the private sector, communities and research institutions.

17
Detailed in chapter Administrative instruments

18
Detailed in the Digitization - Innovation - Data Analysis chapter

19
Idem 15.

20
Detailed in the Digitization - Innovation - Data analysis chapter

3.1 Complementary public policies to manage land use

As discussed, urban planning uses a variety of tools to direct development and structure land use, the most important of which are regulating land use conditions by prohibiting certain types of land use and imposing built environment requirements. But the motivations and interests of future residents, landowners or developers, are determined by factors that lie outside urban planning plans and regulations, whether we are talking about central or local level policies.

It is important that these existing policies are known and adapted or modified, otherwise the measures in the plans may not have the desired effect. Some policies can be modified at the local level so that they are in line with planning, but some cannot be modified or adjusted, as they are set centrally. Examples of such policies that influence certain land use or travel demands or behaviour would be:

— national programs offering state-guaranteed loans or subsidies for house purchase, which only consider eligible new-build housing, not the rehabilitation of older ones, with the effect of exacerbating the deterioration of buildings;

— Subsidizing agriculture, a factor that stimulates the maintenance of agricultural land in peri-urban and rural areas;

— regulations on enrolling pupils at the school in the district where the pupil resides may seem to reduce travel; the measure is flawed in that temporary changes of residence are accepted (which do not actually happen), so that pupils travel long distances to the 'better' school in their parents' cars; in this case the solution is not land-use planning (if there are enough schools and they are well distributed in the territory), but rather reducing the differences between schools;

— tourism promotion policies (and the emergence of online platforms) that have led to the use of buildings in central areas of (European) cities being used predominantly for short-term rentals for tourists; the effect being to increase the price of housing in central areas and to move locals to peri-urban areas, with more and more cities trying to impose new rules on tourist rentals or discourage them through increased taxes.

Local public policies conceived as measures accompanying (or complementing) town planning regulations are necessary to stimulate certain behaviours or discourage others and, if they are within the local level's remit, have the advantage that their development and approval do not take as long and can therefore be more easily adjusted. Of course, as with any public policy, local policies need to be informed.

3.2 Urban operations and operational tools

Urban operations emerge as necessary and useful in the case of large-scale transformations in areas that will change functionally, socially or infrastructurally. These instruments continue by detailing and operationalizing the provisions of the general urban plans, being materialized at the planning level by zonal urban plans that contain measures and provisions tailored to the specific operation.

That is why the framing of the development of such an area in the types of urban operations is decisive, because the way of structuring and action in planning and implementation are very different. The operations involve separate attributions, but also private and public partnerships of a contractual nature.

3.2.1 Types of urban operations

The draft law on the Code of Spatial Planning, Urban Planning and Construction defines the following types of urban actions:

Art. 184. Urban/rural action zones

(1) Urban/rural action areas include:
— urban regeneration areas;
— urban restructuring areas;
— urbanization and de-urbanization areas;
— public project implementation areas;
— ecological reconstruction zones.

(2) Urban/rural action zones shall be identified and delimited by means of spatial planning documents and urban planning documents.

(3) The spatial planning and urban planning documents shall establish legal limits and urban planning limits and prohibitions established in application of Article 178, to create the conditions for carrying out urban planning operations of public interest.

Chapter III. Urban restructuring areas

Art. 213. Urban restructuring areas
The urban restructuring areas comprise areas within an administrative-territorial unit, for which the competent local public authorities have ascertained that the necessary conditions for triggering urban restructuring operations have been met.

Urban restructuring may require changes to the boundaries of land in the area subject to restructuring, including changes to private property rights as a result of boundary changes, in accordance with the law.

Art. 214. Establishment of urban restructuring areas
Urban restructuring areas are defined by general urban development plans.

Urban restructuring areas may be updated by a general urban plan or a zonal urban plan. To carry out urban restructuring activities, local public authorities may establish urban planning limits and prohibitions pursuant to Article 178 and may propose urban restructuring and local development operations.

Capitolul IV. Urbanization / de-urbanization areas

Art. 215. Urbanization/de-urbanization areas
Urbanization areas are areas which, by the spatial planning documents or general urban plans are planned to be included in the urban area of the localities, and which provide urban planning regulations on equipping these areas with public access infrastructure and public utilities.

De-urbanization areas are areas in demographic decline, which by the land use planning documents or general urban plans, are planned to be removed from the urban area of the localities to be transferred to the rural areas.

The local public administration will establish the technical, legal and financial conditions for the decommissioning of existing public infrastructure in the areas proposed for redevelopment.

The urban planning documents introducing land into the urban area must include regulations on the land related to communication routes, technical and utilities infrastructure, public services and facilities related to the new urbanization area as well as the directions and manner of development of such land.

Capitolul V. Areas of implementation of public projects

Art. 216. Areas of implementation of public projects
The areas for the implementation of public projects are the areas for which territorial reserves have been identified and delimited by means of spatial

planning and urban planning documents, to implement the projects and investments included in the action plan and investment programs related to the spatial planning and urban planning documents.

For the areas referred to in para. (1) by urban planning documents, the local public administration authorities shall establish urban planning limits and prohibitions established in application of Article 178, to ensure the realization of public projects that ensure the smooth functioning of localities and citizens' access to services of general interest.

For the realization of public projects of local or national interest that have not been foreseen in the spatial planning or urban planning documents, the local or central authorities initiate the realization of the urban planning documents necessary for the implementation of these projects, which are approved and approved as a matter of urgency, by reducing the approval deadlines by at least 50%.

3.2.2 Urban regeneration

Regeneration is one of the most widely used terms for necessary urban transformations, already supported by legislation and financial instruments from European or national funds, even private ones.

But there is a great need to clarify **urban regeneration as a process**, not just a succession of projects.

The effects of successful regeneration are always the result of the integration of public and private cooperation, sometimes over long periods of time, between the administration and the users of the area in question, in a coordinated process based on a transparent methodology. The involvement of users is no longer based solely on information, but through cooperation, however difficult it may be, at each stage of the process, with the involvement of specialists appointed by all the parties involved in the process. So, the key to the regeneration process is participation and involvement and above all the integrated progress of the communities in the regeneration area, the emergence of cooperative mechanisms, not just the technical improvement of the area. In certain cases, for a period determined in advance based on indicators to be achieved in the regeneration process, special rules can also be adopted for these areas, of an administrative, urban planning or fiscal nature.

To equate regeneration with the rapid implementation of measures usually of road infrastructure (streets and overpasses) or landscape, or even of private interest through large shopping centres, only circumvents the purpose of regeneration and hijacks by misappropriation a process that is highly relevant for local communities.

Emergency Ordinance No. 183 of 2022 on establishing measures for the financing of urban regeneration projects[21] states in the introductory section:

„proiectele de regenerare urbană au un impact major asupra con"urban regeneration projects have a major impact on the living and housing conditions of the population and make a decisive contribution to their improvement and to the development of urban and rural localities"

"land is a finite and scarcely renewable resource, and in the absence of urban regeneration projects, the urban and peri-urban areas are constantly being extended, affecting the environment and the financial resources of the administrative-territorial units that have to extend the building and road infrastructure"

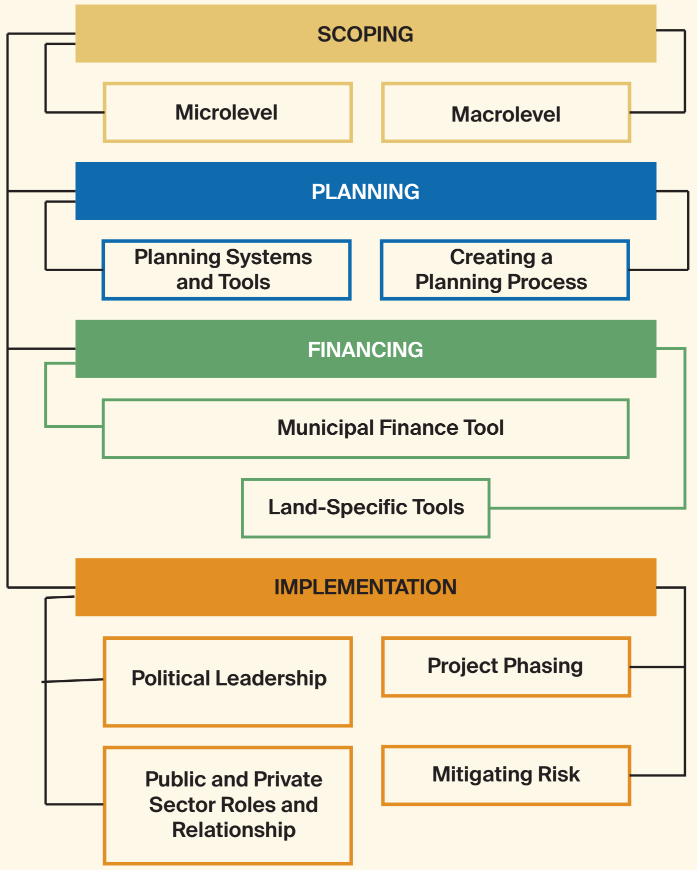
"the categories of interventions generated by the urban regeneration of degraded areas and which are carried out by the administrative-territorial units are of strategic importance in the concept of optimization, conservation and enhancement of the entire existing urban capital, compared to other forms of intervention generated by the community and the private sector, so that they can contribute to improving the quality of life and economic growth of the city"

"Driving urban regeneration projects into the economy, which can include encouraging and attracting investors in creative industries and green infrastructure, with a direct impact on reducing state budget revenues,

21 https://legislatie.just.ro/public/DetaliiDocument/263273

"Whereas the above-mentioned elements are in the public and strategic interest, are a priority of the Government Program and constitute an emergency and extraordinary situation [...] with an impact on the elimination of territorial disparities and the socio-economic development of urban localities, respectively the increase of the population's living standards and their quality of life"

Figure 1.1 Defining the process of urban regeneration projects



Process map for defining the urban regeneration pathway, starting from the goal and linking planning, financing and implementation:
Source: World Bank, Regenerating Urban Land, A practitioner's guide to leveraging private investment.

3.2.3 Restructuring

The urban planning guide for limiting and combating climate change and urban sprawl (draft)[22] developed in 2023 by MDLPA provides the following tools and measures to limit and combat urban sprawl with the impairment of property rights - restructuring of urban sprawl areas:

1. Land operationalization allows public authorities and owners to share the costs and benefits of urban development.
2. The tool works like this:
   — Urban dispersed areas (UDAs) identify sub-areas characterized by low land use, lack of roads, infrastructure and social facilities. In these sub-areas, urban development operations are carried out involving the parcelling of private land and its provision with technical and public infrastructure and basic public services (street layout, public utilities, adequate public spaces, etc.) Instead of paying a development tax, owners cede part of their land to the local authority.
   — The original plots are split, the land given to the public authority is removed, then the remaining land is re-parcelled. The new parcels that owners receive as a result of parcelling are smaller than the original properties but are of higher value as they are now equipped with the appropriate infrastructure and have access to basic public services. The public authority allocates part of the land received for the realization of streets, public spaces and spaces for necessary social equipment. The rest of the land can be sold to cover the costs of infrastructure investments or can be used to consolidate the municipality's land reserve.
3. The advantages of land operationalization are:
   — The public authority undertakes urban development projects by increasing the value of land, involving both landowners and residents.
   — The costs of providing housing and access to social infrastructure are shared between the public authority and the owners;
   — Speculative behaviour is avoided;
   — The initial investment costs incurred by the public authority can be amortized relatively quickly;
   — The land reserve of the public authority may increase.
   — The disadvantages of land operationalization are:
   — Reaching an agreement on land value and compensation rules is a lengthy negotiation process.
   — Getting the agreement of all the owners involved is tricky.
4. The results of correctly performed land use operationalization meet the following conditions:
   — All owners in the area designated for urban operation shall participate in land operationalization;
   — After land operationalization, the infrastructure of the restructured area is improved;
   — After land operationalization, all owners receive equitable benefits;
   — After the land operationalization, all owners receive the property rights to the new projected plots, according to the compensation rules established at the beginning of the process;
   — After land operationalization, there is no residual land;
   — The costs of land operationalization borne by the owners and the public authority are lower than the costs of other types of urban operations pursuing the same objectives.
   — The necessary conditions for the operation of the instrument are:
   — Transparency in formulating the objectives that the public authority has for a given area;
   — The public authority to establish a clear and transparent regulatory framework;

22 https://www.mdlpa.ro/pages/consultareghidproceduri

- Obtain the consent of all landowners affected by the operation.
- Using land operationalization involves the following steps:
- The land operationalization mechanism is proposed in the strategies (Integrated Development Strategy, Development Strategy) or in the strategic components of the General Urban Development Plan (PUG) or in the mobility components of the projects;
- Subsequently, the land operationalization is regulated by the Local Urban Development Regulation (RLU) of the General Urban Development Plan (PUG), which establishes: (1) the areas where it can be used and (2) the regulations that the parcelling must comply with. The public authority also lays down the procedural steps that must be followed throughout the urban planning operation.

3.2.4 Recommendations on the powers of local authorities in the situation of a private initiative of PUZ (urban regeneration)

The initiative for urban regeneration of an area does not belong only to the local authority, but in some cases to a (majority) owner of the land or to investors, and even if the area is not (yet) delimited as an urban regeneration area by the General Urban Plan, the administration should not limit itself to only approving the changes of the urban planning regulations proposed by the initiator (induced by the functional relocation/reconversion, organization of traffic and access, etc.), but to coordinate the regeneration process - which is based on planning (and then implementation of investments related to public facilities and infrastructure) or to enter into partnership with private developers in a management structure.

It is recommended that the local administration, through the responsible structure[23], carries out at least the following activities:

- **establishing the thematic program** which is required to contain general medium and long term objectives, including climate neutrality, in line with the adopted strategic and programmatic documents and based on a multidisciplinary and participatory rationale, at various relevant territorial scales (aiming at the desired impact on the neighbouring areas, the whole city and metropolitan area);
- **delimitation of the urban regeneration area** in line with the thematic-program based on a study prepared by specialists - preferably internal, or in collaboration with external specialists;
- **Establishing the partnership framework and milestones** for an integrated urban regeneration approach (concerted multidisciplinary approach) to ensure that all aspects of sustainability are addressed:
  - Sector mainstreaming - addressing the full range of sectoral policies, including infrastructure, transport, employment, social desegregation, education, green spaces, housing, culture, etc.
  - territorial/spatial integration - coherence and complementarity of actions and policies planned or implemented in neighbouring areas or on a larger territorial scale;
  - Coherently planned actions and responsibilities at different institutional levels: local administration, partnership structures at metropolitan level, subordinate institutions, deconcentrated services, utilities, local transport companies, etc;
  - the involvement of all stakeholders interested and/or affected by the implementation of the planned actions or by the financial-fiscal measures that will accompany the approach.
  - **Contributions to the detailed diagnosis of the area**, by providing existing data and analysis, establishing requirements for analytical and prospective studies;
  - **defining the optimal urban development alternative/policy** in the regeneration area and setting detailed

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See recommendations in the chapter Administrative tools

objectives, based on the conclusions of the background studies, including economic-financial impact and alternative scenarios for securing the costs of public investment, and on public consultations;
— **Negotiation of indicators of quality and public interest**, including climate, based on the study of scientific models for predicting climate, social and economic impacts. These tools already exist and can be used and commissioned in order to have an objective basis for decisions taken by both parties, which can also be used to inform and involve the public;
— **definition of monitoring indicators** and necessary organizational actions[24]; based on the monitoring, some facilities or mechanisms will be suspended when the indicators are reached;
— **elaboration of the action plan for implementation**, which will include all detailed activities, milestones, roles in implementation and estimated costs, as well as any necessary institutional and operational arrangements (property circulation, notary procedures, HCL for CF registrations, etc).

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See recommendations in the chapter Administrative tools

3.2.5 Recommendations on the requirements for the elaboration of PUZ, including at the initiative of other public institutions or private entities

Planning at the level of certain areas is necessary both to detail the regulations and actions proposed at the higher territorial level (established by the PUG) but may also be necessary to adapt to new public policies (such as climate resilience, energy efficiency, mobility, housing, etc.) or to respond to new dynamics and orchestrate different evolving interests. The zonal urban plan can therefore be the instrument to discuss in more detail or (re)discuss the decision-making framework to ensure the response to needs and opportunities that have evolved over time.

The urban development plan can also be considered as a contract between the community and the public administration - just as at the PUG level this contract stipulates what exactly, when exactly and with what resources the local authority (but also other responsible parties, e.g. the administrators of the railways or utilities transportation networks) will accomplish, at the level of an area the PUZ can represent a more detailed contract, with specific provisions for the characteristics of the area, but respecting the "big" contract at the level of the city or metropolitan area.

It is important to emphasize that this zoning contract is not just with the residents of the area or just with its more frequent users, but with the whole community (as in the case of the PUG) - the benefits spill over to the whole system, as unaddressed dysfunctions have knock-on effects at the city scale. Also, no matter who proposes to initiate a Zonal Urban Plan (PUZ), it does not serve certain owners of real estate (land and buildings) at a particular moment in time, but serves the general interest. This is important to keep in mind, not only because owners change (and this is normal), but also because of the purpose and nature of the urban plan:

> "(1) Town planning activity is the activity of public interest coordinated by local and/or central public administration authorities, through which they plan, organize and determine the directions of development, the use and occupation of land and buildings within the basic administrative-territorial units.
> (2) Urban planning shall ensure the protection of natural and built landscapes, including archaeological sites, the conservation of biodiversity and the creation of ecological continuities, public safety and sanitation, as well as ensuring mobility needs and ensuring accessibility and universal design for a disability inclusive society, sustainable mobility, climate resilience and energy efficiency.
> (3) The main purpose of urban planning activity is to regulate and coordinate the complex development of localities in accordance with the sustainable and competitive development of the national, regional, county and inter-community territory, with

their economic, social, cultural and territorial potential and with the aspirations of their inhabitants."[1]

Through this "contract", ratified by a decision of the Local Council, the local public administration undertakes to mobilize the necessary public resources and to impose (on anyone, on everyone) the measures and rules for the sustainable and balanced development of the territory.

The zoning urban plan, like the PUG, is a NORMATIVE administrative act containing general and impersonal rules of conduct and having the force of law. Therefore, the PUZ does not apply to certain persons (as is the case in individual administrative acts, such as, for example, the report of a contravention), such as the current owners of the buildings in the regulated area, but also to future owners: "the decision of the local council approving the zonal urban development plan is a normative administrative act, applicable to all legal subjects who will want to build in the area to which the plan refers, thus having general and repeated applicability and establishing general rules of urban development."[2]

The beneficiary of the PUZ is therefore, as in the case of the PUG and regardless of who initiates the proposal for the elaboration of the PUZ and its type, the whole community, through the deliberative body at local level that approves the plan (the Local Council).

In view of this, even if the proposal to initiate the planning process at area level comes from an entity other than the one approving the plan, the role that the local government is required to play in the preparation of the PUZ is similar as if the authority initiates the plan. The result in terms of the organization of the area must satisfy both the general interest and the achievement of sustainable development objectives.

Thus, when the need for planning at the zonal level is identified (or established by the PUG), either by monitoring territorial dynamics and the implementation of policies or plans, or by adopting new policies (such as those for the transition towards climate neutrality), or by signalling from other institutions (e.g. Ministry of Transport) or civic groups, etc., or by receiving documentation arguing the benefits of intentions that may not be in line with the current provisions in the area, the specialized service (or urban planning agency) should prepare the **supporting package** for the elaboration of the PUZ:

a) collect and bring together all existing information, data and analysis relevant to area planning, such as:
   - strategies, sectoral public policies in force, other decisions in force (including fiscal) available internally or requested from other entities (e.g. utility providers, but may also be school inspectorates, IGSU, CFR SA, etc);
   - urban planning or investment documents in the area or adjacent areas (past, in application/under development/under preparation or future intentions);
   - statistical data and forecasts (demography and social conditions, economy, modal flows, mobility, environmental conditions, climate, energy, etc.); if some of these data are already publicly available as open data, only their list will be compiled and the way to download them will be specified;
   - working support (preferably in GIS format) containing utility network routes, traffic routes, public transport routes and stops, location of facilities (schools, health services, culture, etc.), including land and buildings, transportation pattern, etc;
   - annual reports on the state of the territory [3], monitoring reports on the progress of the actions foreseen in the climate action plan, etc;

b) to carry out a delimitation study of the **regulatory area** and the study area for the PUZ, if they are not already delimited by the PUG (as regeneration or restructuring areas), according to the need for coherence, climatic requirements and/or the organization of the traffic system and the estimated territorial impact.

Based on the package of data and information, the specialized service (or the urban planning agency given this task) is required to construct the technical argumentation for initiating the PUZ. The **technical argumentation** includes the conclusions of studies or reports on the degree of compliance of the current urban development plan with the legal provisions and the adequacy of its provisions to the development trends, socio-economic and climatic challenges.

By the **incipient/preliminary program-topic** included in the requirements for the public procurement of services for the elaboration of the PUZ, or submitted to the entity proposing to initiate the PUZ (if it is not the local authority that will approve it) by the notice of opportunity or initiation, the local authority would be required to establish:

— targeted economic, social and climate benefits, already established for the area (e.g. through urban regeneration conditions set by the PUG), or distinguished through the analysis of intentions;

— directions, objectives and targets (indicator values and indicators) to be achieved, including those related to the transition to climate neutrality or eco-neutrality in line with the Climate City Contract, as appropriate[4]:
  - promoting urban regeneration, using existing buildings to limit land artificialization and resource use;
  - density consistent with context, index margins;
  - urban and landscape integration with the surroundings, avoiding the formation of urban canyons;
  - identification and protection of cultural/identity heritage and values;
  - stimulating and diversifying the economic structure;
  - Ensuring functional mix (and margins within which to study alternative proportions of functions) and other measures to reduce travel time and distances;
  - facilitating access to various public facilities and services (education, culture, health, social centres, etc);
  - creating public spaces for active mobility;
  - facilitating access to public transport;
  - Resource saving and circular economy;
  - promoting energy efficiency and renewable energy production and energy recovery;
  - conservation and restoration of ecological soil functionalities
  - and limiting artificialization (biotope index);
  - Rainwater retention and reuse;
  - extension of planted areas and tree canopies (providing shade), etc.
  - other requirements from the assessors - transportation, utilities, environmental agency, etc.

— the necessary background studies to be prepared (in addition to the existing ones), which will contribute, together with the results of the public consultations, to the final thematic program.

— the characteristics of alternative proposals (how they differ, what they have in common) and how they should be presented in terms of explaining the impacts - alternative scenarios for eliminating or mitigating dysfunctions, for exploiting existing potential and for addressing needs (including in terms of transition to climate neutrality) identified prospectively, including the contribution to the translation of the Spatial Development Strategy and sectoral local/metropolitan policies into the area

— requirements for the preparation of the action plan, including activities that are already known (ongoing).

Together with these materials (the supporting data package, the technical argumentation and the thematic program) it is necessary to establish and describe **the stages of the process**, their durations, together with the **public information and consultation plan** [5], possibly also a communication plan. The public information and consultation plan should specify the objectives of each stage of information and/or consultation, precisely specified target groups and stakeholders, tools/methods and materials to be developed, persons involved (and whether in-house or contracted facilitators will be used), and the estimated costs of carrying out these activities. The phasing will also include negotiation activities, possible mediation, as well as administrative and legal operations.

All these data, information, requirements, phasing will be included either in the package related to the procurement of the services for the elaboration of the PUZ (if not elaborated internally by the responsible structure or agency), or in the notice of opportunity/initiation [6] sent to the "external" initiator. In the preparation of this package, it is important to consult with the Technical Commission for Urban and Regional Planning.

The Notice of Initiation should be sent to the entity that proposed the preparation of the PUZ and to the public if the PUZ is in one of the situations.

Prin avizul de inițiere este indicat să fie transmise entității care a propus elaborarea PUZ și publicului dacă PUZ se află în una din situațiile:

a) the degree of complexity, the dynamics of the area or the estimated impact of the proposals require that the elaboration of the PUZ be entirely under the responsibility of the local authority;
b) the elaboration of the PUZ will be managed by the local public administration authority in partnership with the person or persons who proposed the PUZ;
c) the elaboration of the PUZ is the exclusive responsibility of the person who proposed the initiation of the PUZ, in compliance with the provisions of the initiation notice (with all the information package submitted - data and analysis, GIS support, regulatory area and study area, thematic-program, the plan for public information and consultation).

Even when the elaboration of the PUZ falls under the exclusive responsibility of the person who proposed the initiation of the PUZ, the local authority remains the coordinator of the process of elaboration, endorsement and approval of the plan, the manager and organizer of the public information and consultation activities, as well as the co-author of the action plan for implementation. And, of course, it is the public authority that implements the plan and evaluates, in a participatory way, its effects.

Good practice

Radical Area Transformation: Site4016 Stavanger, Norvegia

Investitor:Investor: Smedvig Property (private company)
Procurement procedure: IPD (Integrated Project Delivery)
Cost: 2-3 Billion NOK
Year of inauguration: Ongoing
Public engagement: Community involvement and co-creation, partnership with local high schools to promote the industry.
URL: www.site4016.no

Authorship

Masterplan: @Site
Architects: Eder Biesel/Mad/Helen&Hard
Case description: Nordic Edge – Bjarne Uldal

Project description

Site 4016 is an industrial area in the outskirts of the city of Stavanger. For many years the area was a nondescript and unattractive business district, but the area is now undergoing a radical transformation. The property developer Smedvig has over the last 5-6 years bought a significant number of properties in the area and is now turning its vision of turning the site into a regional knowledge and development centre for the construction industry.

Site 4016 is bringing together the leading players from all areas of the construction industry, and more than 100 companies have already joined the business cluster. The core idea being to facilitate collaboration and support knowledge and capacity building efforts to make the construction industry leaner, greener and more profitable.

All pictures credited: Smedvig

Site 4016 is being built with the future in mind. Environmental and sustainability considerations are part of its very fabric:

— Site 4016 generates its own power using solar cells and related technology. The energy produced is distributed via an energy hub to each of the buildings in the area
— Smart building technology giving tenants access to the data they need for efficient energy use and to reduce their consumption
— A green workplace: within the cluster green spaces are included for the tenants to enjoy. It is also becoming one of the most cycle-friendly workplaces in the region, with cycle lanes, a bike park, changing rooms and
— Carpooling: to reduce the number of cars, Site 4016 offer carpooling, enabling people to take their bike or a bus to work and then have cars available on-site during work hours.

Site 4016 is also a key player in the New European Bauhaus project NEB-STAR. New European Bauhaus (NEB) combines sustainability, aesthetics and inclusion to create comprehensive, forward-looking urban environments. The Site 4016 concept is a concretization of these principles, where innovation, technology and human interaction play a central role.

The idea is to use the area as a testing ground for new methods for site development, cooperation, and citizen involvement. We want to develop solutions for more sustainable buildings and inclusive cities and move an entire industry in a more environmentally friendly direction. To be able to achieve that we believe we also need to focus on the softer elements. NEB-STAR therefore aims to work with social innovation to become climate neutral faster - in an inclusive, aesthetic and sustainable way. NEB-STAR consists of partners from both public agencies, organisations, municipalities and private business. The idea is to learn from each other and create new forms of collaboration that give us faster and more efficient results.

Here are some examples on how the NEB values – beautiful, sustainable, together – have been brought to life at Site 4016:

Sustainability: Spinn is a groundbreaking circular building at Site 4016 with a circularity index of 70%. It demonstrates how reused materials can be integrated into new buildings. Site Energi is a good example of supplying green energy to an entire area. NEB values are included in the revised sustainability programme. Social sustainability is safeguarded through the collaboration with the NGO Fullt Fokus.

All pictures credited: Smedvig

Inclusion: We involve tenants, pupils, students and artists in the development process. This gives the users an active role in the design of their surroundings and ensures that various needs are taken care of. We have also developed 'The Sandbox' - a creative space and knowledge centre that plays a vital role by providing facilities that promote ideation, collaboration, and sustainable solutions. 'The Sandbox' has first-class meeting rooms, conference rooms, and large rooms with large screens, tailored to support productivity and future-oriented work.

All pictures credited: Smedvig

Beauty: Aesthetics and functionality go hand in hand in our projects. We prioritize design principles that promote well-being and use nature-based solutions to strengthen the quality of urban spaces.

All pictures credited: Smedvig

To sum it up: Site 4016 has become a platform for testing new digital and sustainable solutions. Here we experiment with innovative technologies to improve energy efficiency, resource management and user involvement. We continue to explore new concepts, strengthen collaboration with academia and business, and share insights to contribute to a wider transformation of the real estate sector. We also believe that the concept of Site 4016 can be scaled both nationally and internationally.

Examples of eco-neighbourhoods in France:

https://lesjoyeuxrecycleurs.com/des-chouettes-idees-vertes/eco-quartier/
https://interlace-hub.com/ecoquartier-approach-france

[1] Draft Law on the Code on Spatial Planning, Urban Planning and Construction, initiator's form approved by the Senate in 2023: https://www.cdep.ro/proiecte/2023/400/10/8/se464.pdf

[2] https://www.iccj.ro/2021/10/01/decizia-nr-12-din-28-iunie-2021-2/

[3] provided for by the Draft Law on the Code on Spatial Planning, Urban Planning and Construction

[4] Adapted from the Guide de l'aménagement durable pour des territoires sobres, résilients, inclusifs et créateurs de valeurs, part of the ÉcoQuartier approach of the Ministry of Spatial Planning and Decentralization and the Ministry of Ecological Transition, Biodiversity, Forestry, Sea and Fisheries, updated July 2024 https://www.ecologie.gouv.fr/dossiers/guide-lamenagement-durable-territoires-sobres-resilients-inclusifs-createurs-valeurs

[5] in accordance with the Methodology for informing and consulting the public on the elaboration or revision of spatial planning and urban development plans, approved by MDRT Order No 2701 of 2010

[6] in Law 350/2001 the opinion is called "of opportunity", in the draft Code it is called "of initiation"

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Mirror Mission
Cities Hub Romania

Possible Cities

Integrated toolkit
for climate neutrality

Digitization and urban data

Data governance — participatory, multiscale and territorial

Norbert Petrovici

7

Digitization and urban data

Data governance - participatory, multiscale and territorial

Data and Governance Frameworks for Climate Neutral Cities: Monitoring, Reporting, and Strategic Interventions

Before one can even conceive of a coherent trajectory toward climate neutrality in urban environments, it becomes essential to interrogate the infrastructural, institutional, and epistemic conditions that enable the systematic governance of greenhouse gas (GHG) emissions. Far from being a matter of technological deployment alone, the pursuit of net-zero cities demands a coordinated articulation of data regimes, regulatory instruments, and territorialised monitoring architectures, each embedded within broader political and economic rationalities.

What emerges, then, is not merely a technical configuration but a regime of climate accountability whose viability hinges on the integration of disparate datasets concerning energy consumption, emission typologies, and socio-behavioural patterns. At the core of this chapter lies an inquiry into the modalities through which such information can be mobilised, standardised, and rendered actionable within the urban milieu. To proceed, however, it is necessary to first define the conceptual perimeter of GHG monitoring by distinguishing these emissions from other ambient pollutants, thereby clarifying the specific legal and operational mandates associated with their regulation.

In the Romanian context, the intersection of EU sustainability directives and national legislative enactments generates a stratified field of responsibility in which both municipal administrations and private actors are variably enrolled. The asymmetry of institutional capacity across cities, coupled with the often-fragmented nature of environmental competences, renders the implementation of integrated monitoring systems a particularly delicate affair. The legal apparatus, formally aligned with EU Green Deal imperatives, frequently lacks the granularity and operational elasticity to accommodate urban-specific emission profiles.

To remedy this disjuncture, the chapter examines various accounting schemes, ranging from production-based inventories to consumption-oriented and supply-chain-inclusive models, each offering distinct epistemological and political advantages. The elaboration of Multi-Regional Input-Output (MRIO) models permits a recalibration of local emission datasets through the regionalisation of economic flows, thus providing a more balanced understanding of how urban activities reverberate through extended production networks.

However, such analytical sophistication presupposes a corresponding investment in the digital and organisational infrastructures necessary to sustain continuous, high-resolution data collection. The development of open and semi-open platforms, conceived as socio-technical assemblages rather than mere repositories, may facilitate cooperative modes of knowledge production, involving universities, municipal agencies, and private stakeholders in a shared project of urban decarbonisation. The experience of several Western European cities demonstrates that such architectures, when attuned to local administrative and political particularities, can materially condition the success of mitigation policies.

Nonetheless, substantial deficits persist. Romanian urban areas continue to operate under conditions of informational scarcity, most acutely in relation to real-time energy use, disaggregated sectoral emissions, and fine-grained geospatial data. This informational lag compromises not only the precision of emission inventories but also the credibility of climate strategies articulated at the local level. The chapter therefore advocates for a phased, yet deliberate, expansion of smart metering systems, GIS-integrated monitoring, and IoT-enabled sensors, all of which constitute prerequisites for a functional data ecosystem.

If deployed with strategic foresight, such investments may not only align Romanian cities with EU climate objectives but also serve as catalysts for endogenous economic revitalisation. By anchoring policy interventions in empirically validated data flows and ensuring their adaptability across diverse urban contexts, local administrations can reassert a degree of agency within a policy field often dominated by supranational metrics and funding conditionalities. In so doing, the prospect of climate neutrality ceases to be a technocratic aspiration and becomes, rather, an operational horizon around which urban futures may be reorganised.

1 Understanding Key Measurement Areas for Net Zero Cities

1.1 Defining a Net Zero City: Balance and Reduction of Greenhouse Gases

Before defining the operational and technical conditions that govern urban trajectories towards climate neutrality, the conceptual contours of the Net Zero city must first be articulated. The notion itself, more institutional than merely technical, rests upon the carefully maintained equilibrium between anthropogenic emissions of greenhouse gases and their systematic atmospheric extraction. This state of equilibrium requires not sporadic interventions but an enduring, strategic modulation of urban metabolic processes: systematic amplification of energy efficiency, deliberate infrastructural mobilisation towards renewable energies, endogenous enhancement of carbon sinks embedded within the urban fabric, and a profound rearticulation of production and consumption logics via circular economy principles. Framed as such, urban mitigation appears as a continuous negotiation between ecological constraints and institutional capacities, rather than as discrete, punctual events.

1.2 Greenhouse Gases Covered in Net Zero Policies

Climate governance regimes pursuing the objective of Net Zero primarily focus on a select group of greenhouse gases. These are chosen not simply for chemical specificity, but due to their pronounced contribution to radiative forcing. The group is comprised of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (F-gases). Carbon dioxide, emitted mainly from fossil fuel combustion across sectors such as transport, residential heating, and industry, forms the baseline for global warming potential (GWP), assigned a reference value of unity. Methane, primarily emanating from organic waste decomposition and fugitive industrial releases, possesses a considerably amplified radiative effect, exhibiting a GWP twenty-eight to thirty-six times greater over a century's temporal frame. Nitrous oxide, generated predominantly through fertiliser use, vehicular emissions, and certain industrial processes, reaches even higher magnitudes, between 265 and 298 times that of CO_2. Finally, F-gases, extensively employed in refrigeration systems, semiconductors, and insulation technologies, represent the upper extreme, with GWPs ascending well into the thousands. Their prioritisation, therefore, arises not from volumetric prevalence but from an administrative calculus grounded in their acute radiative intensity.

1.3 The Distinction Between Greenhouse Gases and Air Pollutants

For municipalities to govern the urban atmosphere with a degree of coherence and strategic foresight, a rigorous distinction must be upheld between greenhouse gases and classical air pollutants, even as certain substances resist such binary classification. Greenhouse gases, in their primary function, act upon the planetary climate system by trapping infrared radiation, thus contributing to the slow but inexorable destabilisation of global temperature regimes. Air pollutants such as nitrogen dioxide (NO_2), fine particulate matter (PM_{2-5}), and ground-level ozone (O_3), by contrast, manifest their effects more acutely at the local scale, impairing respiratory health, reducing atmospheric transparency, and eroding the ecological stability of urban environments. Yet any strict analytical division between these categories is difficult to sustain. Emissions like methane, black carbon, and nitrogen oxides traverse both regimes simultaneously, functioning as short-lived climate pollutants while aggravating local air quality. Their hybrid status not only complicates regulatory classification but also demands a more refined institutional architecture. In response, municipalities find themselves obliged to articulate dual regulatory strategies: one oriented toward climate neutrality benchmarks, in accordance with EU-level decarbonisation frameworks, the other grounded in the compliance obligations of the Ambient Air Quality Directives.

Table 1
Overview of Greenhouse Gases and Air Pollutants in nZEB Policies

A comparison of pollutants covered under nZEB policies, highlighting their types, examples, and environmental effects.

Object of nZEB policies	Pollutant Type	Examples	Effect
Da	Greenhouse Gases	CO_2, CH_4, N_2O	Trap heat, causing global warming.
Nu	Air Pollutants	NO_2, PM_2.5, O3	Cause respiratory diseases, smog, acid rain.
Da	Overlapping Gases	CH_4, NOx, Black Carbon	Contribute to both air pollution and climate change.

1.4 Measuring Greenhouse Gases and Air Pollutants: Challenges and Approaches

Measurement regimes for GHGs and air pollutants diverge not only in technical instrumentation but also in their epistemological premises. Air pollutants are susceptible to direct sensing: networks of urban sensors provide granular, often real-time data, registering pollutant concentrations with both spatial and temporal fidelity. Greenhouse gases, by contrast, elude such immediate detection. Emissions inventories, structured around activity data, fuel use, and emissions factors, remain the principal means of quantification. Atmospheric concentration data, whether collected through terrestrial sensors or satellite constellations (e.g., Copernicus Sentinel-5P or NASA's OCO-2), require complex modelling to deduce source attribution and spatial dispersion. While such data inform planetary-scale flux modelling, they rarely possess the spatial resolution necessary for actionable urban policy.

The deployment of CO2 sensors in urban contexts further reveals a methodological disjuncture. These instruments capture concentration levels, not emission volumes, and must therefore be integrated with transport and diffusion models to yield locationally meaningful insights. Moreover, while air quality data supports immediate regulatory action, triggering, for instance, traffic restrictions or public health advisories, GHG measurements operate within a more extended temporal horizon, oriented toward strategic decarbonisation rather than acute mitigation.

Thus, the asymmetry between these measurement paradigms must be recognised not as a deficit, but as a reflection of the divergent ontologies of the phenomena they aim to capture. The challenge for urban authorities lies in integrating these systems into a coherent informational architecture, one capable of supporting both immediate responsiveness and long-term climatological planning

Table 2
Comparison of Measurement Approaches for Greenhouse Gases and Air Pollutants

A side-by-side analysis of the differences in approaches, granularity, and challenges associated with measuring GHGs and air pollutants.

Criteria	GHG Measurement	Air Pollution Measurement
Approach	Inventories, satellite data, fuel consumption data, sensors (limited).	Direct sensors measuring pollutant concentrations in air.
Granularity	Typically, citywide or sector-based.	Real-time, high-resolution (street level).
Challenges	Hard to measure small-scale CO_2 emissions in real time.	Sensitive to short-term variations (traffic, weather).
Estimation	Requires modelling and indirect estimates.	Requires high sensor density.

2 Legal Obligations for Measuring Net Zero Emissions

2.1 Multi-Level Governance Structure for Emission Monitoring in Romania

Before one can evaluate the formal intensity of climate-related regulatory obligations in Romania, it is imperative to delineate the institutional scaffolding within which emission monitoring is structured. What emerges is a multi-scalar apparatus of governance—a system marked not by hierarchical clarity but by the differentiated allocation of competencies across national, regional, and municipal levels. This distribution, while often described in administrative terms, reflects deeper constitutional tensions between centralised authority, subsidiarity principles, and the procedural rationalities imposed by EU environmental acquis.

At the national level, sovereignty is operationalised through legislative and reporting obligations vis-à-vis European directives and international agreements. However, the effective localisation of monitoring, its translation into territorial practices and material infrastructures, depends upon a dispersed constellation of actors whose coordination is neither structurally guaranteed nor uniformly resourced. In this sense, the Romanian governance architecture exhibits a form of delegated responsibility without symmetrical capacity, where central institutions regulate in principle, but local and regional bodies execute in practice, often under conditions of institutional asymmetry and fiscal precarity.

2.2 Air Pollution Measurement: Legal Requirements

At the top of this institutional structure is the Ministry of Environment, Waters and Forests, responsible for setting policy priorities and supervising the national compliance framework. Under its authority, the National Environmental Protection Agency (ANPM) manages the "Reţeaua Naţională de Monitorizare a Calităţii Aerului", a network of 162 stations tasked with ensuring conformity to legally prescribed air quality thresholds. The centrally standardised system functions through regional branches and local agencies whose responsibilities include regulatory enforcement, data reporting, and the implementation of remedial measures when pollutant concentrations exceed the normative ceilings established by the EU Ambient Air Quality Directives.

Municipalities, although not legally compelled to maintain dedicated environmental departments, are nonetheless bound by secondary obligations: they must coordinate with regional environmental authorities and elaborate action plans once legal exceedances are recorded. Their role, then, while ostensibly auxiliary, becomes critical in mediating the spatial realisation of national standards. This functional ambiguity, between obligation and initiative, frequently results in variable levels of engagement, particularly in localities lacking either technical infrastructure or administrative expertise.

Table 3
Regulatory Framework for Measuring Greenhouse Gases and Air Pollutants

Key legal and institutional differences in the responsibilities and data usage for GHG and air pollution monitoring in Romania.

Aspect	Greenhouse Gases (GHGs)	Air Pollutants
Regulatory Authority	Ministry of Environment, Waters and Forests	Ministry of Environment, Waters and Forests (Ministerul Mediului, Apelor și Pădurilor)
Monitoring Agency	National Institute of Statistics (INS) in collaboration with Eurostat, UNFCCC	National Environmental Protection Agency (ANPM)
Local-Level Responsibility	Municipalities do not have legal obligations for GHG measurement but may develop local climate strategies.	Regional and Local Environmental Protection Agencies oversee air quality monitoring in cities.
Legal Framework	EU Emissions Trading System (EU ETS, Directive 2003/87/EC), Corporate Sustainability Reporting Directive (CSRD)	EU Ambient Air Quality Directive (2008/50/EC, updated 2016/2284/EC)
Measurement Methods	Emission inventories, indirect fuel use estimations, industrial reporting; satellites and atmospheric models also used.	Direct sensors & monitoring stations measure pollutants in real-time.
Entities Required to Measure	Large companies (over 500 employees) from 2024. Medium and large businesses meeting financial/employment thresholds from 2025. Companies under EU ETS (energy, industry, aviation) must report CO_2 emissions. National GHG Inventory submitted to Eurostat and UNFCCC.	ANPM and local environmental agencies for air quality reporting. Industries with significant emissions (e.g., power plants, refineries) must conduct self-monitoring and report.
Data Usage	Used for carbon taxation, emission reduction targets, and climate policy.	Establish air quality levels. Identify zones exceeding legal pollution thresholds. Develop and enforce Air Quality Improvement Plans in affected areas.
Legal Obligations for Cities	Cities are not legally required to report GHGs but may adopt voluntary Net Zero strategies.	If pollution exceeds legal limits, cities must create an Air Quality Improvement Plan.

Legal Obligations for Companies	From 2025, GHG inventories are mandatory for medium and large companies meeting certain thresholds under the Corporate Sustainability Reporting Directive (CSRD).	Industries with high emissions must report air pollutants (NO_2, SO_2, PM10, etc.) under the Industrial Emissions Directive (IED).

2.3 Greenhouse Gas Measurement: Legal Obligations

In contrast to the more proceduralised regime of air pollutant monitoring, the measurement of greenhouse gas emissions adheres to a dual-track system combining national statistical reporting and corporate disclosure mandates. At the institutional core of this regime, the National Institute of Statistics, in collaboration with the Ministry of Environment, compiles GHG inventories submitted to Eurostat and the United Nations Framework Convention on Climate Change. These reports, grounded in standardised methodologies, reflect Romania's commitment to the EU's Climate Law and the Paris Agreement, albeit at a level of abstraction insufficient for granular urban policy design.

However, a more recent and structurally transformative development arises from the EU Corporate Sustainability Reporting Directive (CSRD), transposed into Romanian law through Minister of Finance Order no. 85/2024. This legislation imposes a series of escalating obligations on enterprises: from 2024, public interest entities exceeding 500 employees must disclose sustainability indicators; by 2025, the requirement extends to approximately 5,300 companies, including medium and large firms, listed corporations, and local subsidiaries of non-EU parent companies. The thresholds, RON 25 million in assets, RON 50 million in turnover, or more than 50 employees, create a relatively wide perimeter of applicability.

These obligations, although ostensibly technical, in fact reconfigure the relation between private capital and environmental governance. Firms are no longer passive recipients of regulation; they become generators of environmental data, instrumental to national and EU-level climate accounting. Consequently, the inventory requirement functions not only as a disclosure mechanism but as a mode of surveillance, recasting sustainability as a fiscal and reputational metric within market logics.

2.4 Voluntary City-Level Commitments to Climate Neutrality

Romanian municipalities are not juridically required to measure or report greenhouse gas emissions. Even so, an increasing number of cities are enlisting in transnational initiatives such as the Covenant of Mayors for Climate and Energy. Despite no formal enforcement, this voluntary commitment offers local authorities a structured path to organise their climate initiatives through emission inventories, strategic planning, and ongoing monitoring. In practice, this engagement helps to bridge the gaps in national legislation by aligning local climate strategies with the broader architecture of European policy.

3 Accounting Methods for Greenhouse Gas Emissions in nZEBs

Greenhouse gas emissions accounting varies based on the chosen methodology for generating inventories, with production-based and consumption-based approaches offering distinct perspectives on emissions attribution.

3.1 Production-Based Accounting: Territorial Emissions Attribution

Before emissions can be governed, they must first be rendered visible within the spatial and institutional logics of climate accountability. In this regard, production-based accounting, often termed territorial emissions attribution, constitutes the foundational methodology underpinning national and local greenhouse gas inventories. It delineates responsibility by assigning emissions to the geographical locus of production, irrespective of where the final consumption of goods or services occurs. Emissions are thereby anchored to the territory in which the fossil fuels are combusted or industrial processes take place, establishing a clear regulatory perimeter aligned with juridical sovereignty.

Operationally, this method aggregates emissions derived from energy use, primarily coal, oil, and natural gas, through the multiplication of physical fuel quantities by standardised emission factors (carbon emitted per unit of energy). Additional emissions from industrial transformations, such as clinker production in the cement industry, are quantified through process-specific coefficients applied to production volumes. What this model captures, then, is a spatialised materiality of carbon emissions, limited to the territorial confines of a city or nation but inclusive of all production, regardless of the goods' ultimate destination.

This remains the main approach in state-centric climate regimes, forming the basis of submissions to the United Nations Framework Convention on Climate Change (UNFCCC), national climate strategies, and emissions trading systems such as the EU Emissions Trading Scheme (EU ETS). Its relative simplicity, rooted in administrative energy and production data, facilitates longitudinal comparisons and compliance monitoring. However, the method introduces a form of epistemic block: it excludes emissions embedded in imported goods while incorporating those in exports, thereby masking the broader ecological footprint of consumption.

Such a methodological bias serves state-based reporting requirements, but it proves increasingly inadequate considering the globalisation of value chains and the delocalisation of production. In effect, production-based accounting reifies territorial responsibility while neglecting the distributed character of carbon-intensive economic activity. For cities and regions heavily reliant on imported goods, this produces a systematically deflated emissions profile, distorting the normative landscape of mitigation responsibility.

Table 4
Comparison of Production-Based and Consumption-Based Greenhouse Gas Accounting Approaches

A side-by-side evaluation of the scope, trade inclusion, policy relevance, and data requirements associated with each accounting method.

Feature	Production-Based Accounting	Consumption-Based Accounting
Scope	Emissions within boundaries	Emissions linked to consumption
Trade Inclusion	Exports included, imports excluded	Exports excluded, imports included
Policy Relevance	Territorial regulation	Addressing carbon leakage
Data Requirements	Energy use, production data	Input-output tables, trade data

3.2 Consumption-Based Accounting: The Carbon Footprint of Consumption

To address the spatial limitations of traditional emissions accounting, consumption-based accounting introduces an alternative attribution logic, one that aligns responsibility with final demand rather than production locale. Often labelled the "carbon footprint" method, it reallocates emissions across the global supply chain, assigning them to the jurisdictions or social groups whose consumption patterns ultimately drive production. The analytical shift is profound: from emissions as by-products of local economic activity to emissions as the embodied cost of lifestyle and affluence.

Methodologically, this approach reconstructs territorial emissions by adding the carbon embedded in imports and subtracting that exported. A more refined variant relies on Environmentally Extended Input-Output (EEIO) models, which trace intersectoral economic dependencies using Leontief inverse matrices. Here, emissions are treated as systemic externalities propagated through global production networks. The outcome is a disaggregated carbon profile revealing not only direct emissions but also those absorbed via supply chains, distributed across geographies and temporally deferred from the point of consumption.

This model has found increasing resonance within corporate sustainability reporting, supply chain decarbonisation strategies, and Environmental, Social, and Governance (ESG) benchmarking, particularly as firms are pressed to disclose Scope 3 emissions. Moreover, its capacity to reveal the externalisation of environmental burdens, from high-income consumer economies to low- and middle-income producer regions, renders it politically salient for global justice debates. Yet this very comprehensiveness introduces a dependency on harmonised trade data, sectoral emissions coefficients, and accurate economic classifications, each of which varies considerably in precision and availability.

The consumption-based model thus operates as both a diagnostic and normative tool, exposing the spatial inequities of climate responsibility while offering an alternative metric for policy alignment. Its uptake, however, remains constrained by methodological complexity and the absence of legal frameworks enforcing its use at national or municipal levels

3.3 Comparing Production- and Consumption-Based Approaches

When examined through concrete examples, the divergent logics of production- and consumption-based accounting become more apparent, especially in relation to household energy use and the lifecycle of consumer goods. Consider natural gas heating: both accounting methods assign emissions to the point of combustion, meaning the territorial and consumption approaches converge. The carbon output is counted locally, as there is no upstream trade component to displace responsibility.
Electricity use introduces a distinction. Under production-based accounting, emissions are registered at the location of power generation, often in another region or country, thereby excluding the consuming locality from the emissions ledger. Consumption-based accounting, however, internalises imported electricity by assigning the associated emissions to the household that consumes it. The shift here is from an infrastructural to a behavioural focus, reflecting a broader recalibration of climate responsibility.
Consumer goods provide a sharper contrast. If a mobile phone is domestically produced, the associated emissions, spanning manufacturing, packaging, and logistics, are fully recorded under production-based accounting. However, if the same device is imported, those emissions disappear from national inventories, despite the product's use within the local economy. Consumption-based accounting reincorporates them, attributing the upstream carbon load to the final user. It thereby restores visibility to outsourced emissions, offering a more comprehensive portrait of environmental impact.
Ultimately, the distinction between the two models is not only methodological but epistemological: one reflects a regulatory rationality grounded in territorial control, the other a cosmopolitan ethics of accountability. Each lends itself to different governance modalities, state-led mitigation in the former; consumer- and firm-driven responsibility in the latter. A more integrated approach, combining both perspectives, may be necessary if urban and national policies are to respond adequately to the transboundary nature of the climate crisis.

4 Frameworks for Measuring Greenhouse Gas Emissions in Cities

Before any policy may credibly claim alignment with climate neutrality objectives, it must first be anchored in a consistent system of measurement, one that renders emissions intelligible, traceable, and administratively actionable. The fragmentation of urban metabolism across territorial, infrastructural, and transboundary flows necessitates differentiated accounting frameworks, each bearing distinct epistemological assumptions and regulatory utilities. The following classification outlines four principal models through which greenhouse gas (GHG) emissions are measured in cities, with particular attention to their methodological architecture and policy relevance[1].

4.1 Territorial Source-Based Accounting Framework

The territorial source-based framework, frequently adopted as the initial step in municipal climate action, centres on emissions generated strictly within the administrative perimeter of the city. This model, while limited in scope, enables a jurisdictionally contained assessment of emissions from locally operated systems: power plants, vehicular traffic, waste incineration, land-use change, and small-scale agriculture. It thus privileges those emission sources most directly within the city's regulatory reach. Several protocols operationalise this model:

— The **IPCC Guidelines for National Greenhouse Gas Inventories**, adapted at the urban scale, provide a technocratic scaffold for quantifying territorial emissions by sector, relying on local data concerning fuel consumption, land conversion, and waste management.

— The **Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC)**, in its basic configuration, limits itself to Scope 1 emissions: those arising from combustion or process activities within the urban boundary. It does not extend responsibility to energy imported from beyond the city.

— Through the **Covenant of Mayors (CoM)** and the first-generation **Sustainable Energy Action Plans (SEAP)**, cities compile Baseline Emission Inventories (BEIs), which cover residential, commercial, and industrial emissions along with local transport and waste. Though primarily designed for 2020 targets, the methodology remains foundational for infrastructural diagnostics.

— The **European Energy Award (EEA)** employs territorial data to guide municipalities in setting benchmarks for decarbonisation, facilitating interventions where emissions are most administratively tractable.

— The **Kyoto Protocol Localised Reporting Framework**, adapted from the national scale, confines itself to local emissions without recognising imported carbon, reinforcing a bounded conceptualisation of responsibility.

— While methodologically consistent and administratively straightforward, this framework overlooks emissions embedded in supply chains and imported infrastructure, an omission that risks misrepresenting the true climate burden of affluent, consumption-intensive urban areas. Nevertheless, its precision in quantifying directly manageable emissions makes it a useful instrument for infrastructure-focused mitigation efforts, particularly in smaller municipalities or those at the outset of climate planning.

1

Ramaswami, A., Tong, K., Canadell, J.G. et al. Carbon analytics for net-zero emissions sustainable cities. *Nature Sustainability* 4, 460–463 (2021). https://2t11ey3dc-y-https-doi-org.z.e-nformation.ro/10.1038/s41893-021-00715-5

Table 5
Protocols for Territorial Source-Based Accounting of Greenhouse Gas Emissions

Summary of key protocols focusing on Scope 1 emissions and locally controlled interventions for urban decarbonisation.

Protocol/Tool	Primary Scope	Coverage	Exclusion
IPCC Guidelines (Territorial Module)	Scope 1	Direct emissions from energy, transport, waste, land use	No transboundary Scope 2 or 3 emissions
GPC Basic Level	Scope 1	Local fuel use, transport, waste	No embodied or imported emissions
Covenant of Mayors (BEI – SEAP)	Scope 1 (some Scope 2 optional)	Stationary energy, transport, waste	Minimal Scope 2; excludes indirect Scope 3
European Energy Award (EEA)	Scope 1	Municipal operations, energy, waste	No transboundary accounting (Scope 3 excluded)
IPCC-Kyoto Protocol	Scope 1	Localized energy, land use, waste	No global or consumption-based emissions

4.2 Community-Wide Infrastructure Footprinting

By contrast, the community-wide infrastructure footprinting framework expands the analytical horizon beyond localised emissions, encompassing the full life cycle of provisioning systems, electricity, heating, mobility, waste, food, and construction. This shift corresponds to a recognition that urban decarbonisation cannot be achieved without intervening in upstream and downstream flows.

Advanced iterations of this framework include:

— The **Global Protocol for Community-Scale GHG Inventories (GPC)** in its extended form integrates **Scope 2** (imported electricity and heat) and **Scope 3** (supply chain emissions), offering a granular depiction of urban carbon flows. Cities such as Paris and London, under the aegis of the **C40 Cities network**, apply this model to monitor embedded emissions across fuel supply, construction materials, and food systems.

— The **ICLEI-USA Community Protocol** broadens coverage further to incorporate biogenic carbon and emissions from end-of-life materials, enabling an assessment of emissions arising from food waste, construction debris, and land-use transitions.

— Under the **European Energy Award's EMT 2.0 tool**, second-generation reporting systems quantify emissions from imported energy, embedded materials, and residual urban waste. This holistic monitoring enables cities to align infrastructure investments with long-term decarbonisation goals.

— The **Covenant of Mayors' SECAP (Sustainable Energy and Climate Action Plans)** for 2030 enshrine lifecycle tracking into climate planning, requiring the inclusion of retrofitting emissions, energy import carbon intensity, and supply chain-related emissions in project design.

— The **PAS 2070 standard**, designed for metropolitan areas, implements Direct plus Supply Chain (DPSC) accounting. It quantifies emissions from both local combustion and global trade flows, capturing the carbon intensity of imported goods, food systems, and construction inputs.

Table 6
Community-Wide Infrastructure Footprinting Protocols

A comparison of protocols covering emissions embedded in local and transboundary activities, infrastructure, and imports

Protocol/Tool	Scopes Covered	Emissions Focus	Exclusion from Territorial Source-Based
GPC Advanced (Scope 1+2+3)	1, 2, 3	Energy, transport, construction materials, waste	Includes transboundary flows and upstream emissions
ICLEI-USA Advanced Protocol	1, 2, 3	Waste, transport, lifecycle construction materials	Covers upstream production, not just local activities
European Energy Award (EEA) – Advanced	1, 2, Some 3	Public utilities, infrastructure, biogenic carbon	Tracks embodied carbon and imported energy
Covenant of Mayors (SECAP BEI Advanced)	1, 2, 3	Retrofitting, infrastructure, energy systems	Captures embodied emissions beyond direct consumption
PAS 2070 (Direct + Supply Chain)	DPSC	Comprehensive citywide footprint from imports to local	Goes beyond local activities to assess full supply chains

Such community-wide protocols are particularly relevant for Romania's **M100 cities**, including Cluj-Napoca, Timișoara, and Alba Iulia, which are progressively integrated into trans-European infrastructure and production chains. For these urban areas, Scope 2 and 3 emissions often exceed those captured by territorial methods, rendering traditional inventories insufficient for meaningful policy design. The particular strength of this framework comprises of its capacity to integrate the infrastructural metabolism of cities by tracing how materials, energy, and waste are produced, consumed, and circulated at both local and global level. Capturing emissions embedded in building retrofits, transport systems, and imported energy, it enables local administrations to expand targeted decarbonisation strategies aligned with the **EU Green Deal** and the circular economy agenda. Its application is particularly valuable in formulating procurement standards, evaluating large infrastructure projects, and establishing carbon budgets for urban planning departments. However, this approach requires not only technical expertise but also sustained inter-institutional collaboration, as accurate accounting depends on high-quality trade data, sectoral emissions coefficients, and comprehensive life cycle assessments, resources often unavailable at the municipal level without national or academic support.

4.3 Consumption-Based Footprinting

Whereas traditional emissions accounting anchors responsibility in territorial or infrastructural domains, consumption-based footprinting proposes a redistribution of accountability, one that situates emissions within the sphere of final demand. Here, it is not the geography of production nor the material infrastructure that constitutes the primary unit of analysis, but rather the consumer and the everyday act of consumption. This framework, therefore, abstracts emissions from their immediate point of origin, assigning them instead to the urban household as the ultimate locus of environmental consequence.

— Protocols such as PAS 2070, in its consumption-oriented configuration, limit their scope to the emissions embedded in goods and services consumed locally, particularly food, clothing, appliances, and housing. Crucially, emissions associated with exports or intermediate production inputs are excluded, yielding a model focused exclusively on urban lifestyle patterns and the carbon intensity of household behaviour. The framework serves less as a diagnostic of urban production than as a mirror of collective consumption, rendering visible the ways in which affluence, dietary preferences, and household technologies shape the urban carbon profile.
— To operationalise this logic, Multi-Regional Input-Output (MRIO) models, such as EXIOBASE and Eora, are employed to trace the upstream emissions embedded in household purchases. These models use sector-specific emissions intensities to allocate emissions across national and international trade flows, revealing, for instance, the environmental cost of importing electronics from East Asia or food products from Central Europe. Yet, by design, they do not capture emissions from exports, maintaining the framework's orientation toward internal consumption.
— A more granular variant appears in Environmentally Extended Input-Output (EEIO) models, which disaggregate emissions by sector and trace them along the entire supply chain until the point of final use. Once a good is consumed within the household, emissions tracking terminates, thus preserving the framework's focus on localised end-use rather than on systemic economic activity. Cities in Sweden, the Netherlands, and Germany have adopted EEIO models to construct lifestyle-based mitigation policies, particularly in sectors such as transport, energy, and food.
— The GHG Protocol's guidance on consumption-based accounting further institutionalises this framework, aligning it with the sustainability agendas of C40 cities such as Portland and Oslo, which seek to influence personal behaviours through soft policy instruments, public campaigns, green nudging, and low-carbon infrastructure access. These protocols enable interventions at the intersection of household responsibility and systemic emissions, offering levers for carbon reduction outside the realm of direct municipal regulation.

În rețeaua C40, acest cadru e tot mai folosit pentru intervenții specifice legate de stilul de viață: de la promovarea dietelor mai sustenabile, până la campanii pentru reducerea deșeurilor. Sunt intervenții „mici" ca amploare administrativă, dar cu un potențial semnificativ de schimbare. Pentru că, în fond, dacă vrei să reduci emisiile la nivel urban, trebuie să știi nu doar unde sunt fabricile, ci și ce pun oamenii în coșul de cumpărături.

Tabel 7
Protocols for Consumption-Based Footprinting of Urban Greenhouse Gas Emissions

Overview of protocols tracking household-related emissions and their key exclusions compared to total supply chains.

Protocol/Tool	Coverage	Exclusions Compared to Total Supply Chain	Key Applications
PAS 2070 - CBA Method	Household goods, food, clothing, housing	Excludes emissions from exported goods and services	London's city-level carbon footprint
MRIO Models - Household	Goods and services consumed locally	No emissions related to exports or non-consumed goods	Used in urban climate planning (e.g., Sweden)
EEIO Models -Household	Embedded emissions in consumer products	Excludes industrial exports	Germany and Netherlands for local inventories
GHG Protocol-Consumption	Household emissions from food, transport, housing	Stops tracking at final consumption; does not follow full supply chain	Oslo and Portland
C40 Cities Consumption	Consumption lifestyle (diet, transport, goods)	No total city production or export-related emissions tracked	Paris, Copenhagen, other C40 cities

4.4 Total Supply Chain Footprinting

In contrast to the circumscribed lens of consumption-based models, total supply chain footprinting adopts a panoramic perspective. It seeks to register the entirety of emissions generated by a city's economic activity, across production, consumption, and trade, whether directed inward or outward. This method accounts for emissions embedded in industrial outputs, infrastructure projects, imports, and exports alike. By doing so, it displaces the artificial boundaries of territorial governance and consumer behaviour, revealing the metabolic entanglements through which cities shape the planetary carbon budget.

— The PAS 2070 Direct Plus Supply Chain (DPSC) protocol exemplifies this expansive logic. It couples territorial emissions with those embedded across supply chains, differentiating between emissions for local consumption and those arising from export-driven sectors. The protocol captures emissions from steel production, logistics, construction materials, and manufacturing, all of which may serve external markets, yet remain materially anchored in the urban fabric.

— MRIO models, including EXIOBASE and Eora, extend this approach by attributing emissions to every node in the trade network, mapping, for instance, the carbon intensity of port activities in Rotterdam or industrial exports from Cluj-Napoca. These models are particularly suited to urban economies embedded in global trade infrastructures, where supply chains stretch far beyond municipal borders. Similarly, EEIO models applied at the economy-wide level offer cities a detailed depiction of emissions flows across manufacturing, logistics, and construction, thereby aligning climate inventories with economic structure.

— The Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC), when implemented in its most comprehensive form, incorporates both locally generated emissions and those embodied in exports. This dual orientation enables cities to align emissions tracking with infrastructure planning, industrial strategy, and cross-border trade policies.

— International institutions have contributed to the consolidation of this framework. The OECD's Total Urban Supply Chain Emissions Approach and the CDP Supply Chain Module enable cities to quantify emissions from energy-intensive industries, transport logistics, and regional trade. In doing so, they provide the empirical infrastructure for cities such as Tokyo, New York, and Hamburg to measure the full extent of their global carbon footprint.

The epistemological distinction between this framework and the consumption-based model lies not only in scope but in orientation: while the latter privileges lifestyle modification and behavioural change, the former provides the data architecture necessary for macroeconomic restructuring. It enables municipalities to design fiscal instruments, industrial policy, and investment strategies aligned with decarbonisation, especially in contexts where exports and logistics constitute major emission sources.

Table 8
Total Supply Chain Footprinting Protocols for Comprehensive City-Level Emissions

Summary of key protocols capturing emissions across production, exports, and local consumption in trade-intensive cities.

Protocol/Tool	Coverage	Exclusions Compared to Consumption-Based	Key Applications
PAS 2070 (DPSC Method)	City-wide production, export-related emissions	Excludes direct attribution to household consumption	London's comprehensive GHG accounting
MRIO Models (Total Output)	Global supply chains related to local production	Tracks emissions from exports, not limited to local consumption	Rotterdam, Amsterdam, large port cities
EEIO Models (Total Economy)	Economy-wide emissions from all sectors	Does not focus on consumption patterns; tracks production & trade	Applied in Sweden and Germany for city-level inventories
GPC Advanced Total Supply Chain	Local consumption + exports + infrastructure	Tracks industrial production and export-oriented sectors	Used in C40 cities (Tokyo, NYC)
OECD Total Urban Supply Chain	All economic activities, including exports	Does not focus on lifestyle or household emissions	Economic and trade-focused cities
CDP Supply Chain Module	Business supply chains, exports, manufacturing	Does not specifically target household consumption	Used globally in major cities

5 Measurement Requirements for Cities Joining the Covenant of Mayors

5.1 The Sustainable Energy and Climate Action Plan (SECAP)

To become a part of the Covenant of Mayors, local governments must put together a Sustainable Energy and Climate Action Plan (SECAP), a plan encompassing greenhouse gas emission monitoring, climate risk analysis, and the action needed to alleviate these risks. The SECAP build on the Baseline Emission Inventory (BEI) – Advance protocol, which calculates the emissions for the most important sectors of buildings, transport, energy, and waste. In addition, the Climate Risk and Vulnerability Assessment (RVA) identifies the expected effects of climate change in the city ecosystem by informing mitigation and adaptation strategies. The intervention target is not only to reduce the emissions but also to enhance climate risk resilience. Reporting under the Global Protocol for Community-Scale Greenhouse Gas Emissions.

5.2 Reporting under the Global Protocol for Community-Scale Greenhouse Gas Emissions

When they report their emissions, cities apply the Global Protocol for Community-Scale Greenhouse Gas Emissions (GPC) as a global guideline for city-scale emissions estimation.
The GPC disaggregates emissions into three scopes: first, captures direct emissions from city-source sources, including fuel combustion in buildings and city transport emissions; second, includes indirect emissions from electricity, heat, and cooling consumed in the city but produced elsewhere; and third, captures other indirect emissions associated with supply chains and consumption, including product embedded carbon and transport emissions of waste. This categorization assures a synchronized and comprehensive approach to accounting for municipal-level emissions. Adherence to IPCC Guidelines for Local Emissions Assessments.

5.3 Alignment with IPCC Guidelines for Local Emissions Assessments

Urban municipalities would also harmonize their inventories according to the guidelines developed by the Intergovernmental Panel on Climate Change (IPCC) that are currently the basis for national reporting to the United Nations Framework Convention on Climate Change (UNFCCC). Such standards, when utilized locally, allow cities to better estimate emissions by either (1) activity-based modelling, through direct data of energy consumption, transport use, and industrial production, or (2) via proxy-data use, where GHG multipliers at the national level are utilized to estimate municipal emissions in lieu of municipal-level data.

Tabel 9
Sectoral Coverage of Greenhouse Gas Reporting Under the SECAP BEI Advanced Protocol

List of sectors included in the reporting framework, with examples and specific data types required.

Sector	Examples
Municipal Buildings	Public offices, schools, hospitals, libraries
Residential Buildings	Energy consumption from households
Transport	Public transport, private vehicles, fleet emissions
Industry & Business	Commercial and industrial energy use
Energy Supply	Electricity, district heating, renewables
Waste Management	Landfill methane emissions, recycling impact

6 Inventories of Greenhouse Gas Emissions for the M100 Mirror Mission

6.1 Overview of the M100 Cities Initiative

What the M100 initiative attempts to enact is not simply a programme of urban decarbonisation, but a recalibration of administrative rationalities, wherein Romanian municipalities are reconfigured as active nodes within a transnational climate governance regime. Echoing the architecture of the EU's Mission 100, the national programme offers a procedural framework for the elaboration of Sustainable Energy and Climate Action Plans (SECAPs), predicated on a comprehensive emissions baseline. At the core of this reporting logic lies the Baseline Emission Inventory – Advanced Protocol, a methodologically enriched approach that extends beyond territorial emissions to encompass the embedded carbon of local consumption. The adoption of such a dual-register inventory, territorial and consumption-based, does not simply amplify precision; it introduces a conceptual shift, whereby urban lifestyles, supply chains, and infrastructural metabolism become legitimate domains of climate accountability. Yet this ambition, however laudable, remains unrealised in the absence of a standardised, interoperable, and policy-aligned data infrastructure, one capable of translating fragmented administrative datasets into decision-relevant indicators aligned with both national commitments and EU regulatory standards.

6.2 Data Collection Infrastructure

Conceived not merely as a technical scaffold but as a procedural dispositif, the *Central Data Portal* must function dually: as an integrative platform for emissions data and as a regulatory interface that facilitates oversight, comparability, and adaptation. Its architecture must reflect both the segmentation of urban systems and the need for horizontal integration across functional domains.

— **Buildings**: Data acquisition will require coordination with utility companies (electricity, gas, district heating), cross-referenced against cadastral databases, energy performance certificates, and municipal renovation registries. Disaggregation by building typology, age cohort, and heating system will allow for a granular emissions profile, indispensable for retrofitting scenarios and investment planning.

— **Transport**: Here, emissions accounting must synthesise data from fuel distributors, traffic monitoring systems, vehicle registries, and public transit operators. The inclusion of EV charging station outputs and modal share data will permit an articulation of both direct (Scope 1) and indirect (Scope 3) emissions. Crucially, cities must address not only vehicular emissions but also the embodied carbon of transport infrastructure.

— **Waste**: Local sanitation authorities will provide the basis for GHG estimation, waste volumes, treatment technologies, methane recovery, and recycling rates. These figures, often overlooked, are critical for the articulation of circular economy objectives within the SECAP framework.

— **Energy and Renewables**: Collaboration with Transelectrica, ANRE, and regional DSOs will be necessary to obtain the emissions factor of imported electricity and the contribution of renewable sources. The capacity to dynamically adjust Scope 2 emissions based on the carbon intensity of the grid is central to accurately modelling decarbonisation trajectories.

— **Land Use and Green Infrastructure**: Zoning data, green space inventories, and afforestation plans must be centralised, with sequestration estimates based on species-specific carbon uptake models and verified through remote sensing. Such information is vital not only for offset accounting but also for spatial planning under climate resilience criteria.

6.3 Remote Sensing and Behavioural Surveys

To confine emissions accounting to administrative or infrastructural metrics is to ignore the spatial-temporal diffusion of urban carbon. Therefore, to complete the architecture of GHG inventories, it becomes necessary to mobilise *remote sensing technologies and behavioural diagnostics*, tools that illuminate the otherwise invisible drivers of emissions.

— **Remote Sensing:** Satellite data from the Copernicus and Sentinel programmes, supplemented by UAV (drone) imaging, will enable the validation of land-use changes, the assessment of canopy growth, and the detection of thermal anomalies. Such data is indispensable for measuring the effectiveness of nature-based solutions and monitoring sequestration interventions at scale.

— **Behavioural Surveys:** Structured surveys targeting domestic and tertiary building occupants will reveal patterns of energy use, thermostat preferences, appliance loads, ventilation practices. When cross-analysed with smart meter data and building envelope characteristics, such insights refine the behavioural parameters of energy demand models, thus enabling more realistic scenario forecasts.

By integrating these two data domains, cities can move beyond static inventories toward dynamic models, ones capable of responding to behavioural change and infrastructural transformation in real time. Moreover, this integration facilitates the mobilization of citizens not merely as passive data points but as co-producers of climate knowledge.

6.4 Centralised Data Portal and Reporting

The Central Data Portal must not be reduced to a digital archive. Rather, it must be conceived as a governance infrastructure, a platform that consolidates data submission, validation, visualisation, and strategic foresight. Key functionalities include:

— Automated API Integration, ensuring real-time flows from utilities, registries, and monitoring systems;
— Validation Algorithms to detect anomalies and ensure methodological coherence across reporting cycles;
— Customisable Dashboards, disaggregating emissions by sector, scope, and geography;
— Versioning Protocols and Metadata Management, securing traceability and audit compliance;
— Tiered Access Control, allowing public transparency without compromising data sensitivity;
— Geospatial Tools for mapping emissions clusters, green corridors, and infrastructure deficits;
— Scenario Modelling Modules, supporting prospective evaluations (e.g. retrofitting 20% of residential stock, modal shift in transport);
— Multi-format Outputs, facilitating reporting to the Covenant of Mayors, EU Green Deal platforms, and Romanian national climate agencies.

Data updates should follow a hybrid temporal logic: real-time for transport and energy data; quarterly or annual for sectors such as waste and land use. Alignment with standards, GPC, IPCC, PAS 2070, ISO 37120, will ensure interoperability across governance scales

Table 10
Data Repository Structure for M100 Cities' Greenhouse Gas Inventories

Detailed overview of data types, providers, standards, formats, and update frequencies needed for sectoral emissions tracking.

Sector	Data Type	Provider	Standard	Format	Freq.
A. Buildings	Energy consumption (electricity, natural gas, district heating)	Local utility companies (e.g., E.ON, Electrica, local district heating providers)	IPCC Guidelines, ISO 14064	CSV, XML, API	Monthly/ Annual
	Building stock data (public, residential, tertiary)	National Building Register	GHG Protocol (Scope 1 & 2)	GIS shapefiles, CSV	Annual
	Energy audits	Energy efficiency agencies, private energy auditors	EN 16247	PDF, CSV	Annual (sample-based)
	Renovation and retrofit activities (building upgrades)	Municipal housing offices, private construction firms	GHG Protocol, SECAP guidelines	CSV	Annual
B. Transport	Public transport fuel consumption	Local transport operators (e.g., CTP)	IPCC Guidelines, GPC	CSV	Monthly
	Fleet composition and vehicle registration	National Vehicle Registry (RAR), municipal transport departments	EEA standards for transport	CSV, API	Annual
	Traffic flow and congestion data	Municipal traffic monitoring systems	ISO 37120	GIS, CSV	Continuous (real-time)
	Fuel sales data	Local fuel distributors, ANRE (Romanian Energy Regulatory Authority)	IPCC Guidelines	CSV	Monthly
	EV charging data	Private EV charging operators, municipal EV programs	Open Charge Point Protocol (OCPP)	JSON, CSV	Monthly
	Transport mode share (modal split)	Municipal Household travel surveys, transport models	GHG Protocol, EU Transport Standards	CSV, Excel	Annual
	Vehicle activity (passenger-km, tonne-km)	Municipal traffic monitoring systems, Local public and private transport operators	ISO 14064	CSV, API	Continuous
C. Waste and Circular Economy	Waste generation and composition	Local waste management companies	GHG Protocol (Scope 1, 3)	CSV	Quarterly
	Wastewater treatment emissions	Municipal wastewater operators	IPCC Guidelines for Wastewater	CSV	Quarterly/ Annual
	Recycling rates and treatment data	Recycling companies, municipal operators	IPCC Guidelines	CSV, PDF	Quarterly
	Methane emissions from landfills	Landfill operators, environmental agencies	IPCC Waste Sector Methodology	CSV, XML	Annual
	Leachate management data (landfill wastewater)	Landfill operators, environmental monitoring agencies	IPCC Waste Methodology	CSV	Annual
	Composting and anaerobic digestion emissions	Composting facilities, agricultural waste operators	IPCC Guidelines for Agriculture	CSV	Annual
	Industrial waste data	Local industries, environmental agencies	GHG Protocol (Scope 3)	CSV	Quarterly/ Annual

D. Energy Production	Renewable energy production (solar, wind, biomass)	Renewable energy operators, ANRE	IPCC Guidelines	CSV, API	Monthly
	Energy grid mix	Transelectrica, ANRE	ISO 14067	CSV, XML	Monthly
	Emissions from power plants	Transelectrica, local power producers	GHG Protocol (Scope 2)	CSV, PDF	Quarterly
	Backup generators and emergency power use	Municipal facilities, industrial facilities	GHG Protocol (Scope 1)	CSV	Quarterly/ Annual
	Energy losses in transmission and distribution	Transelectrica, local distribution companies	GHG Protocol	CSV, XML	Quarterly
	Bioenergy emissions (biomass plants)	Local bioenergy plants	IPCC AFOLU Guidelines	CSV	Monthly/ Annual
E. Industry & Business	Process-related emissions (e.g., cement, steel, chemicals)	INS County level	IPCC Guidelines, ISO 14064	CSV	Quarterly/ Annual
	Emissions from combined heat and power (CHP) plants	Local power producers	GHG Protocol	CSV	Monthly/ Quarterly
	Energy efficiency data for commercial and industrial buildings	INS County level	ISO 50001	CSV	Annual
F. Land Use and Green Infrastructure	Land use and urban green spaces	Municipal urban planning departments, Municipal cadastral offices	ISO 37120	GIS shapefiles, CSV	Annual
	Carbon storage in soil and vegetation	Local agricultural and forestry agencies	IPCC AFOLU Guidelines	CSV	Annual
	Urban reforestation and afforestation plans	Municipal environment departments	ISO 14067	CSV, XML	Annual
	Urban heat island and cooling effect from green spaces	Local environment and meteorological offices	ISO 37120	GIS, CSV	Annual
	Tree planting and carbon sequestration	Municipal environment departments	IPCC AFOLU Guidelines	CSV	Annual

7 Municipal Investments Required for SECAPs Under the BEI Advanced Protocol

7.1 Infrastructure Investments for Emissions Tracking

To render the urban carbon profile both visible and governable, municipalities must first deploy an integrated suite of infrastructures designed to quantify emissions with precision and spatial granularity. Such infrastructural augmentation is not limited to devices; it entails the establishment of feedback loops, administrative interoperability, and procedural continuity across multiple departments.

— **Traffic Monitoring Systems:** Investments in vehicular sensing technologies, automatic counters, GPS transponders, and congestion analytics, enable cities to estimate vehicle-kilometres travelled (VKT) and fuel usage in real time. These data, structured through centralised platforms, inform Scope 1 emissions accounting while simultaneously supporting the implementation of low-emission zones, congestion pricing, and modal shift policies. Without such temporal and spatial granularity, transport-related decarbonisation remains speculative.

— **Household Energy and Mobility Surveys:** Behaviourally calibrated surveys, conducted annually or biennially, capture appliance ownership, thermostat settings, travel routines, and energy expenditures. When triangulated with smart meter readings and census data, these surveys introduce a sociotechnical layer into emissions modelling, thereby enabling cities to target behavioural campaigns with empirical rigour.

— **Urban Planning and Cadastral Integration:** GIS-based planning tools, in conjunction with digital cadastral registries, allow emissions to be mapped onto the built environment. Floor area, age of construction, and heating systems, parameters stored within cadastral databases, support emissions modelling at the parcel level. These data are essential for identifying high-emission zones and targeting retrofitting investments.

— **Environmental Monitoring Systems:** Municipal environmental departments must be equipped with carbon monitoring sensors (for soil, biomass, and green spaces), as well as remote sensing capacity for canopy analysis and green infrastructure tracking. Urban forests and wetlands, when properly accounted for, enter the emissions ledger not as decorative assets but as carbon sinks, integral to net-zero calculations.

— **Waste and Water Emissions Technologies:** Methane and NO_x sensors at landfill sites, flow meters in wastewater facilities, and composting site monitors provide real-time data on fugitive emissions. Such infrastructure enables not only measurement but also intervention, through landfill gas capture systems, anaerobic digestion units, or low-energy water treatment options.

— **Smart Energy Monitoring Systems:** The deployment of smart meters across municipal, residential, and industrial buildings, linked to centralised dashboards, automates data collection, reduces latency, and enables immediate policy feedback. These systems shift emissions monitoring from retrospective reporting to proactive governance.

— **Remote Sensing and GIS Subscriptions:** Access to Copernicus, Sentinel, and high-resolution drone imagery ensures that land-use changes, deforestation, and urban expansion are continuously monitored. These data inform both emissions inventories and climate resilience planning, particularly in peri-urban zones susceptible to heat stress and habitat loss.

The infrastructural investments described above do not operate in isolation. Their value lies in their systemic integration, across departments, data layers, and planning cycles, such that emissions become not only measurable, but governable..

7.2 Capacity-Building and Human Resource Development

Regardless of their sophistication, technological infrastructures remain inoperative without qualified personnel to activate them. Municipal investments must therefore extend to the creation and professionalisation of a local administrative workforce trained in the epistemologies of climate governance.

— **Staffing**: Permanent posts for environmental engineers, GHG inventory analysts, energy auditors, and urban ecologists must be institutionalised within city administrations. These professionals form the core of emissions reporting and scenario modelling, while field inspectors conduct on-site verifications, monitoring construction activities, fuel storage, and waste treatment facilities with mobile data collection tools.

— **Training and Certification**: Periodic training workshops, structured around IPCC protocols, GPC methodologies, GIS platforms, and building energy simulation tools, should be delivered through consortia of universities, technical agencies, and accredited private providers. This professional upskilling ensures that municipal actors are not merely data collectors, but epistemic agents within the climate transition.

— **Participatory and Community-Based Capacities**: Community engagement initiatives, such as voluntary energy reporting portals, awareness campaigns, and citizen science programmes, extend emissions tracking into the domestic and informal domains. NGOs and civil society organisations, once trained in emissions monitoring protocols, can operate as intermediaries, augmenting the municipality's data reach and fostering a culture of shared responsibility.

7.3 Collaborations with Utility Companies and Industries

The operationalisation of Scope 2 and Scope 3 emissions accounting, relating to imported electricity, construction materials, and embodied emissions in supply chains, requires the establishment of legally binding data-sharing agreements with utility providers, industrial actors, and service operators.

— **Electricity and Heat Utilities**: Data on hourly consumption, load profiles, and emissions factors must be made available in standardised formats, with monthly or quarterly reporting protocols. This data must be disaggregated by user category (residential, commercial, institutional) to ensure analytical granularity.

— **Waste and Water Operators**: Emissions data from landfill gas systems, incineration units, and wastewater methane releases must be reported with precision. Real-time APIs can facilitate this, provided that mutual standards and legal safeguards are in place.

— **Construction and Logistics Firms**: Embedded carbon in construction materials and logistics emissions (freight, warehouse energy use, fleet fuel consumption) must be tracked through collaborative disclosure frameworks. This is essential for cities with export-oriented or rapidly urbanising economies.

7.4 Financing and Access to EU Funding

Finally, to support the material and institutional investments required, municipalities must pursue a blended financing strategy that mobilises both endogenous and exogenous resources.

— **Municipal Budgets** must be allocated not only for equipment procurement but for sustaining recurring expenditures: salaries, maintenance, software licensing, and staff development.

— **EU Funding Instruments**, including Horizon Europe, European Structural and Investment Funds, LIFE, and climate-linked programmes of the European Investment Bank, offer access to capital that can underwrite infrastructure, research, and innovation.

— **Green Bonds and Public-Private Partnerships** may serve as additional mechanisms, particularly for retrofitting programmes or smart grid development.

Table 11
Investments Required for SECAP Implementation and Monitoring

Breakdown of municipal resources, required investments, and key use cases to support climate action and monitoring..

Municipal Resource	Investment	Primary Data Provided	SECAP Sector	Use Case
Municipal Traffic Monitoring Systems	Traffic sensors, automatic vehicle counters, GPS tracking, centralized data systems	Vehicle-km traveled (VKT), congestion, fuel consumption	Transport	Calculate transport-related emissions, monitor congestion, implement low-emission zones
Household Surveys	Household energy and transport surveys, data analysis software, incentivized participation	Energy use, appliance ownership, commuting patterns	Residential, transport	Refine energy models, assess travel patterns, and evaluate energy-saving campaigns
Municipal Urban Planning Departments	GIS-based planning tools, green infrastructure monitoring, spatial analysis systems	Land-use data, emissions hotspots, green space expansion	Land use, transport, buildings	Identify emissions from urban sprawl and construction, promote compact city development, and track green zones
Municipal Cadastral Offices	Digital cadastral databases, data-sharing platforms, staff training	Building characteristics (age, floor area, energy sources), infrastructure data	Buildings	Integrate building data into energy models, identify retrofit targets, and support spatial emissions tracking
Municipal Environment Departments	Carbon monitoring sensors, biodiversity tracking tools, water-energy models	Carbon sequestration, cooling effects of green spaces, emissions from water and waste	Land use, adaptation, waste	Monitor carbon sinks, assess green space impacts, and link adaptation projects to emissions reductions
Remote Sensing and GIS Systems	GIS software, satellite imagery (Copernicus, Sentinel), drones	Land-use changes, tree cover, carbon sequestration	Land use, adaptation	Track afforestation, urban greening, and green infrastructure over time
Waste and Water Monitoring Technologies	Gas monitoring sensors, flow meters, methane monitoring at landfills and composting sites	Methane, NOx, CO_2 emissions from waste management and wastewater treatment	Waste, water	Measure emissions from waste treatment, guide landfill management, and improve wastewater mitigation
Smart Meters and Energy Monitoring Systems	Smart meters across buildings, centralized energy monitoring software	Real-time energy consumption data from municipal, residential, and industrial sectors	Buildings, energy supply	Automate data collection, track energy use trends, support decarbonization strategies
Environmental Officers and Energy Auditors	Hiring permanent staff (engineers, data analysts, energy auditors), real-time data collection devices	Energy use, emissions reports, validation of external data	All sectors	Monitor energy use and emissions across key sectors and validate data accuracy

Field Inspectors	Mobile inspection devices, on-site monitoring of fuel consumption, construction emissions, and waste management practices	Real-time data on fuel consumption, construction site emissions, and waste practices	Transport, construction, waste	Ensure accurate reporting and compliance with emissions reduction policies
Training and Capacity Building Programs	Training workshops on IPCC guidelines, GHG protocols, GIS, energy modeling, organized with universities and technical agencies	Knowledge on GHG accounting, emissions modeling, GIS mapping	All sectors	Equip staff to handle advanced data collection, emissions accounting, and policy evaluation
Community Engagement Programs	Awareness campaigns, online portals for voluntary energy and transport reporting, local NGO involvement	Energy consumption data, behavioral insights	All sectors	Foster participatory data gathering, involve residents and businesses in emissions reduction efforts
Collaboration Agreements	Data-sharing agreements with utilities, transport operators, waste management firms, construction companies	Scope 2 (electricity imports), Scope 3 (supply chains, construction materials)	Energy supply, construction	Maintain comprehensive and consistent data flow to track upstream and downstream emissions
Financial Investments	Funding staff salaries, maintaining equipment, training programs, EU funding (Horizon Europe, EIB, Structural and Investment Funds)	Financial resources for sustained emissions monitoring and capacity building	All sectors	Support long-term emissions reduction activities and ensure financial sustainability

8 Multi-Regional Input-Output (MRIO) Analysis for City-Level CO_2 Emissions

8.1. Framework Overview and Objectives

At its core, MRIO[2] analysis constructs a relational portrait of urban emissions, one that encompasses not only what is produced within a city's territorial perimeter, but also what is consumed by its residents, facilitated by its infrastructure, and embedded in its economic metabolism. This dual accounting allows for the simultaneous estimation of production-based and consumption-based emissions, refined through two key indicators:

Areal Carbon Footprint (ACF): Defined as the aggregate emissions stemming from all consumption-related activities within the geographic confines of the city, the ACF encompasses household consumption, public service provision, tourism, and investment in long-term assets, most notably, Gross Fixed Capital Formation (GFCF). Whether a tonne of CO_2 originates from a resident's gas stove, a visiting tourist's hotel stay, or the construction of a tram line, it enters the ACF. This measure renders the urban space as a totality of consumption, irrespective of the consumer's identity.

Personal Carbon Footprint (PCF): In contrast, the PCF attributes emissions specifically to the lifestyle and habits of resident households. It captures emissions from domestic energy use, personal mobility, and goods and services consumed by residents, regardless of origin. By excluding emissions from infrastructure investments, public services, and non-resident consumption, the PCF becomes an ideal metric for behavioural and lifestyle interventions, those aimed at energy efficiency, transport modal shift, and sustainable consumption.

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Allan, G., Connolly, K., & Maurya, A. (2023). The city within the global: A framework for the simultaneous estimation of city emissions metrics. Journal of Cleaner Production, 429, 139323. https://doi.org/10.1016/j.jclepro.2023.139323

8.2 Environmentally Extended Input-Output Tables

The analytical substrate of MRIO analysis is the input-output table, a matrix describing the interdependencies among economic sectors. In its environmentally extended form (EE-IOT), this table is augmented by emissions data, transforming a monetary flow chart into an emissions accounting system.

- **National Input-Output Tables (IOTs)**: Provided by Institutul Național de Statistică or Eurostat, these matrices capture the monetary exchanges among sectors at the national level. To transpose these to the urban scale, the MRIO framework requires their disaggregation and spatial attribution.
- **World Input-Output Database (WIOD)**: By embedding international trade flows and emissions intensities across countries and sectors, WIOD enables cities to account for emissions embedded in imports, steel from Ukraine, textiles from Bangladesh, electronics from East Asia. Thus, MRIO resists methodological nationalism by design.
- **The Leontief Matrix**: Derived from the technical coefficients of the IOT, the Leontief inverse captures both direct and indirect dependencies. An increase in demand for construction services, for instance, cascades through cement, electricity, logistics, and mining, each node contributing emissions, which are then aggregated to estimate the full environmental cost of a unit of final demand.
- **Emission Factors**: Each sector is assigned an emissions intensity (e.g., kg CO_2 per RON of output), allowing for the quantification of emissions induced by shifts in demand. These factors, linked to the Leontief matrix, produce a comprehensive picture of embodied carbon across the economic structure

Without such extensions, input-output tables remain agnostic to environmental concerns; their transformation into EE-IOTs marks the epistemological shift from economic analysis to ecological governance.

8.3 Regionalising Input-Output Tables

National tables, while analytically rich, lack the spatial specificity required for city-level policymaking. To construct regionalised input-output tables, several techniques allow for the adaptation of national flows to local realities.

- **Location Quotients (LQ) and Flegg's Location Quotients (FLQ)**: These indices adjust national coefficients based on a city's sectoral employment or Gross Value Added (GVA) share. For example, if Cluj-Napoca accounts for 2.8% of Romania's IT sector employment, this proportion is applied to the national IT sector's input flows, yielding a city-specific approximation.
- **Employment and GVA Data**: While Eurostat provides NUTS2-level GVA, more granular data must be reconstructed from balance sheets (via data.gov.ro), employment records (via the Territorial Labour Inspectorate), and local registries. These are crucial for sectors such as manufacturing and services, whose localisation patterns differ significantly from national averages.
- **Collaboration with INS Romania and Local Administrations**: Where statistical resolution is insufficient, institutional cooperation becomes indispensable. Direct access to municipal databases or county-level INS offices permits the calibration of input-output matrices to reflect urban economies' structural singularities.

Regionalisation is not a mere act of scaling down. It is an epistemic operation that demands judgment, inference, and strategic simplification, each decision altering the representation of urban economic causality.

8.4 Regionalising Emission Factors and Incorporating Environmental Extensions

The refinement of emission factors to reflect local conditions is both an empirical necessity and a methodological risk. Four strategies delineate the spectrum of possibilities.

— **Strict Mirroring**: This approach assumes that local emissions intensities are identical to national averages. Though methodologically expedient, it often leads to overestimation in service-oriented cities and underestimation in industrial hubs.

— **Electricity-Adjusted Coefficients**: Here, emissions factors for the electricity sector are modified based on the city's role in distribution versus generation. For instance, a city hosting no power plants but consuming imported electricity should reflect the emissions of grid generation, not local production.

— **Fuel Use-Adjusted Coefficients**: Using municipal energy balances or fuel sales data, emission factors are recalibrated to reflect actual fossil fuel consumption in transport, industry, and residential heating. This strategy improves the realism of inventories in fuel-intensive cities.

— **Combined Electricity and Fuel Use Adjustments**: The most refined approach merges local electricity consumption patterns with sector-specific fuel data. In Bucharest, for instance, where imported electricity predominates and service sectors dominate, this dual adjustment produces a more accurate portrayal of emissions.

By applying these techniques, cities correct the distortions inherent in national averages, allowing inventories to reflect not only local consumption but also the structure of local production systems. This correction is crucial for designing fair and effective mitigation strategies, ones that neither overburden nor absolve urban economies inappropriately.

8.5 Local Data Sources for Regionalisation

PThe final condition for a functional MRIO system lies in the availability, and mobilisation, of local data. Without it, regionalisation remains speculative.

— **Demographic and Consumption Data**: Obtained from municipal registries or INS Romania, these data inform household consumption patterns, per capita emissions, and modal shares in transport.

— **Sectoral Employment and GVA**: Derived from company balance sheets, municipal budgets, and tax registries, these data allow for the calibration of the economic structure underlying the regionalised IOTs.

— **Energy and Fuel Use**: Utility companies, district heating providers, and fuel distributors serve as primary sources for quantifying local energy demand. Municipal climate action reports further supplement this with sectoral disaggregation.

— **Industrial Output and Turnover**: Data from large employers, business registries, and local chambers of commerce permit the refinement of emissions coefficients in capital-intensive sectors such as metallurgy, logistics, and cement.

— **Waste and Wastewater Statistics**: Provided by local operators, these figures underpin methane and nitrous oxide estimates for the waste sector, critical for full-spectrum emissions accounting.

Transport Statistics: VKT, ridership levels, and fleet composition, often scattered across public transport operators, traffic departments, and mobility surveys, must be consolidated into a coherent emissions module.

To access and integrate these datasets, municipalities must establish institutional partnerships, with county-level statistical agencies, energy providers, industrial associations, and research institutes. These relationships are not ancillary; they are the institutional infrastructure of knowledge production.

Table 12
Steps and Data Sources for Developing Environmentally Extended Input-Output Tables (EE-IOTs)

A structured outline of key data requirements, sources, and the transformation processes used in constructing EE-IOTs.

Step	Data Required	Sources	Transformation or Calculation
1. Data Collection	- National Input-Output Tables (IOTs)	- Romanian National Statistical Institute (INS), Eurostat	No transformation; base dataset for inter-sectoral dependencies analysis.
	- World Input-Output Database (WIOD)	- WIOD, international sources	No transformation; complements national tables with global linkages.
	- Population and demographic data	- INS Romania, city registries	Used to estimate household consumption and transportation demand.
2. Regional-ization of Input-Output Tables	- Emissions coefficients (national or global)	- WIOD, Eurostat environmental accounts, IPCC	Base emissions factors by sector.
	- Sectoral employment and GVA	- INS Romania (regional GVA data), data.gov.ro for company-level data, local chambers of commerce	Apply Location Quotient (LQ) or Flegg's Location Quotient (FLQ) methods to derive city-specific input-output tables.
3. Regional-ization of Emission Factors	- Industrial output and turnover	- Regional industrial reports, national company databases, large companies' financial reports	Weighted allocation of national outputs to city-specific input-output tables based on turnover ratios.
	- Sectoral fuel mix and energy consumption data	- Utility companies, local fuel distributors, municipal energy reports	Adjust emissions coefficients (electricity and fuel use adjustments) using local fuel consumption patterns and energy mix.
	- Sectoral electricity and fuel consumption	- Utility companies, local energy agencies (e.g., ABMEE), municipal climate action plans	Direct mapping to sectors; used for regionalizing emission factors (electricity and fuel-use adjusted coefficients).
	- Local data on electricity distribution vs. generation	- Employment in non-generation activities (e.g., administrative services), energy agencies	Adjust the electricity coefficient to reflect non-generation activities (e.g., grid distribution and services).
4. Environ-mental Extensions to IOTs	- Environmentally Extended IOTs (EE-IOTs)	- Derived from IOTs and local emission factors	Integrate emission coefficients with the Leontief inverse to assess the impact of changes in final demand.
5. Calculation of Emissions	- Final demand by sector	- Household consumption surveys, INS, municipal databases	Production-Based Carbon Account (PBCA): Apply emissions coefficients to sectoral output to compute local production-based emissions.
	- Final demand by sector	- Household consumption surveys, INS, municipal databases	Consumption-Based Carbon Accounts: Compute ACF (total consumption-based emissions) and PCF (household-specific emissions).
6. Scenario Analysis and Sensitivity Testing	- Energy transition plans, infrastructure investment plans	- Local climate action plans, national renewable energy projects	Test different scenarios, such as expanding public transport or increasing renewable energy share.
7. Reporting and Monitoring	- Consistent reporting through established frameworks	- GHG Protocol, European Energy Award (eea), data.gov.ro	Continuous monitoring using reported data and real-time sensors where applicable; adjust strategies based on results.

8.6 Calculating Production-Based and Consumption-Based Emissions

Once the environmental extensions have been judiciously incorporated, emission coefficients refined, regionalised, and linked to sectoral outputs, the MRIO apparatus becomes analytically operational. The ensuing calculations bifurcate along two complementary but epistemologically distinct lines: the Production-Based Carbon Account (PBCA) and the Consumption-Based Carbon Account (CBCA), each illuminating different modalities of urban responsibility.

— **Production-Based Emissions (PBCA)**: These are computed by applying adjusted emissions intensities to the output of local sectors, capturing all greenhouse gas emissions physically generated within the city's territorial boundaries. Whether through manufacturing, construction, local transport, or waste treatment, the PBCA reflects the carbon implications of endogenous economic activity. This metric, spatially grounded and policy-sensitive, enables the identification of sectoral concentrations of emissions and provides the empirical basis for targeted mitigation strategies, particularly those involving technological upgrades, regulatory intervention, or fuel substitution.

— **Consumption-Based Emissions (ACF and PCF)**: In contrast, the CBCA traces emissions embedded in final demand, be it from residents, visitors, or institutions. The Areal Carbon Footprint (ACF) captures all consumption-related emissions occurring within the city, regardless of the emitter's residence status. It includes emissions from local consumption, tourism, and capital formation. The Personal Carbon Footprint (PCF) narrows the analytical lens to resident households, omitting public infrastructure and collective services. These distinctions matter: while the ACF offers a panoramic portrait of urban carbon metabolism, the PCF is better suited for designing lifestyle-based interventions and behavioural change policies.

8.7 Scenario Analysis and Policy Recommendations

MRIO's value does not reside solely in retrospective accounting. Its diagnostic potential becomes truly operational when deployed in the form of scenario analysis, a tool for simulating futures and stress-testing policy interventions. Through variations in final demand, emissions coefficients, or energy mixes, cities can model the systemic repercussions of specific decarbonisation pathways.

— **Example**: Retrofitting residential and tertiary buildings in Cluj-Napoca not only diminishes direct energy use but also reduces reliance on imported electricity and heating fuels, thereby affecting both Scope 1 and Scope 2 emissions. By altering household final demand, the scenario further contracts upstream emissions embedded in construction materials, appliances, and heating technologies.

— **Electric Transport Promotion**: Shifting modal shares toward electric public transport yields compound benefits. Locally, tailpipe emissions vanish; regionally, emissions shift to the electricity grid. If the grid is decarbonised concurrently, total emissions fall. The MRIO model reveals these trans-scalar effects, wherein local decisions reverberate across national and even international supply chains.

— **Policy Tailoring**: For cities such as Iași or Brașov, the expansion of renewable energy production (photovoltaics, biogas, district geothermal) may provide the highest marginal gains in emissions reduction. For Bucharest, behavioural interventions and service sector decarbonisation may prove more effective, given the city's role as a consumption hub.

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8.8 Monitoring and Reporting Framework

No emissions accounting system can claim legitimacy in the absence of monitoring and reporting protocols. MRIO models, despite their sophistication, must be embedded within institutionalised frameworks of verification, calibration, and iterative refinement.

— **Standards Alignment**: The MRIO system should be harmonised with internationally recognised frameworks such as the GHG Protocol for Cities (ICLEI–WRI) and the European Energy Award (EEA), both of which provide methodological guidance and benchmarking tools for local governments.

— **Temporal Continuity**: Regular data updates, annually for consumption, biannually for structural coefficients, ensure that inventories remain relevant. Adjustments must be made as energy mixes evolve, behavioural patterns shift, or economic structures undergo transformation.

— **Public Accountability**: Transparent dashboards, data visualisation platforms, and community-facing reports transform emissions inventories into instruments of civic engagement. MRIO thus becomes more than a technical model, it becomes a political tool for participatory governance.

— **Institutional Architecture**: A dedicated MRIO unit within the municipal administration (ideally under the department of climate and sustainability) must coordinate data collection, model maintenance, scenario testing, and policy alignment. This unit would interface with utilities, industrial partners, research institutions, and national agencies to ensure cross-sectoral coherence.

9 Data Governance for Net Zero Cities

9.1 Integrating Energy, Emissions, and Consumption Behaviour Data

To govern emissions is, first, to know them in their full social and spatial complexity. This entails an expansion of the informational scope, from standardised energy usage statistics to the more diffuse registers of everyday practice: how residents heat their homes, which transport modes they favour, how waste is sorted or discarded. Such behavioural data, often captured through periodic surveys, must be systematically integrated with conventional energy and emissions datasets.

A multi-scalar logic of disaggregation is essential. Data must be resolvable at the scale of buildings, blocks, and neighbourhoods. Only then can policies respond to differentiated socio-economic profiles and infrastructural legacies. For instance, electrification strategies in peripheral housing estates will require distinct interventions from those in dense historic centres. Behavioural datasets, thermostat settings, car usage frequency, appliance profiles, are not auxiliary; they are central to designing equitable and effective decarbonisation measures.

9.2 Establishing a Centralised Data System for Monitoring Progress

A centralised, interoperable data platform constitutes the backbone of any functional emissions governance regime. It must consolidate real-time and historical data from utilities, transport operators, municipal departments, and even private households, each contributing a fragment of the carbon narrative. This system, ideally cloud-based, should be equipped to process standardised indicators linked to specific mitigation goals: reductions in GHG intensity per capita, shifts in mode share, improvements in building energy performance. However, utility does not derive solely from integration, it also requires legibility. Thus, data dashboards, interactive mapping interfaces, and temporal comparison tools must be embedded into the platform. The experience of cities such as Copenhagen and Oslo underscores the value of intuitive visualisation: not as a cosmetic feature, but as an instrument of decision support, enabling both technocratic oversight and public scrutiny.

9.3 Ensuring Data Accessibility and Transparency

Opacity is antithetical to democratic climate governance. Transparency, by contrast, transforms data from a proprietary asset into a public good. Open-access portals, such as that of Barcelona, demonstrate how policy legitimacy and citizen engagement can be strengthened through granular public access, provided sensitive data (e.g., individual billing) is adequately anonymised or aggregated. A semi-open architecture, in this regard, is prudent. While protecting individual privacy, it allows researchers, civil society actors, and municipal planners to engage in independent assessment, simulation, and critique. Metadata must accompany datasets, not only documenting sources and methods but also clarifying temporal resolution, geolocation, and uncertainty margins. Formalised data-sharing agreements between cities, utilities, and research centres (e.g., through memoranda of understanding or standard data use agreements) should institutionalise these flows.

9.4 Defining Data Types, Collection Responsibilities, and Storage Protocols

Effective data governance is inseparable from institutional clarity. What must be known, who must collect it, and how it must be stored, these questions cannot remain ambiguous. The following categories delineate core data types.

— **Energy Consumption**: Disaggregated by source (electricity, gas, biomass) and sector (residential, tertiary, industrial), ideally at the meter or building level.
— **Transport Activity**: Mode share, fuel types, VKT, fleet composition, and public transport usage.
— **Building Performance**: Energy efficiency ratings, retrofit status, envelope integrity, and heating systems.
— **Waste and Water**: Volume and type of waste, treatment pathways, methane recovery data, and wastewater treatment emissions.
— **Behavioural Indicators**: Survey-based data on energy use practices, mobility choices, and attitudes toward sustainability.

Municipalities should assume the role of coordinating nodes, not always the producers of data, but the architects of its integration. Cloud-based servers with automated APIs must be deployed for secure storage, version control, and user-specific access. Machine learning techniques, while no panacea, can assist in pattern recognition, outlier detection, and forecasting, provided that ethical and methodological safeguards are observed.

9.5 Addressing Current Data Gaps and Examples of Missed Opportunities

Despite growing commitments to decarbonisation, most Romanian cities still operate with data blind spots. Among the most critical: the absence of high-resolution, building-level energy data, which compromises the targeting of retrofit investments and the calibration of efficiency gains. In district heating upgrades, for example, cities have often failed to capture post-intervention emissions reductions, thus impeding replication and scaling. Quarterly or annual data collection rhythms are another liability. Seasonal fluctuations, short-term demand spikes, or anomalous weather effects are masked in low-frequency reporting. Smart meters and IoT-based monitors can rectify this, permitting not only real-time monitoring but also the construction of more nuanced baselines and interventions responsive to temporal dynamics. Moreover, the lack of disaggregation by socio-economic status restricts the design of just climate policies. Without understanding how energy burdens vary by income, household size, or dwelling type, cities risk reproducing inequalities under the banner of neutrality.

9.6 Localised Data Collection and Urban-Level Analysis

Applied research cannot flourish in a data vacuum. A semi-open system, protected by encryption and governed by data use protocols, permits collaboration without compromising confidentiality. Under such a system, anonymised datasets, metered energy use, mobility traces, building stock features, could be accessed by universities, NGOs, and private firms under defined conditions. Universities are well-positioned to conduct scenario modelling, cost-benefit analyses, and policy evaluations, provided data flows are consistent and methodologically traceable. Data-sharing agreements should specify purpose, time limits, data handling protocols, and intellectual property clauses. Secure servers and decentralised data architecture would further enhance resilience.

9.7 Developing a Semi-Open Data System for Applied Research

Applied research cannot flourish in a data vacuum. A semi-open system, protected by encryption and governed by data use protocols, permits collaboration without compromising confidentiality. Under such a system, anonymised datasets, metered energy use, mobility traces, building stock features, could be accessed by universities, NGOs, and private firms under defined conditions. Institutions are well-positioned to conduct scenario modelling, cost-benefit analyses, and policy evaluations, provided data flows are consistent and methodologically traceable. Data-sharing agreements should specify purpose, time limits, data handling protocols, and intellectual property clauses. Secure servers and decentralised data architecture would further enhance resilience.

9.8. Priority Action Areas for Data Collection and Governance

Transforming current practices into a climate-intelligent data ecosystem requires, above all, a reorientation of institutional priorities and infrastructural investments toward integration, accessibility, and strategic foresight. Central to this endeavour is the codification of a multisectoral data inventory, one that clearly delineates the datasets to be collected, the entities responsible for collection, the frequency of updates, and the protocols governing access. Yet such codification must be embedded within a broader architecture of collaboration: public–private partnerships with utility providers and mobility operators must be institutionalised through binding data-sharing agreements, ensuring that vital information flows are not left to ad hoc arrangements. At the infrastructural level, sustained investment in cloud-based systems is indispensable, not merely for storage, but to guarantee interoperability, cyber-security, and real-time processing across platforms. In parallel, open-data policies must be operationalised, allowing non-sensitive data to be released in standardised, machine-readable formats that support both public scrutiny and academic research. The physical substrate of this ecosystem lies in the rapid deployment of smart monitoring devices, smart meters, air quality sensors, IoT systems, capable of capturing fine-grained, continuous data across energy, transport, and environmental domains. Underpinning all these elements is the imperative to build institutional capacity: cities must establish dedicated data governance units, endowed with adequate resources, trained personnel, and inter-agency mandates, capable not only of managing data flows but of orchestrating a transition to informed, anticipatory urban climate governance.

10 Investments in Data Economies as Local Economic Multipliers

Before one can conceive of climate neutrality as an operational horizon, it is necessary to reconceive the infrastructure of urban economic development itself, not merely as a passive stage for the application of environmental policy, but as an active terrain where data, digitalisation, and sustainability coalesce into a new mode of economic regeneration. In this sense, the expansion of urban data ecosystems, particularly those oriented toward energy infrastructures, environmental monitoring, and resource circularity, must be understood not solely in terms of climate policy compliance, but as productive investments, capable of generating returns across multiple dimensions: technological, fiscal, and territorial.

When municipal administrations embed smart technologies, smart meters, IoT-enabled devices, GIS platforms, into their infrastructural landscape, they do not merely collect data; they inaugurate new circuits of value. These technologies require procurement, installation, calibration, and ongoing maintenance, much of which falls within the competence of local small and medium-sized enterprises (SMEs). Their involvement, ranging from device engineering and software customisation to data analytics and interface design, forms the nucleus of digitally enabled industrial clusters. Such clusters, often anchored in proximity to universities or innovation districts, benefit from cumulative learning effects and knowledge spillovers. They enable the emergence of high-skilled employment ecosystems and generate intellectual property that can be both licensed and exported. Romanian cities, should they invest strategically in this domain, stand to reposition themselves not as passive recipients of foreign climate technologies, but as producers of situated digital expertise, relevant across comparable contexts in Central and Eastern Europe.

Beyond hardware and software, the architecture of a data economy requires epistemic capacity, the ability to model, simulate, interpret, and advise. Here, universities and research institutes, are not auxiliary stakeholders but central engines. By fostering partnerships with local governments and SMEs, they contribute directly to the co-production of emissions inventories, smart grid simulations, and sustainability diagnostics. This consolidation of applied knowledge gives rise to a consultative economy: research centres and spin-offs offering services, model calibration, policy evaluation, scenario development, to other municipalities. These services, supported through programmes such as Horizon Europe or Interreg, generate both employment and reputational capital. Over time, such cities can become nodes in transnational climate knowledge networks, exporting both data infrastructure models and the institutional protocols that govern them. Furthermore, the academic sector can support human capital development by creating degree programmes and micro-credential tracks in smart cities, energy informatics, and climate governance, attracting students regionally and positioning universities as educational hubs within European innovation corridors.

Investments in circular economy data models, those capable of tracking material flows, recycling loops, and resource efficiency, foster not only environmental gains but local industrial competitiveness. By rendering visible the lifecycle of materials, cities can identify inefficiencies, reduce dependencies on imported raw materials, and support the scaling of local production systems based on reuse, refurbishment, and remanufacturing. Such systems require interoperable data platforms linking municipal waste operators, manufacturers, logistics firms, and retailers. When realised, this infrastructure enables real-time resource optimisation: material stocks are traced, waste streams revalorised, and secondary raw materials fed back into production cycles. In this loop, local firms emerge as suppliers of both goods and digital services, with exportable potential in regions facing similar resource constraints. Thus, the data economy becomes not just a vehicle for monitoring, but a means of reindustrialisation, albeit on post-extractive terms.

Urban transport, long a source of emissions and congestion, becomes a site of economic dynamisation when governed through data. Real-time monitoring of traffic flows, vehicle emissions, and public transport uptake informs both infrastructure investments and behavioural incentives. Cities implementing data-enabled mobility systems, electric bus fleets, congestion pricing, pedestrian priority zones, witness not only environmental improvements but fiscal and commercial gains. Such interventions stimulate adjacent sectors: the installation and maintenance of charging stations, the expansion of shared mobility platforms, the retrofitting of public space for active transport. Local businesses benefit from increased foot traffic and air quality gains, while engineering and design firms secure new contracts. Moreover, tourism and real estate experience positive externalities, as clean, navigable cities become more attractive to investors and visitors alike.

The decentralisation of renewable energy production, whether solar photovoltaics, micro-wind, or biomass, is often constrained not by resource potential, but by the lack of predictive, real-time data systems. Through scale deployment, smart monitoring platforms would allow cities to synchronise production with demand, forecast fluctuations, and optimise grid loads. In doing so, they would stabilise energy costs, reduce reliance on volatile imports, also ensuring long-term fiscal sustainability. In addition, the revenue generated through feed-in tariffs or local electricity markets could be reinvested into social or infrastructural projects, thus, reinforcing distributive justice. At the same time, the local expertise developed in system integration, storage optimisation, and regulatory navigation becomes a tradable knowledge asset, enabling Romanian cities to participate actively in European energy innovation ecosystems.

In sum, investments in data infrastructures for climate governance are not merely technical or instrumental; they are strategic, generative, and distributive. They reconfigure the urban economy around informational sovereignty, innovation capacity, and territorial embeddedness. The data economy, when aligned with climate neutrality objectives, becomes a multi-sectoral multiplier, stimulating job creation, institutional innovation, and international competitiveness. Romanian cities stand at a threshold: by embedding data governance into urban development plans, not as a support function but as a foundational logic, they can transition from peripherality to leadership in the European Green Deal architecture. In this vision, data is not a means to track what already exists; it is the medium through which new economic futures are conceived, modelled, and enacted.

Mirror Mission Cities Hub Romania

Possible Cities

Integrated toolkit for climate neutrality

Administrative instruments

Urban planning centers
Public policies and financial instruments
Public procurement — green criteria
Competition for solutions

Dorin Beu
Claudia Pamfil
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Administrative instruments

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1 Administrative tools

1.1 Introduction

While climate change adaptation and mitigation are global challenges, there is a consensus on localized contributions at local government level in creating the necessary conditions and facilitating a transition to a circular economy and the achievement of collective national and European climate goals. The Paris Agreement recognizes the significant role not only of the signatory countries, but also of local governments, underlining that the involvement of all levels of government is the main pillar in addressing climate change, in accordance with the national laws of the signatory parties. Similarly, the European Green Pact identifies local authorities as key partners working with EU institutions and advisory bodies to combat climate change through a range of initiatives that directly support local governments in their efforts to reduce their emission levels and adapt to the effects of climate change (EC).

In the context of economic, social and climate transformations, traditional models of governance are increasingly challenged by territorial fragmentation, regional inequalities and unequal distribution of development opportunities. An analysis at the Romanian level shows that the last decade has not only been a period of economic prosperity, but also one of deepening regional disparities, and that the benefits of post-socialist transition and European integration are unevenly distributed, with a strong polarization between urban and rural areas: while the capital and other large cities have been able to attract high levels of investment that have created better jobs, in large rural areas people are finding it difficult to earn a living. In today's context of the need for transformation driven by climate change and the concentration of investment in developed urban areas, these disparities risk widening as long as local problems are not fully understood, and solutions are not tailored to the specific context of each region.

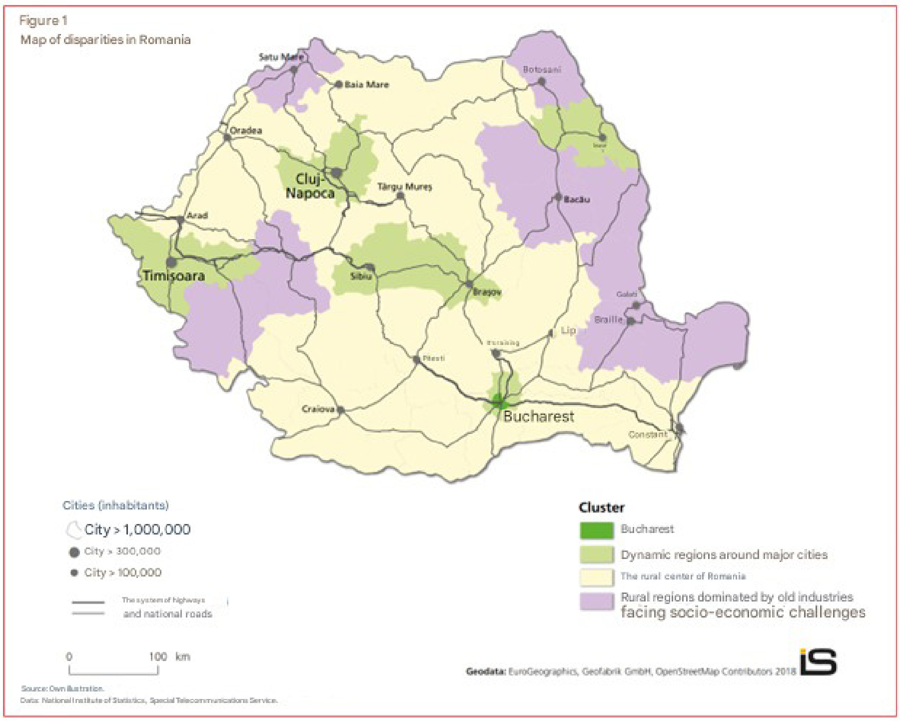

Fig. 1

Map of disparities in Romania.
Source: https://www.fes.de/ro/politici-pentru-europa/romania-inegala

Multi-level governance (MLG) provides a necessary framework for the coordination of public policies between local, regional, national and supranational levels, ensuring a balance between the overall strategic vision and concrete implementation at local level. An essential element of this governance model is decentralization. In Romania, decentralization has been consolidated through a series of normative acts, among which the most important are: the Decentralization Framework Law 195/2006, which establishes the fundamental principles of the decentralization process, such as subsidiarity, the provision of resources corresponding to the transferred competences and the accountability of local public administration authorities in relation to the competences they are entrusted with; OG 57/2019 on the Administrative Code, which integrates and updates the regulations on public administration, including decentralization issues. Article 77 details the rules of the decentralization process, emphasizing the importance of the transfer of competences from the central to the local level.

The decentralization process therefore implies strengthening local autonomy and applying place-based policies as solutions to local problems, covering political, administrative and fiscal dimensions. As regions and metropolitan areas become key actors in the management of investments, infrastructure and public services, they acquire a strategic role in the transition towards climate neutrality. Climate policies cannot be effective without the active involvement of local authorities, which are closest to the economic, social and environmental realities of the communities they manage. Moreover, decentralization and climate policies are interlinked, as cities and regions must implement measures to reduce carbon emissions, adapt to climate change and develop green infrastructure, while national governments and European institutions provide strategic guidance, funding and legislative frameworks. So decision-making authority and policy implementation are shared between local, national and European levels. These relationships reflect several key dimensions of governance:

— Vertical coordination: localities align their policies with national and European policies, where EU and national policy provide the regulatory framework and financial instruments, and local administrations implement environmental policies on the ground;
— Horizontal coordination: municipalities from different Member States engage in mutual learning and joint initiatives through EU-funded networks and beyond. E.g. Covenant of Mayors, Green Cities Agreement, Urban Nature Platform, Eurocities etc.;
— Bottom-up and top-down interaction. Governance dynamics are not purely top-down. Cities have become an increasingly important presence in EU decision-making through consultative mechanisms such as the Committee of the Regions and the multi-level dialogue on climate and energy, mandated by the European Climate Act. This allows cities to influence EU environmental policies, while also receiving EU guidance and oversight.

1.2 Link between (sectoral) public policies and between policy and action levels

Incoherent public policies and fragmentation of actions reduce the scope for improving the overall situation, and there is even a risk that some actions cancel each other out, thus seriously reducing effectiveness and unduly increasing costs, in particular environmental and social costs. The ambitious objectives of moving towards climate neutrality cannot be achieved without a rigorous, continuous linking of actions across the different areas involved. Important aspects of this linkage are already foreseen in the planning processes and should be reflected in integrated action plans and a unified monitoring system, but there may be shortcomings in this respect due to, on the one hand, outdated and unlinked planning documents and, on the other hand, the way of working based on separate administrative departments and subordinate units, which increases the risk of slippage.

Lack of observation, analysis and evaluation mechanisms to direct urban development in the public interest towards achieving climate resilience and climate neutrality goals can lead to improvisation, inconsistency, imprecision, unpredictability, and the misalignment of planning and prioritization of public investment and financial planning with strategic documents, sectoral public policies and urban planning can lead to failure to achieve targets, undesirable impacts (segregation, marginalization, underequipped areas, uncontrolled urban sprawl), waste of resources or unjustified future burdens.

Recommendations/How?

— **analysing the broader** (integrated) context of an issue or the achievement of an objective and recognizing the potential knock-on effects in different domains and the implications for the different parts of the administrative apparatus and the different subordinate institutions or collaborative/partnership structures corresponding to these domains;

— **setting up or strengthening institutional mechanisms for horizontal coordination** between departments, directorates and services in the organizational chart, as well as vertical coordination between regional, metropolitan/functional urban area, local, administrative sub-units - as in the case of Bucharest -, subordinate institutions (public domain administrations, agencies) and public enterprises, in order to resolve policy divergences early on and find trade-offs between different sectoral priorities, and for information exchange and allocation of responsibilities and resources;

— **Regular** (if not continuous) inventorying and auditing of possible discrepancies between the adopted strategic documents, urban planning documents and administrative acts - decisions of the local (or general, as the case may be) council and correcting them by cancelling or updating administrative acts - e.g. the existence of local council decisions that establish the obligation to provide a minimum number of parking spaces, in contradiction with the objectives of low-emission zones or with the urban planning regulation that stipulates not to exceed a maximum number of parking spaces;

— **Establishing a system of labelling** (visible and publicly visible) of administrative acts, so that it is easy to trace which (climate transition) objectives, measures or actions correspond to which administrative acts

— **linking the contents of the opinions and agreements**, as administrative operations prior to the issuance/adoption of the administrative act, so that they show how the request/proposal concretely responds to the elements monitored by the climate transition;

National climate strategies and policies

The National Integrated National Energy and Climate Change Plan (NIICP) sets emission targets, energy transition and climate change adaptation measures. The plans provide a framework for each Member State to define concrete scenarios, trajectories and measures to meet national and European climate targets, in the context of EU legislation such as the Fit-for-55 package and the Effort Sharing Regulation (ESR) which sets national GHG emission reduction targets up to 2030 in the transport, buildings, agriculture, small industry and waste sectors. The GHG emission reduction target, negotiated at European level in the framework of the ESR for Romania and made mandatory, is -12.7% GHG emissions compared to 2005.

National and regional decarbonization plans, including sector-specific strategies for buildings, mobility and industries.

National and Local Legislation:
— National environmental legislation and specific measures to integrate climate policy into urban planning, such as regulations for building renovation, mobility and renewable energy systems.
— Specific regulations targeting energy efficiency, including strategies to reduce emissions from the transport and industry sectors.

Align local strategies with national and European strategies
In developing circular economy strategies and action plans, local governments can adopt a variety of tactics tailored to the local and national context. Examples such as Shenzhen have developed policies directly linked to national visions, closely aligned with national plans. Others, such as Paris, have created local plans in parallel with national strategies, and cities such as London or Brussels have started to develop roadmaps before national visions were defined. Many European cities have also taken inspiration from the EU's Circular Economy Action Plan to create their own local strategies.

Establishing progress indicators and an evaluation framework (e.g. recycling rates, air quality, pollution, use of renewable energy sources, but also other types of indicators such as number of jobs created, new skills acquired, etc).

Active involvement of a wide range of urban actors and citizens, participation in the decision-making process of developing local strategies.

Adopt a prioritized sectoral approach that can prioritize emission reductions.

Aligning local and regional budgets with climate targets
Green budgeting is a process of analysing and labelling budgetary and fiscal expenditures that contribute to achieving environmental objectives, i.e. assessing the environmental impact of budgetary or fiscal policies; a practice whereby public authorities integrate environmental and sustainability considerations into the budget planning and execution process. In Romania, green budgeting was approved by GEO 75/June 2024 and the implementation stage is still in its early stages. At local level green budgeting will be applied from 2026.

The process of analysing and labelling the budgetary expenditures of the budgets referred to in Art. (2) of Law no. 273/2006 on local public finances, as amended and supplemented, shall be applied as of 2026.(2) At the local public administration level, the process of analysis and labelling of budget expenditures shall cover the local public investment expenditures included in the budget, based on the public investment program of each administrative-territorial unit, in the development section.

Green budgeting tools consist of scoring budgetary and fiscal expenditure according to the 6 environmental objectives as set out in EU Regulation 2020/852: climate change mitigation, adaptation to climate change, sustainable use and protection of water and marine resources, transition to a circular economy, pollution prevention and control, and protection and restoration of biodiversity and ecosystems. Beyond the opportunities arising from aligning financial decisions with climate objectives, prioritizing investments in sustainable and low-carbon projects, green budgeting can help local governments to mobilize additional sources of public and private finance, reducing financing gaps while meeting the requirements of transparency and accountability in their actions.

At the same time there are several challenges: methodological, operational, resource and political. The lack of standardized methodologies tailored to the specific budgetary specificities of local governments is a major methodological hurdle, while resource constraints are both human and financial. From an operational point of view, one of the difficulties is to create a dedicated organizational structure based on cross-departmental coordination. At the political level, maintaining constant support from the administration and decision-makers, stakeholder involvement and balancing social and environmental objectives are key to the success of this practice. Moreover, to have a sustainable impact, green budgeting needs to be integrated into an ongoing strategy, not just applied occasionally (OECD, 2022).

Other fiscal measures with the potential to facilitate cities' transition to a circular economy in financial terms and at the same time generate additional revenues can be in the form of taxes, charges, fees or fines that can be used both to incentivize beneficial market behaviours and developments and to discourage unsustainable practices.

1. Built environment, renovation of existing buildings

Member States have a central role in setting priorities for the renovation of buildings, while respecting certain constraints imposed by the Directive. In the case of residential buildings, the focus should be on those with the poorest energy performance for two main reasons. First, investments in these buildings generate the highest economic benefits, offering the best cost-effectiveness ratio. Secondly, there is a significant social impact, as these buildings often house vulnerable citizens for whom improved living conditions are essential. Thus, the renovation of poor performing buildings is at the intersection of social policy, climate and environmental policy and economic policy.

Tools: Building Renovation Passport, Energy Performance Certificates, Minimum Energy Performance Standards (MEPS), MC001 - methodology for calculating the energy performance of buildings.

2. Local Public-Private Partnership (PPP) policies

Local authorities play a key role in stimulating collaboration between the public, private and civil sectors. Involving diverse stakeholders in the formulation and implementation of public policies is crucial for innovation and systemic change, especially in the context of the circular economy. Building strategic partnerships can ensure greater outreach, shared accountability and mutually beneficial outcomes.

Instruments: ESCO contracts, fiscal instruments

Dissemination and technical assistance actions

Through information and dissemination campaigns on the benefits and opportunities of the transition to a circular economy, local authorities can gain support from citizens in achieving their collective climate goals.

Instruments: One stop shops

2 Attracting or sharing capacity and increasing skills (for coordination, monitoring, evaluation)

2.1 Capacity to coordinate the implementation of plans and actions

A key feature of effective climate action and energy neutrality is enabling climate change governance arrangements, the leadership role of local authorities and the way in which partnerships in vertical (between local, regional and national authorities) and horizontal (civil society, private sector and public authorities) governance are developed. The role of transition manager is that of local authorities and therefore a common, consistent direction for the transformation processes is needed. Thus, the new governance models should encourage public administration to evolve from traditional, separate structures towards more holistic, strategic, cross-cutting, integrated and citizen or stakeholder-oriented structures, ideally with common objectives and well-defined actions.

Effective management involves not only decision making and problem solving but also requires a pro-active attitude to research and seize opportunities, both within and outside the organization. Problem solving by its nature is reactive. But opportunities require a pro-active style that involves a course of action that anticipates necessary changes.

Organizations are set up to perform some functions, but these functions are changing. Organizational charts are designed to show how formal authority is distributed at different levels of the organization, a fixed image to convey reality in a dynamic world, sometimes showing hierarchies instead of collaborations, routine instead of initiative. But the shape of the organization should reflect what the organization wants and/or is mandated to achieve. In a program-based and thus results-oriented approach, as is also necessary for the transition to climate neutrality, the way of working must be interdisciplinary and interdepartmental. A programme-based organization in which employees actively contribute to policy-making is much more attractive to job-seekers.[1]

If the city or metropolitan area does not yet have an urban planning centre that would best provide the necessary skills and way of working [2], then it is preferable that the process is led by the public administrator[3] with a management contract updated accordingly.

Recommendations/How?

— Establishing as early as possible the necessary internal partnership framework, including communication arrangements; it is useful to formally record the fundamental principles underpinning the team's collaboration and the working methods that will be used;
— The process of transition to climate neutrality should not be seen as an end point in the preparation of technical documentation, but rather as a governance tool that generates decisions and actions of strategic value for community development;
— A solid management structure (supported by strong political leadership) in which the local authority is the coordinator, but not the only active organization; the involvement of stakeholders who participate in the preparation of the action plan and actions and, subsequently, of new relevant actors who can strengthen the implementation of the initiatives, generating a favourable climate for the creation of partnerships between public and private actors that allows a more efficient, rapid and targeted implementation, facilitating also its regular updating;
— Activating communication processes, by establishing measures to keep interest and participation high throughout the process and providing accurate and focused information to the actors responsible for action at various stages of the process.

Good practices on the capacity to manage and coordinate the planning and implementation processes of integrated initiatives have highlighted some recommendations of actions needed and actions to avoid:

1

https://mrsc.org/stay-informed/mrsc-insight/june-2022/making-government-work-attractive

2

See the next section on this.

3

c. Art. 244, 245 și 543 ale Ordonanței c. Articles 244, 245 and 543 of Emergency Ordinance No. 57 of 2019 on the Administrative Code..

FROM	NO
DO systematize planning efforts into a well-defined, repeatable process procedure.	DO NOT implement a process just to satisfy a particular program or funders' requirements
YES take into account the existing legal framework in terms of legitimizing the process and results of implementation	DO NOT rely on the attitude that only what is written in the law is allowed; it is the other way around: what is not written in the law is allowed!
DO involve all relevant local government departments (including finance, human resources, communication, etc.) and elected representatives in the process	DO NOT leave the task of organizing the process to one department
DO adapt to the existing organizational framework and resources, but also be creative in matching them to the process	DO NOT avoid creating changes to the internal organization rules
YES ensure that the core task has the right legitimacy, a clear understanding of responsibilities and includes sufficient staff to support the process	DO NOT assign or receive tasks if there are no skills needed to perform them (consider training for possible missing skills)
YES establish working relationships based on interdependent needs and respect, not hierarchies and influence	DO NOT consider some members of the working group or even some stakeholders more important than others
YES develop and design an explicit communication plan	DO NOT let communication activities happen only after decisions have been taken
YES consider outsourcing certain services where no one has the necessary skills	DO NOT outsource the management/ coordination process; avoid putting local government in a passive position.
DO be flexible to change the whole context during the process	Do NOT rush the process for the sake of reporting results
YES control the process in relation to the established and possibly readapted phases	DON'T let the process happen by itself - important steps and information may be missed
YES ensure a comprehensive collection of data and information in an open manner	DO NOT collect only information that is convenient for possible interventions already planned
YES ensure a transparent and open method for determining the area of intervention	DO NOT channel interventions in an already established area without specific analysis and criteria
YES make sure there is a match between resource allocation and objectives	DO NOT create false expectations; however, DO NOT apply resource-generated interventions (don't choose a funding opportunity without analysis and integration and maintaining the strategic perspective)
YES consider synergetic multi-sectoral projects to achieve the objectives	Do NOT consider a project to be exclusively an investment; a project is basically something designed for the future, it also contains social, educational or cultural measures etc.
YES consider real alternatives by using consultative tools	DO NOT delay the identification and evaluation of alternatives for too long; DO NOT launch unnecessary alternatives or only permutations of options

DO ensure that all funding procedures (and their duration) are included in the timetable of activities, especially if there is more than one funding source; submit regular progress reports to which are necessary for the timely release of reimbursements.	DO NOT think about monitoring and evaluation activities only at the end of the process - but plan them from the beginning and consider benchmarks and reporting on intermediate successes/achievements
YES maintain full transparency about the process itself and its outcomes; details of projects, budget and sources of funding should be public	DON'T disregard the need to publicly justify any opinions not considered or options proposed.
DO be open and prepared to have a genuine team position in relation to other stakeholders; be ready to accept other points of view	DO NOT impose a particular initiative or suggest false justifications to bring others to your already formed option
DO remember that it is a continuous two-way learning process between local government and the community	DON'T be afraid to say, "I don't know, but I'll try to find out!"

2.2 Monitoring capacity and tools

Coordination of implementation is closely linked to the essential ability to track and report on the extent to which targets have been achieved and progress in performance towards climate neutrality - the collection and monitoring of 'evidence', needed both in (re)planning and in evaluating implementation. Ideally, it is precisely data, information, analysis of developments and trends and forward-looking simulations that should lead to the setting of targets and plans (whether strategic or operational), not data collected retrospectively to justify the plan, or some measure already adopted[4]. Once it is clear what the evidence is needed for, how it will be used and the level of detail required, the way in which monitoring is carried out, with regular or ongoing data collection and analysis is also established.

Regular monitoring reports and relevant indications on the impact of policies and plans are part of the evidence base that informs future decisions. It is therefore very important that the indicators used for monitoring are truly relevant to the implementation of the plan and are stable over time to capture developments. Not only to save effort, but also to ensure consistency (over time and between levels/types of plans or measures) it is important to establish what data is readily available and already monitored, what is to be obtained from other institutions and what collection or interpretation operations could be carried out with other organizations. Depending on these, the main options for ensuring capacity to collect data and develop analysis for monitoring may be:

— activating **internal capacity and knowledge**, where data and reports from its own departments are accessible through internal IT platforms, or data from interoperable IT systems of other institutional partners, as well as reports from research and analysis, including public consultation and opinion polling activities;

— - hiring **consultants**: when skills or numerical capacity are not sufficient internally or when time is very short; it is desirable that representatives of the responsible department or structure work closely with the consultants so as to internalize processes and skills;

— - collaboration with **other institutional partners**, either authorities in the metropolitan area or other organizations (research centres, universities, professional associations, non-governmental organizations, real estate agencies, etc.) that may have more recent data or may be willing to share the costs of data collection or monitoring; collaboration with authorities in neighbouring localities also has the advantage of increasing territorial coordination.

4

See also chapter **Digitization and urban data**

Data processing and sharing should be an ongoing process, and the frequency and resources required need to be determined according to the importance of the dataset to the plan and the milestones set in the action plans. Periodic stocktaking is also needed that can demonstrate whether it is time for a more fundamental reassessment, for example if new information emerged that would show that the baseline values of some indicators are significantly different from the initial assumptions.

Many local authorities use area profiles to bring together the findings of thematic studies and to develop a detailed understanding of areas within metropolitan or functional urban areas. Area profiles involve dividing the territory into spatial units of different sizes, depending on the nature of the area and the objectives to be monitored established through planning. For a city centre plan, the areas identified could be much smaller, for example, different neighbourhoods, especially as this scale makes it easier to measure progress on energy efficiency.

Within a city there may be different territorial units for data collection and analysis::

— **reference territorial units** established by the General Urban Plan, urban subdivision of the territory of the administrative-territorial unit, characterized by functional and morphological homogeneity from the urban and architectural point of view, aiming at homogeneous urban regulation;
— **urban action zones** (for urban regeneration, restructuring, ecological reconstruction, etc.) established by means of spatial planning documents and urban planning documentsș
— **traffic analysis areas** related to transport modelling in the Sustainable Urban Mobility Plan, which do not always correspond to census tracts (used in past censuses);
— **Marginalized urban areas**, partly overlapping with census tracts, defined as areas within cities and municipalities that have a shortage of human capital, low levels of formal employment and poor housing conditions[5];
— **census tracts**, defined exclusively for the purpose of organizing data collection in the field and the census enumerators' rules, with a surface area and shape that vary from one locality to another, depending on its type and relief;
— **polling stations**, delimited for the organization of the elections and which may be updated by the mayors, by order, only with the approval of the Permanent Electoral Authority[6].

Because monitoring should be done at a metropolitan or sometimes regional scale, there is also the challenge of administrative territorial boundaries, which can only be overcome by establishing common standards and an integrated or at least interoperable computerized data collection system. Also, in addition to working with local authorities in the metropolitan area (or any area beyond the TAU boundary), there is a need to work with all relevant data holders, such as utility companies, waste collection service providers, transportation service providers, etc.

It is therefore important that the structuring of the database needed to monitor progress in the transition to climate neutrality allows reporting at different aggregation scales, and this probably implies collecting data at the building and household level (as the smallest unit common to all areas and aspects to be monitored and analysed), and that the analysis (let alone the publication of progress values) is done in aggregate so that sensitive information is not revealed.

Even if not all data will be able to be collected or measured and there will be some degree of uncertainty, the measures put in place cannot be considered unjustified, but it is strictly necessary to recognize and explicitly address uncertainty. In such situations where the relevant level of precision is not possible, it is preferable to refer to a range of possible outcomes. It would, however, be extremely harmful to claim certain information that is not certain. Where the realization of the actions, and consequently the proposed strategy, is jeopardized by uncertainties, it is necessary to explore all possible alternatives through relevant discussions with key partners and to obtain their support.

5

Atlas of Marginalized Urban Areas in Romania, https://documents1.worldbank.org/curated/es/857001468293738087/pdf/882420WP0P1430085232B00OUO0900Atlas.pdf

6

So that the number of voters assigned to a polling station does not exceed 2,000 and is not less than 50, the distance between the polling station and the domicile/residence of the voter does not exceed, as a rule, 3 kilometers. and the territorial area of the polling station must, as a rule, be compact in accordance with Law No 208 of 20 July 2015 on the election of the Senate and the Chamber of Deputies, as well as on the organization and functioning of the Permanent Electoral Authority.

Monitoring tools
European cities are increasingly adopting innovative tools and technologies to monitor and accelerate the climate transition, integrating smart solutions into urban management. These tools facilitate the collection and analysis of data essential for implementing emission reduction strategies and achieving climate neutrality.

Example:

1. **The Climate Resilient City Tool** (CRCTool) supports the selection of nature-based solution options in urban adaptation planning and stakeholder dialogs to address risks related to precipitation, drought and heat. CRCTool explores the spatial planning of adaptation options, mainly nature-based solutions (NBS), in an urban area or neighbourhood. It uses a conceptual urban water balance model to calculate the hydrological effects of solutions that are introduced by users. CRCTool can be used on a computer to explore and compare adaptation options or on a touch screen for co-creating urban designs with stakeholders. These results are displayed on a mapping interface and in an accompanying table. The tool provides information on hydrological effectiveness and an indication of construction and maintenance costs.
   The Climate Resilient City Tool is available at: https://publicwiki.deltares.nl/display/AST/Climate+Resilient+City+Tool+Documentation

2. The city of Stuttgart, prone to air pollution and the urban heat island effect, has used a **Climate Atlas to develop zoning regulations**. Keeping open spaces, expanding green areas and implementing measures such as green roofs increase resistance to heat waves and improve urban air quality.
   The Climate Atlas for the Stuttgart Region was published in 2008, building on earlier work in this field carried out by the City of Stuttgart since the 1980's and by the in-house Department of Urban Climatology (existing in the City of Stuttgart since 1938). As part of a research project on "Integrative Urban-Regional Adaptation Strategies" carried out by the Federal Ministry of Education and Research (BMBF), the Climate Atlas is currently being updated and its content is being further developed to become an online tool for urban-regional information and advice.
   The Climate Atlas provides standardized climate assessments for cities and municipalities in the Stuttgart region and includes maps showing regional wind patterns, cold air fluxes, air pollution concentrations and other relevant information needed to inform planners on how to improve climatic conditions, which could be the basis for new projects and retrofits. The Atlas classifies urban areas on the basis of their role in air exchange and cold air flow in the Stuttgart region, as well as the topography, density and character of the built environment and green spaces. The Atlas thus distinguishes between eight categories of areas, and for each of these different planning measures and recommendations are provided.

   It is available at: http://www.stadtklima-stuttgart.de/index.php?start_e

2.3 New professions to emerge in town halls

In recent years, the emergence of artificial intelligence, combined with climate change that may lead to unprecedented disasters (see the floods in the area of Galati or Valencia), the occurrence of events difficult to anticipate (pandemics, the war in Ukraine), the digitization of municipalities (including their subordinate buildings), social media (where the speed of transmission of real or false information is very fast) have created an extremely dynamic environment that requires new professions or at least new *skills*. The academic environment does not have a very fast reaction speed, so city halls will need employees with cross-cutting skills who need to be extremely versatile to these changes.

It is no coincidence that the concept of VUCA, which stands for *Volatility, Uncertainty, Complexity and Ambiguity*, is a new buzzword in management. This concept describes the dynamics and lack of predictability of the challenges for cities and for the mayors who run them. The term VUCA was first used by the U.S. Army War College in 1990 to describe the post-Cold War era but has since been increasingly used in business management and more recently at the community level. The four characteristics of the modern, uncertain and complex world:

1. **Volatility**: Rapid and unpredictable changes, such as sudden changes in climate or technological breakthroughs
2. **Uncertainty**: Difficulty in predicting future events, even when information is available
3. **Complexity**: Many interrelated factors make it difficult to identify causes and effects
4. **Ambiguity**: Unclear or contradictory information allowing different interpretations

These factors require a high degree of adaptability and innovative solutions from mayors and local council staff.

Volatility refers to the speed and unpredictability of changes in the environment. These can be sudden fluctuations in the political situation, unexpected crises or technological breakthroughs. The challenge is to react flexibly and quickly to these changes.
Uncertainty refers to the unpredictability of future events. Even when information is available, the future remains unclear, making decisions risky. Mayors must be able to make informed decisions in uncertain environments and develop strategies that are flexible enough to respond to unforeseen developments.
Complexity refers to the multitude and interconnectedness of influencing factors in the environment. These factors often interact in unpredictable ways and require mayors to have a deep understanding and the ability to analyse and manage multifactorial situations.
Ambiguity means that information is unclear or contradictory and allows for different interpretations.

Mayors need to be able to make decisions in situations where the available information does not provide clear solutions, while assessing potential risks and opportunities.

These four elements of VUCA place high demands on the adaptability and strategic thinking of mayors and local councils. They must be able to react quickly, develop innovative solutions and continuously learn to succeed in a VUCA world. To face these new challenges, mayors will need a new type of management and new professions to help them cope with situations they were not confronted with 10 years ago.

The role of traditional professions is enhanced with new skills and knowledge, in particular related to the green and digital transition. Environmental sustainability and digital transformation require a workforce that is not only technically efficient but also adaptable and capable of continuous learning. The speed of change in this area is increasing, as is the risk of decisions having undesirable long-term effects (choosing solutions that must be abandoned over time due to technological advances in other areas).

Cross-cutting skills are the cornerstone for the success of Zero Carbon and smart cities and mean digital literacy, multi-stakeholder involvement and collaborative governance. If 30 years ago, the focus was on over-specialization, now it is important to acquire digital skills and on the sustainability side (carbon emissions, circular economy, etc.

Key skills are related to shaping the operational landscape for smart cities and Zero Carbon. A specialized workforce is the backbone of the effective operation of smart cities.

Resilient management is important for city halls: enabling smart cities to thrive in a VUCA world. Resilience is a key characteristic of smart cities, enabling them to withstand and recover from various disruptive impacts, including, natural disasters, cyber-attacks and pandemics.

In addition, green and digital competences are extremely important for shaping a sustainable and technologically advanced urban landscape. The green transition is central to the aim of smart cities to develop sustainable and environmentally friendly urban spaces.

Emerging occupational profiles for future urban developments

Management: roles combining strategic planning, innovation and coordination of smart city initiatives

Technical: Specialized positions focused on the implementation and management of technical solutions in the urban context

Zero Carbon and Smart Cities: dedicated positions for the development of climate neutral and smart cities

Sustainability: Professions focused on sustainability, promoting green infrastructure

Occupational profile:

1. *Chief Innovation Officer*. serves as the driving force behind innovation in a municipality, using digital technologies and making data-driven decisions to transform urban governance
2. *Smart City Resilience Director*. Providing a strategic vision for improving city resilience, the Smart City Resilience Director plays a crucial role in building a city's capacity to withstand various challenges, including natural disasters, cyber threats and social disruptions
3. *Civic technologist*. Promoting digital inclusion and public engagement, the Civic Technologist designs, implements and manages civic technology solutions that promote increased citizen participation and service delivery
4. *Multicultural facilitator*. Integrating diverse perspectives and promoting intercultural understanding, the Multicultural Facilitator plays a key role in promoting a harmonious and inclusive urban environment

Occupational profile:

1. *Smart City Data Analyst*. The Data Analyst serves as a data steward, collecting, analysing, and interpreting large amounts of urban data so that policy decisions are based on real information and optimize city operations
2. *Artificial intelligence and machine learning researcher*. Harnessing the power of artificial intelligence and machine learning to revolutionize urban systems
3. *Expert Digital Twin*. It orchestrates the creation of a virtual representation of the city, integrating data from various sources to provide real-time information about city operations
4. *Cybersecurity Manager*. The Cybersecurity Manager protects the City's digital infrastructure from evolving cyber threats.
5. *Augmented reality designer/developer*. Create immersive augmented reality experiences that enhance urban applications such as tourism and education
6. *Smart Grid Engineer*. Design and maintain the infrastructure that powers smart cities
7. *Autonomous Vehicle Operator/Technician*. Monitors, controls and maintains autonomous vehicles, ensuring their safe and efficient operation
8. *Digital health coach*. Enables people to manage their health using digital tools and platforms.

Occupational profile: Zero Carbon and City

1. *Smart City Planner*. Serves as a visionary leader, conceptualizing and executing smart city projects to enhance urban sustainability
2. *Urban Mobility Manager*. Optimizes urban transport systems, ensuring the efficient and sustainable movement of people and goods
3. *Expert in urban aerial mobility*. He pioneered the integration of urban drone technologies, paving the way for innovative delivery, maintenance and monitoring services
4. *Municipal Broadband Manager*. The Municipal Broadband Manager spearheads the deployment of municipal broadband networks, extending high-speed internet access to unserved areas
5. *Intelligent Building Manager*. Optimize energy-efficient and technologically advanced buildings by integrating intelligent systems such as lighting and HVAC

Occupational profile:

1. *Green infrastructure specialist*. Designs and implements green infrastructure projects such as parks, green roofs and rain gardens to enhance urban sustainability and resilience
2. *Circular Economy Manager*. Develops strategies to promote the circular economy, a resource-efficient approach to economic development
3. *Climate change specialist*. Develops and implements strategies to mitigate and adapt to the impacts of climate change
4. *Professional in biodiversity protection*. Protect biodiversity, ensuring the health and diversity of plant and animal species in urban environments
5. *Local Energy Communities Manager*. Supports the creation and management of renewable energy communities, promoting public properties for renewable energy generation
6. *Heat island managers* are crucial professionals who oversee strategic temperature management in urban environments. They monitor, analyse and mitigate the effects of urban heat islands, promote green spaces and smart cooling solutions, educate communities and collaborate with experts to create resilient, liveable and sustainable cities

The list of these new professions is not exhaustive, and it is likely that the dynamics of technology will add some new ones in the coming period. What is to be kept in mind is the need for continuous training of city hall employees and openness to transversal skills.

2.4 European Energy Award — eea

The European Energy Award (short for *eea* - not to be confused with the European Environment Agency - EEA) is a quality management and award scheme for municipalities and regions and aims to help local authorities in establishing interdisciplinary approaches and implementing energy efficiency and climate policy measures. The EEA website is *www.european-energy-award.org*.

The European Energy Award was started in 1991 by specialists working in Swiss municipalities and is a bottom-up system, in contrast to the Covenant of Mayors system. The first certified city was Schaffhausen (Switzerland) and was originally called Energiestadt or Cite de l'energie or Citta dell'energie, depending on the area in Switzerland. The scheme involves getting a percentage of the maximum 100%, which allows comparisons between different communities in one country or different countries.

The name was later changed to European Energy Award and is used under this name in Germany, e5 in Austria, Transition Ecologique in France, ComuneClima in Italy and PacteClimat in Luxembourg.

A brief comparison between the *eea* and the Covenant of Mayors (CoM for short) is presented in Table 1. The CoME Easy Project[2] facilitates the realization of a Climate and Sustainable Energy Action Plan - SEAP using the *eea* catalog: the eea catalog of measures covers all CoM areas and can facilitate the realization of a SEAP and its monitoring. Prioritization of actions using the EIB and reduction potential: using the EIB, *eea* municipalities can prioritize sectors and measures according to their potential for energy savings and GHG emission reductions over the period.

Table 1
Comparison between eea and CoM

	eea	CoM
Strategic approach	Defined at municipal level in line with national and EU level	European and international level
Commitment	Politically and technically defined (energy department)	Politically powerful
Support devices	Menu of measures and actions	Format for EIB/MEI
Support for the implementation of action plans	Technical support with external consultants (mandatory)	Territorial Convention Coordinators and Local and Regional Energy Agencies (if available)
Guidelines and materials	Evaluation guides	Guides, libraries, funding schemes, adaptation, engagement material
Monitoring	Annual internal reviews, external audit every 4 years	Every 2 years (action reporting)/ Every 4 years (full reporting)
National adaptation	Made by the national eea national office and approved by the board	Local emission factors can be used

In a pilot phase are Belgium, Croatia, Greece, Romania, Serbia and Ukraine. Since 2020 the system has started to be used in Bulgaria, North Macedonia and Slovenia within the European H2020 project EXCITE *www.excite-project.eu*. Between 2018 and 2020 another European CoME Easy project *www.come-easy.eu* synchronized data between the European Energy Award and the Covenant of Mayors to make reporting in the two systems much easier by providing the assessors with computer conversion facilities

Since 2016, the Romania Green Building Council - RoGBC, has been implementing the European Energy Award under the Sustainable Community - European Energy Award (*www.eeacomunitatesustenabila.org*), in a five-step system (25%, 37.5%, 50% and 75%). RoGBC was also part of the CoME Easy and EXCITE projects. As of 2020, Vama Buzăului, Iași, Alba Iulia (2021) (Figure 4), Cluj-Napoca (2022) and Turda (2022) have been *eea* certified.

eea presentation

The European Energy Award - eea is a qualified tool for the management and control of energy-related municipal policies that enables municipalities to identify strengths, weaknesses and potential for improvement and, above all, to implement effective energy efficiency measures. The success of the municipality's efforts is visible through an award, called the European Energy Award - in the case of Romania Sustainable

Community. The standardized assessment allows benchmarking between eea communities.

If until a few years ago, the effort was focused on buildings, the increasing speed of the green transition has shifted the focus to municipalities, because of the huge potential for action and vision. Energy-related measures at municipal level have a multiplier effect, good municipal example drives action at residential, commercial and industrial level and immediate awareness of success and results has a high potential for communicating lessons learned. Municipal actions demonstrate the feasibility and viability of national and European energy policies, while measures and actions at local level led to local investment and less dependence on external resources, and the end result is a better quality of life for citizens.

eea is a management process: "Plan-Do-Check-Act"

Plan
- Political commitment of the mayor or council
- Current state assessment
- Targets and strategies, policies, planning

Do
- Program of activities
- Implementation and operational measures
- Awareness and preparedness

Check
- Evaluation and control
- Reporting procedures
- Targets review

Act
- Collective actions
- Continuous improvements

The basic principles of *eea* are:

— Collect best practices on energy and environment policies
— Supports Municipalities in developing and implementing their own sustainable energy and environment actions.
— It focuses on energy and environment issues, starting from the fact that most climate change is influenced by energy issues
— Simple control tools for a results-oriented administration (Target setting, measures and actions, responsibilities and financing)
— A holistic vision of municipality: from urban planning to communication.
— Implement a quality management system based on the Total Quality Management (TQM) approach and the new ISO 50'001 standard approach
— Integration of all "key actors" of the municipality
— The consultant as a coach, not a "teacher
— Standardized catalogue of measures, without "mandatory measures"
— Weak positioning in one area can be compensated by better positioning in other areas
— In-depth analysis of existing projects and programs and publication of success stories, the importance of past activities, resulting in an in-depth analysis of all possibilities to establish a policy
— Decision by political leaders, including financing
— Awarding the best municipalities and benchmarking between cities and municipalities
— Networking for exchange of experience

The European Energy Award has six assessment areas:

1 Development and urban-spacial planning
2. Town hall buildings, infrastructure
3. Energy supply, waste
4. Mobility
5. Internal organization
6. External communication

The first stage in the implementation is the realization of an eea team (the format is not standard and is adapted to each municipality and is also depending on the size and specificity of each CL). The composition of the *eea* team includes:

— Mayor, city officials, members of the executive bodies
— Energy and water suppliers
— Urban planning, public buildings
— Offices for Energy Efficiency, Climate and Environment
— External consultant

The tasks of the *eea* team are:

— Initial assessment
— Energy and climate policy plans with targets, responsibilities and deadliens
— Annual budget
— Indicators for (financial planning
— Success rate monitoring and reporting

The performance of a municipality is described in an "Audit File", a catalog of 79 measures, which contain:

— Description of activities and measures
— Quantitative and qualitative indicators
— Defining the 'weight' and importance of activities and measures in 'points'
— Evaluation guide for assessing the implementation of all the 79 measures
— Indicators lists
— Statistic values
— Calculation programs for assessing quantitative indicators

Performance indicators assess the potential of implementation activities according to the actual possibilities of each municipality, and the maximum achievements depend on each municipality. The results are described and quantified in % of actual possibilities and allow for comparison, evaluation and scoring of "effort" for the management responsible for that measure

The quality of implementation of the 79 measures is "reduced" to a % number

The percentage assessment of the potential of each measure is based on the maximum values, expressed in points, available in the Measure Catalog:

7 – 10 points = Important, comprehensive, long-term, long-term measures with sustainable results, e.g. Obligations for

4 – 6 points = More complex, medium-term, feasible measures with broad potential, e.g. instruments

1 – 3 points = Simple and easily achievable measures e.g. activities

The *eea* uses EMT software, available online at *https://tool.european-energy-award.org/*, password-accessible, which calculates the percentage for each domain, resulting in a spider-web graph.

The *eea* is evaluated every four years and the results of this process are:

— Consensus among municipal partners on the current state of play of energy policies, strengths and weaknesses
— Highlighting what has been achieved so far. This leads to easier acceptance of newer and stronger measures
— Capacity building within the administration related to the possibility of a sustainable energy policy
— The municipality's CO2 and energy balance
— Reporting on the energy/climate policy of the municipality, with relevant data for the city
— An optimistic SEAP energy plan and program for the next 4 years, with targets and objectives, planning, funding and responsibilities
— A firm commitment from all those responsible for the programmed activities.

In conclusion, the *eea* is a comparative analysis of a community's realized and planned measures:

It is a "measuring tool" of the successful implementation of the Energy Action Plan

It is a global model of successful implementation.

Official commitment (materialized by a HCL) and a direction accepted by the majority of the political parties in the Local Council

Designated qualified person for *eea* in the City Hall (knowledgeable on energy management system)

Requires inter-departmental cooperation (e.g. working groups)

It requires sufficient staff and budget to implement measures.

Domain 1
Development and urban planning

1.1 Concepts and strategies - Initial energy analysis, targets, balances, energy and traffic planning, program of activities

1.1.1 Climate change strategy at local level, perspectives

The municipality has guiding principles that include qualified and quantified energy and climate policy objectives for local policies, including mobility statements.

The municipality affirms its commitment to energy and climate policy by signing relevant agreements, such as the Covenant of Mayors (*www.covenantofmayors.eu*) or participating in the M100 action.

These general principles are specifically set out in an official document and reflected in local planning documentation.

1.1.2 Balance sheet, indicators systems

The municipality carry out regular (every 2-5 years) energy and climate studies, including mobility statements.
The review includes the following issues, among others:

— Energy consumption
— CO2 balance for the whole TAU territory (bottom-up or top-down approach, e.g. ECORegion gas emissions
— Primary energy and individual indicators for mobility and buildings (energy certificates, nZEB policies), waste

1.1.3 Climate change protection and energy concept

The municipality has an energy and climate protection concept that gives concrete form to the guiding principles - which form the basis for planning tools such as concepts for energy, traffic planning and waste management. The concept may include strategies to protect the environment, develop amenities or protect agricultural activities, among others.

The municipality provides the necessary structures for the implementation of the concept (responsibilities, tasks, program, contact persons, etc.).

The concept is aligned with medium- and long-term goals and strategies and includes a way to achieve these reductions (energy consumption requirements, CO_2 emissions).

change impact assessment

The municipality assesses the impact of climate change, considering the specificity of the municipality's territory

Aspects to analyse:

— Risk assessment (floods, erosion, droughts, forest fire risks, etc.
— Adjusting building standards (nZEB, avoiding extra air conditioning in buildings through shading systems
— Safety of citizens and tourists
— Reduced operation of micro-hydro during hot/drought periods (e.g. reduced hydropower production)

— These issues are discussed with local stakeholders; the results of the discussions are integrated into guiding principles and concepts.

Waste strategy
The municipality prepares concepts/strategies/analyses on energy use potential (use before disposal, resource conservation) for the following waste types:
— Residual waste
— Organic waste
— Waste pits gas
These concepts/strategies/analyses include the promotion of measures to reduce waste and recover reusable materials, increased waste separation and a strategy to reduce energy consumption and CO_2 emissions from waste collection. The charging system reflects the polluter pays principle and therefore promotes recycling and reuse of waste.

1.2 Planning development

1.2.1 Energy planning - Planning tools relevant to climate and energy

The municipality has an energy plan based on an energy and climate change adaptation concept, which includes concrete statements and strategies on:
— Full use of the potential for local energy production
— Increased use of renewable sources
— Reducing consumption/increasing efficiency
— Reducing emissions
— Coordination with spatial planning and other measures in the eea Evaluation Instrument
Energy planning includes the development of a map showing the areas that will be preferentially used for renewable energy and waste heat. The energy planning is supported by a program of activities including strategies and intermediate targets. Implementation is evaluated.

1.2.2 Mobility and planning

The TAU has a traffic plan, which aims to reduce private motorized transport in the municipality and includes concrete statements and strategies on:
— Measures to reduce private transport
— A strategy for parking spaces (Park&Ride at the entrance of the city, expensive parking lots in the central area, Kiss&Ride at schools, etc.
— Promoting footpaths and bike routes
— Promoting/expanding public transport
— Appropriate positioning of facilities that attract or generate traffic (shopping centers, schools, etc.
Traffic planning is supported by a map and a program of activities including strategies and intermediate targets. Implementation is evaluated.

1.3 Obligations of landowners - Building and zoning regulations, land-use planning, PUG, special uses, contracts

1.3.1 Mandatory tools for land owners

Building regulations for landowners reflect the municipality's strategies on energy conservation, energy efficiency and climate protection.
Their requirements may include the following:
— Limit the number of parking spaces
— Compact building design, good insulation and appropriate orientation

- Rainfall collection, low land sealing
- Higher densities in certain areas
- Additional energy efficiency requirements
- Green spaces, their interconnection, regulations on increased natural ventilation
- Special regulations on car-free zones, pedestrian zones
- Fee reductions for green buildings certified BREEAM, LEED, DGNB etc.

1.3.2 Innovative urban and rural development

Energy and climate protection issues and the use of renewable energy play an important role when launching tenders for spatial planning, architectural projects or competitions, or when selling municipal land.
Example:
- Standards for 0 or positive energy or passive houses
- Renewable energy supply (solar panels, biomass, photovoltaic, etc.
- Connection to centralized or local heating systems
- Limit the number of parking spaces
- Biodiversity issues

1.4 Approval and monitoring of building permits

1.4.1 Review and monitoring of building permits

Building permit fees are optimally used to ensure the most energy efficient design possible.
Example:
- Random testing with building inspectors
- Instructions for monitoring staff; definition and quality assurance of monitoring
- Construction documentation with records of quality assurance measures
- nZEB and PV battery installation requirements included in all building permits
- Efficient monitoring systems (including aerial or satellite imagery)
- Requirements for the energy certification of buildings (management and submission of documentation by developers in a uniform format; definition of responsibilities for issuing and monitoring energy certificates for buildings, analysis of databases and their maintenance by the municipality)

1.4.2 Consultation on energy and climate protection issues in building processes

The construction permitting and monitoring processes are used to implement support measures to promote energy efficiency and climate aspects already at an early stage of the construction process.
Example:
- Produce a developer's kit with recommendations on efficient construction
- Recommendations or financing energy consultancy services (contacting specialized consultants
- Recommendations on issuing energy certificates for buildings

The effect of the consultancy can be assessed based on the number of consultations, the number of energy certificates issued and the number of square meters of nZEB buildings and BREEAM or LEED certifications per inhabitant.

Area 2
Municipal buildings, facilities

Buildings and facilities owned or used by the municipality for which the TAU is responsible for energy supply, including street lighting, schools, kindergartens or institutions where the municipality is the majority owner, have been considered. Exceptions specific to the municipality must be justified. Not considered: water supply, sewage, waste (domain 3), county council buildings.

2.1 Energy and water management

2.1.1 Standards for construction and management of public buildings

The municipality has defined energy standards for municipal buildings (new and renovated buildings), including:
— efficient use of electricity
— the minimum percentage of renewable energy
— health and ecological building
— Consider sustainability issues in construction, operation and maintenance
— setting maximum winter and minimum summer temperatures
— limiting air conditioning
— sustainable procurement for construction purposes.
Additional costs must be considered when defining standards.

2.1.2 Initial energy assessment, analysis

The municipality carries out an energy assessment of all relevant buildings and facilities owned by the municipality, e.g. using building energy certificates.

Initial energy assessment includes:
— Calculation of energy consumption for electricity and heat, CO2/ greenhouse gas emissions, water consumption
— A detailed analysis of the type of energy used (central heating, hot water, air conditioning, lighting, cooking, electrical appliances, etc.
— Analysis of possible applications of renewable energy sources
— Assessment of energy saving potential
— Identify immediate measures
— Definition of procedures, the rehabilitation plan.

2.1.3 Analysis and functioning optimization

Analysis of energy (electricity, heat) and water consumption for all municipally owned buildings and facilities (including collection of consumption data of usage types over time, use of smart metering).

2.1.4 The rehabilitation concept

The municipality prepares medium- and long-term rehabilitation plans for all municipal properties with savings potential based on the initial energy analysis (as per 2.1.1).

The rehabilitation concept considers the following:
— Type of measures
— Costs and anticipated savings
— Implementation time
— Responsibilities for implementation
— Financing and investigating innovative financing models such as ESCO contracting
— Reducing the carbon footprint (quantitative targets for reducing CO2 emissions – QALYs)

— Adaptation to climate change (activities to prepare for the impacts of climate change, measures to achieve minimum energy self-sufficiency, appropriate use of air conditioning)

2.1.5 Examples of new construction or renovations

The municipality has implemented exceptional energy standards (high energy efficiency, low CO2 emissions) in new constructions or in the retrofit of one or more municipal buildings. Implementation is aligned with the strategic objectives and the agreed reduction pathway.

2.2 Quantitative targets for energy, efficiency and climatic impact

2.2.1 Renewable energy - heating

The municipality shall increase the use of renewable energy sources in meeting its energy requirements for heating and cooling of municipal buildings and facilities, e.g. heat pumps, biomass thermal energy, geothermal energy, etc. (excluding the use of waste heat as an energy source, see area 3) and evaluate this increased use (in percentage of the total heat demand of municipal buildings and facilities.

2.2.2 Renewable energy - electricity

The TAU increases the share of renewable energy in municipal electricity consumption for buildings and other facilities, e.g. photovoltaic, wind, biomass, micro-hydro, biogas, etc., and makes (in percent of total energy consumed by the municipality).

2.2.3 Energy efficiency – heating

The UAT increases the energy efficiency of heating and cooling systems in municipal buildings and assesses energy efficiency based on energy indices for heating, hot water and cooling systems in the following building types: Offices/services, residential, schools, hospitals, homes, swimming pools.

2.2.4 Energy efficiency - electricity

The TAU increases energy efficiency in terms of electricity consumption in municipal buildings and assesses energy efficiency based on energy indices for electricity in the following building types: Offices/services, residential, schools, hospitals, homes, swimming pools.

2.2.5 CO_2 and greenhouse gas emissions

UAT reduces CO2 emissions and greenhouse gas emissions from the use of municipal buildings.

The city is evaluating the implementation of solutions to reduce CO2 / greenhouse gas emissions from municipal buildings based on emission factors (with primary energy factors) for the following building types: Offices/services, residential, schools, hospitals, homes, swimming pools.

2.3 Special measures

2.3.1 Public lighting

UAT is increasing the energy efficiency of public lighting.

The municipality assesses the energy efficiency of public and architectural lighting based on energy indicators (e.g. energy consumption of street lighting, number of light points, installed power per light point, energy consumption for public spaces, traffic light systems, architectural lighting, etc.). Transition to LED solutions is encouraged.

Consider the use of control systems (remote management) that can reduce the luminous flux according to traffic.

2.3.2 Water use efficiency

UAT increases water efficiency in municipal buildings. The municipality evaluates water efficiency (per capita indexes) and annual water consumption for the following building types: Offices/services, residential, schools, hospitals, homes, pools.

The municipality implements an appropriate policy on water consumption (needs and consumption), including economical irrigation of green areas and considering biodiversity, e.g. limited introduction of chemicals.

Area 3
Energy supply, waste

3.1 Company strategy, supplying strategy

3.1.1 Energy suppliers' strategy

The municipality ensures that suppliers define strategies for better energy efficiency, increased use of renewable energy and climate protection through contracts, cooperations, interconnection rights with municipal utilities/local energy suppliers and energy communities (owned by the municipality or third parties, depending on the degree of liberalization of electricity markets).

3.1.2 Financing energy efficiency and renewable energy

The TAU levies a tax on grid-dependent non-renewable energy sources, or uses part of the revenues from concessions, dividends, etc. to promote energy efficiency, the use of renewable energy and climate protection (e.g. for adjustment measures) (euro/inhabitant/year).

3.2 Products, prices, consumer information

3.2.1 Range of products and services

There is a wide range of services offered in relation to energy efficiency and the promotion of renewable energy sources (the sales side of those products).
Example:

— Energy advice for users/clients.
— - Schemes to replace electric heating systems or heating systems associated with high CO2 emissions (gas-fired plants replaced by heat pumps
— - Bid for installation contracting or savings calculation
— - Demand management activities (supply of energy saving lamps, etc.)
— Energy Supplier Promotion Program
— - Information on individual climate protection measures
— (Evaluation of the implementation of the strategies defined in 3.1.1)

3.2.2 Selling electricity from renewable sources

There is great interest in increasing sales of renewable energy/green energy in the municipality.

The amount of energy purchased from renewable sources (in MWh) within the municipality (as a percentage of the total energy supplied to customers within the municipality) is assessed, including the municipality's suppliers and third-party suppliers.

3.2.3 Influence on user behaviour and consumption

Measures are taken to increase customer awareness and motivation for energy efficiency, use of renewable energy and own energy production by, among others:

— Tariffs based on production costs, including for gas and district heating; offer special tariffs for consumers entering into efficiency agreements
— Detailed information on energy consumption (electricity bill, smart metering), CO_2 emissions and climate impact; offer of CO_2 balances
— Customer support for own renewable electricity production (prosumer
— Online control of decentralized consumption and production for optimal smart grid management

3.3 Local energy production

3.3.1 Residual heat waste

Waste heat from large industrial operations (full potential utilization) is used, considering the potential utilization of industrial waste heat from cooling in particular.

3.3.2 Heating and cooling from renewable sources

The potential of renewable energy sources for space heating, domestic hot water and cooling systems is fully exploited (statement in percent of the total space heating, domestic hot water and cooling systems demand in the municipality). Renewable energy sources are solar, biomass, biogas, geothermal, surface water, ambient heat.

3.3.3 Electricity from renewable sources

There is a high percentage of electricity generation from renewable energy in the municipality (in MWh/a). This share is assessed based on the percentage of the total electricity demand in the municipality (photovoltaic, small-scale hydro, wind, etc.

(use in relation to ecological potential; highest rating if ecological added value is used locally).

3.3.4 Cogeneration and waste heat/cooling from electrical generation

Thermally controlled cogeneration potential (biomass or natural gas fired, considering CO_2 emissions and greenhouse gas emissions) shall be used, taking also into account the use of waste heat from power plants for district heating or cooling.

3.4 Energy efficiency - water supply

3.4.1 Initial energy efficiency analysis and assessment

The water supply system(s) for the municipality operates at a high level of energy efficiency. The assessment is based on energy consumption in kWh in relation to the volume of water supplied in m^3.

3.4.2 Water use efficiency

The municipality distributes appropriate information on water consumption to sensitize consumers to save water, for example:

— Individual water consumption is shown on the bills or attached to the bills
— Consumers are informed about their consumption in the previous year and average consumption data
— Water saving behaviours are encouraged, e.g. through linear rates for all consumption groups (rates reflect actual consumption and promote water saving behaviours)
— Rainwater charges are levied according to the areas sealed
— The quantities of drinking water and waste water are separated.

3.5 Energy efficiency - used water treatment

3.5.1 Initial energy efficiency analysis and assessment

The municipality waste water treatment system operates at a high level of energy efficiency. The assessment is based on recognized indicators.

3.5.2. External use of residual heat

The potential for external utilization of waste heat from sewage collection sewers and/or wastewater treatment plant is exploited.

3.5.3 Waster water gas use

The potential of using sludge to produce energy through anaerobic digestion is exploited.

3.5.4 Rainwater management

The municipality directly promotes the infiltration of rainwater on properties through appropriate systems, the gradual development of separation systems (separation of rainwater and wastewater) etc

This also includes considering the impacts of climate change, e.g. by implementing flood risk management and avoiding the sealing of streets, markets, walkways and other public areas.

3.6 Waste energy

3.6.1 Energy use of waste

The energy potential of waste generated within the municipality is exploited in combustion systems (excluding organic waste, waste gas and flue gas utilization, see 3.5.3, 3.6.2 and 3.6.3).

3.6.2 Energy use of bio-waste

The energy potential of organic waste generated in the municipality is exploited in combustion or digestion systems or in the production of biodiesel / biomethane for heating and transportation.

3.6.3 Energy use of waste produced gas

The energy potential of natural gas generated from landfills in the municipality is exploited.

4.1 Mobility in the local government

4.1.1 Promoting mobility awareness in the local government

UAT intelligently promotes sustainable mobility behaviours among city hall employees. Examples:
— Smart parking management for municipal buildings and facilities (pay by phone or free electronic parking)
— Provide bicycles for city hall employees, introduce car sharing
— Bike parking space
— Financial support for using public transport on the way to work
— Shower facilities
— Financial support for the use of public transport for certain categories (e.g. students, pensioners, etc.).

4.1.2 Public vehicles

The municipality strives for the use of fuel-efficient vehicles and to ensure fuel efficiency in its own vehicles for example by:
— Initial assessment and calculation of current consumption of
— Electric car purchases
— Staff training in economic management
— Testing and introducing efficient mobility models

4.2 Traffic calming, parking lots

4.2.1 Parking management

All public car parks are managed, including those outside the centres (with prices indicated
Example:
— Price levels were set to influence traffic volume
— Solutions for ' parking lots
— Parking spaces in the centre are moved (e.g. underground) and not
— Fees for overnight parking
— Parking revenues are also redistributed to promote alternative mobility
— Orientation guidance and information systems in parking facilities
— Prioritizing car-sharing, creating dedicated car parking spaces

4.2.2 Main transport axes

Ensuring continuous traffic flow on major axes at a reduced speed. This can be achieved through design, organization and signage measures, among others, and implemented in the form of calming rather than traffic calming oriented management.

4.2.3 Speed reduction and more attractive design of public spaces

The municipality implements low speed zones and pedestrian priority through participatory processes.

This includes promoting safe and attractive commuting distances in residential areas and upgrading public spaces, streets and shopping areas to make them more attractive for pedestrian and cycle traffic and to strengthen local provision:
— Attractive design of sidewalks, bike paths and squares
— Pedestrian zones

— Street greening (trees, urban gardens, etc.), installation of chairs and benches
— Reducing speed through natural barriers
— Street lighting adapted to specific use

4.2.4 Municipal delivery systems

The municipality ensures the use of energy efficient logistics systems that are aligned with climate protection.
— Food supplies delivery
— Parking space management, traffic management for delivery
— Promotes delivery by bikes
— Home delivery of shopping promotions
— Home delivery and luggage services

4.3 Non-motorised mobility

4.3.1 Sidewalks network, signalising

The city is creating an attractive sidewalk network throughout the city.
Example:
— Analyze / reduce potential dangerous areas
— Destination and time needed signs
— Measures to improve safe access to schools
— Making pedestrian maps
— Equal treatment for people with disabilities.

4.3.2 Network of cycle paths, signalising

The City provides sufficient, safe, publicly accessible and attractive (where appropriate) bicycle parking, especially at major bicycle destinations and transfer hubs.

4.4 Public transportation

4.4.1 Quality of public transport

The municipality provides high quality public transportation and strives to continuously improve, e.g. through:
— Increased frequency, daily operating hours, operated according to users' needs
— Good inter-regional connections, harmonization and correlation of timetables (buses, trains, suburban trains, etc.), real-time information services rates
— Good bus connections overnight
— Comprehensive access throughout the city
— Taking user satisfaction into account
— Covered, well lighten stations
— Modern, comfortable modes of transportation (low-floor buses etc.), electric buses.

4.4.2 Priority of public transport

The municipality ensures public transport priority through regulations, signalling control, dedicated lanes for public transport, as well as through enforcement of these measures.

4.4.3 Multi-split mobility

The municipality is proposing an offer and promoting multimodal mobility
Example:
— train station connections, carsharing, (night) taxis, rental cars, carsharing agencies
— Demand-oriented requests (reduced services)

— Park&Ride
— Electric bikes for rental
— Bicycle transport facilities on buses, trams, metro and trains

Demand is assessed through market studies, promotional campaigns, customer surveys, etc. Prices should favor multimodal transport.

4.5 Mobility Marketing

4.5.1 Mobility marketing in the city administration

The City shall ensure that PR and active marketing activities are carried out to promote efficient and sustainable mobility

This includes:

— Promoting activities and actions such as mobility management in companies, events and actions in support of sustainable and mobility
— Creating or supporting a mobility information centre
— Information on efficient vehicles and appropriate driving behaviour, such as Eco-Drive courses for individuals, use of driving simulators
— Showcasing vehicles with innovative systems
— Car-sharing and car-sharing offers

All activities are part of a detailed communication concept. (see 6.1.1).

4.5.2 Model mobility standards

The municipality achieves outstanding mobility standards and verifies this through the following indicators:

— Environmentally friendly transport (cycling, pedestrians, public transport) in total traffic volume
— Financial support for public transport (RON / inhabitant)
— Average speed (km/h) of public transport (buses, trolleybuses and trams)
— Efficient, low CO_2 mobility sections

(Assessing the efficiency of the municipality's mobility; some energy efficient vehicles and low CO2 emitting fuels such as biogas/electricity/hydrogen; portions of non-motorized traffic; defining the reduction path and targets).

Area 5
Internal organization

5.1 Internal structures

5.1.1 Human resources, management

The municipality shall ensure that the necessary human resources are available for energy and climate protection in local government (e.g. for energy management, renovation of municipal projects, measurement and monitoring of energy consumption and CO2 balances, implementation of energy management and environmental protection systems in line with quality management systems and standards), including resources for mobility management.

Competences, decision makers, authorities and interfaces at all levels and functions are established and defined by decisions, HCL procedures, instructions, etc. as well as by the job description.

5.1.2. *eea* Committee

There is an *eea* committee responsible for the analysis of energy, climate and environmental issues at inter-departmental level (including all relevant departments; with responsibilities defined within the committee).

The Committee works with a very high level of efficiency and effectiveness.

5.2 Internal processes

5.2.1 Integrating of employees

Together with its employees, the municipality sets annual energy and climate targets and contracts to achieve a high level of staff involvement in the implementation of energy and climate activities as part of a coordinated and continuous improvement process.
Example:

— Award for the most efficient or green building manager or maintenance team
— Systems that value motivational initiative
— Employee motivation system
— Campaigns (energy week in the municipality)

5.2.2 Performance review and annual planning

The municipality conducts annual reviews of eea processes and updates its program of energy policy activities based on verifiable documentation of previous activities (project documentation, documents of previous audits)

Methodological requirements:

— Annual review
— Based on the existing eea evaluation tool
— Analysis of previous year's planning: planning and implementing
— Focus on measures planned for medium and long-term targets (e.g. Covenant of Mayors, climate relevance
— Documentation resulting from the conclusions of *eea* consultants
— Internal and external communication and documentation of results based on indicators.

5.2.3 Continuous training

The municipality promotes and requires continuous energy training for specific target groups (policy and administration, directors, department heads, building managers) and for all staff.

The municipality supports activities that promote awareness of energy efficiency and environmental protection.
Example:

— Energy management for buildings and facilities, software, sustainable building management
— Training on calculating energy and indicators and energy and climate indicators
— Training sessions on environmental responsibility for different groups
— Visits and seminars focusing on relevant issues.

5.2.4 Public procurement

The city is implementing procurement rules that consider energy and climate factors as well as life-cycle costs, e.g. for the following:

— Purchase of office supplies
— Purchase of building maintenance (cleaning)
— Excluding the use of wood from tropical forests and any wood without FSC certification
— Procurement of construction and infrastructure works (including winter road maintenance)
— Other environmentally relevant purchases (e.g. canteen food).

5.3 Finances

5.3.1 Budget for local energy policy

The municipality provides an annual budget to support the following activities relevant to energy and climate issues:
- Green gas assessments, studies, reports, estimates
- PR activities
- Advice and information (e.g. eea consultant)
- External project management
- Cooperation (e.g. school projects_
- Continuous learning
- Giving performance bonuses

(Budget in RON/year and inhabitant)

The City Council accesses specific funds to support energy and environment relevant activities such as European funds, Swiss funds etc

As a principle, each department should have its own energy and environment budget.

Domain 6 Communication, cooperation

6. Communication

6.1.1 The concept of communication and cooperation

The municipality prepares a concept for the planning of the different communication and cooperation activities (coverage of all media, including updates from time to time, responsibilities, target groups, periodicity, etc.)

The municipality defines the cooperation process and takes an active role.

6.1.2 Role model effect, corporate identity

An innovative energy and climate policy is part of a municipality's identity, which is expressed by the following:
- Integrating relevant aspects into the corporate identity
- Visibility on the municipal website and other information and channels
- Authentic, reliable environmental decisions (no car shows, no disposable plates at city events, etc.
- Including biodiversity and natural materials ('natural design') in design
- The role of the municipality as a role model for its residents

6.2 Cooperation and communication with authorities

6.2.1 Social housing institutions

The municipality cooperates with social housing institutions (ANI), cooperatives and (old people's) homes to implement high standards of energy efficiency, use of renewable energies and environmental protection, e.g. through expert support during the design and construction phases, information for specific target groups, etc.

6.2.2 Other municipalities and counties

The municipality cooperates with other municipalities on energy policy issues at county, national or European level, e.g. through:
- Regional exchange of experience (comparison of indices, exchange of documentation) between administrative staff (investment, building and environmental permitting services

— Energy consultants and regional planning groups
— Sensitizing partner municipalities to participate in the eea program
— CO_2 allowance trading (joint implementation)
— Financing development projects and projects with M100 European partner municipalities.

6.2.3 Regional, national authorities and research institutes

The municipality presents its policy on energy efficiency, renewable energy and climate change issues at regional and national level (e.g. through position papers on national legislation, ordinances and plans).

The municipality cooperates with universities/institutions to initiate and promote research and training in these fields.

6.3 Cooperation and communication with industry, business and trade

6.3.1 Energy efficiency program with industry, businesses, traders and services providers

The municipality initiates, supports or gets involved in cooperation projects with local and regional businesses that relate to energy, climate or the environment.
Example:
— participation in widely supported programs such as CO_2 emission agreements with companies
— Regular, informal meetings with entrepreneurs
— Energy fairs with industry and trade
— Mobility, e.g. cycling to work
— Participation in European or Swiss programs

6.3.2 Professional investors

The municipality encourages investors to plan projects that comply with the municipal energy policy, e.g. through voluntary agreements on the highest building standards, energy efficiency and tenant awareness.

6.3.3 Local and sustainable business development

An innovative energy and climate policy is the most important factor in venue marketing:
— Clean technologies
— Eco shopping areas
— Attracting green business
— Eco tourism projects
— Eco leisure offers
— Marketing for "green, regional products

6.3.4 Forestry and agriculture

The municipality supports the sustainable use of forests and agricultural areas (including the potential for economic and ecological use for energy production).

In this context, the municipality grants / promotes / supports:
— Local/regional supply chains for pellets
— Protection of biodiversity (including measures against light pollution
— Avoiding methane release from biogas installations
— Contracts with local producers
— Forest and wood labeling
— Continuous training on good practices and principles of eco farming

6.4 Communication and cooperation with residents and multipliers

6.4.1 Working groups, participation

The municipality ensures intensive cooperation with interest groups, stakeholders and residents and forms working groups to initiate, support and implement projects (in cooperation with the competent administrative department).

6.4.2 Consumers, tennants

The municipality enables and supports residents in achieving sustainable living standards by:
- Availability of CO2 footprinting tools
- Promotion of products and temporary markets
- Initiating energy saving projects and tools
- Information on energy efficient heating and ventilation
- Offers to avoid keeping electrical devices on standby. Best practice examples from specific investments on climate and climate efficiency.

6.4.3 Schools, kindergartens

The municipality works with schools and kindergartens to run energy projects and energy saving weeks at schools and kindergartens (including pupils, teachers and building administrators), for example by offering a bonus or using 50-50 models: a part of the savings in running costs made during the week are paid to project participants in the form of investments or trips. (Evaluation as percentage of participants).

6.4.4 Political parties, NGOs, churches

Multipliers are supported in becoming community role models who influence residents on energy issues. Parties, NGOs and churches are sensitized to act in line with local energy policy.

6.5 Support for private activities

6.5.1 Information centre for energy, mobility, ecology

The municipality provides support through a dedicated department or a dedicated person who can provide energy, ecology and mobility information support (at local or regional level) to advise owners, architects and designers on the subject (e.g. energy consultant, financial support programs, renewable energy technologies, etc.). An information centre is even more appropriate, especially in large cities.

6.5.2 Pilot projects

The municipality has initiated an extraordinary, ambitious pilot project for the specific and remarkable implementation of local energy policy through private projects (e.g. with private investors, industry or trade, projects financed by PNRR funds, Anghel Saligny) and/or played an important role in this project.

The municipality supported the project through consultancy/information and communicated the project outside the locality.

6.5.3. Financial support

The municipality promotes outstanding energy projects of private households, industry and commerce within the municipality.
Example:
- In-depth consultancy (consultancy studies)

- Renewable energy sources and energy efficiency measures
- Mobility and ecological transport
- Water saving measures (water saving devices, use of gray water use)
- Financial support for ecological farming

References

[1] www.european-energy-award.org
[2] Tavella, C., Spoerndli, C., Beu, D, Ceclan, A. CoME EASY-Synchronizing European Energy Award with Other Initiatives Case Study: Romanian Local Communities, Energies 2021, 14(19), 6248; https://doi.org/10.3390/en14196248, Published 2021

3. Urban Planning Centres

The need for the establishment of urban planning centres has long been signalled by the professional community[7] in the field and by the associative structures of local public administrations. More recently, the need has been emphasized again through policies initiated at the central level, for example through mentions of the "absence of an adequate institutional structure for coordination and support in the field of spatial planning and insufficient technical capacity at the level of local public authorities"[8] and through the provisions of the *Draft Law for the approval of the Code of Spatial Planning, Urban Planning and Construction* (April 2022) on the establishment of spatial planning and urban planning agencies as "resource centres of expertise at the disposal of local public administration authorities". Romania's Urban Policy[10] also states:

— Strengthen institutional capacity in areas such as growth management through the implementation of technologies such as climate transition modelling, analysis to define priority development clusters, comprehensive integrated planning, multi-year capital planning and implementation;
— Increasing integrated monitoring and evaluation capacity to track and report on the performance of urban areas, in particular in relation to key indicators adopted as part of urban policy;
— Increased capacity to develop urban regeneration plans, in consultation with property owners/developers, undertaking the necessary upstream planning to improve the targeting and absorption of relevant EU and national funds.
— Increasing capacity in DoT (Transit Oriented Development) approaches - considering the exchange of experience and good practice with other cities in the world that have positive (and negative) examples of DoT and measures to support and promote active mobility.

Recommendations
Setting up a body to function as an urban planning centre/agency, with an executive role, to manage in a single structure the process of linking (project implementation, overall coordination) and monitoring is the most appropriate way to both streamline the planning and implementation process and to attract the specialized skills needed for these processes. These planning centres can be set up at metropolitan level and can take on various responsibilities, such as: integrating and managing databases, publishing open data, monitoring the implementation of public policies, integrated strategy programs or projects in urban planning documents, managing and implementing approved urban planning documents, technical support to county/local councils in drafting specifications for urban regeneration or restructuring plans, and managing public dialogue and consultation

Such a centre would ensure the need to bring together public resources on urban planning (register of certificates, permits, permits, etc.) and to transpose to the territorial level (GIS) the numerous technical data such as urban regulations and easements, street nomenclature, risk zones, temperature evolution, fiscal zoning, etc., as well as to maintain a clear record of public property, utilities and public services of all categories.

Observation of territorial data and dynamics and urban analysis should constitute the main role of an urban planning centre, by:

— Ensuring the processes and operations of permanent updating of the interoperable geospatial database, which includes data and information from all relevant local bodies (public institutions and organizations, network and service operators, etc.), with permanent publication, so that it can be used by all urban actors;
— Adoption of appropriate digital tools, such as the development and management of a GIS database (common or integrated at metropolitan scale) with all infrastructure investments (green-blue infrastructure, mobility, utilities), urban operations,

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Romanian Order of Architects 2018: proposal Bucharest Urban Planning Center (CUB)

8

MDLPA - Explanatory Memorandum Draft Law on the Approval of the Code on Spatial Planning, Urban Planning and Construction (April 2022)

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https://www.mdlpa.ro/pages/elaborarepoliticiurbanesipoca711 as well as indicators of territorial sustainability, energy, climate change, etc;

- Completion of the integrated cadastre system with the registration of properties and analysis of the built stock on different technical criteria, including all attributes that influence the determination of property value and energy performance - local/metropolitan register of buildings, integrated/linked with the National Building Register and the National Infrastructure for Spatial Information in Romania (INIS), Buildings section, published in the national geoportal INSPIRE;
- monitoring statistical indicators at local and metropolitan level and creating tools for analysing territorial data (IT applications, online platforms);
- managing the implementation of strategies and master plans (SIDU, PUG, PMUD, PICA, etc.), urban development plans (PUG, PUZ) and commitments, actions and investments related to the climate contract.

The urban planning centre could also provide in-house capacity for research and technical assistance by:

- elaboration of forecasts and prospections on resources for urban development towards climate neutrality (real estate, natural resources, social resources, energy, economic, financial, functional-structural, etc.) and for the substantiation of public policies, elaboration and publication of prospective analyses and impact analyses;
- Development of methodologies, guidelines, local procedures to be applied in urban planning and procurement activities;
- research activities in the field of urban planning and the provision of interdisciplinary resources for urban planning - background studies, concept notes, design themes and specialized studies related to the procurement of services or works;
- coordinating the process of developing or updating strategic or operational plans;
- specialized assistance in managing and updating GIS documentation.

As the capacity of urban planning centres strengthens and the number of specialists attracted increases, the centre can coordinate or develop complex plans and operations, such as:

- zonal urban development plans initiated by local authorities and other relevant urban development plans (e.g. PUGZM, PUG update), at the request of local authorities;
- coordinates or develops projects for urban regeneration, renaturation, etc;
- urban operations (restructuring, parcelling), with the legal management of land circulation, compensation, etc;
- integrated development strategies or strategies and plans on different sectoral areas, PMUD, etc.

One set of tasks that urban planning centres should not miss are those related to dialogue, consultation and urban/community culture development, through activities such as:

- Publishing open data, analysis, reports, interdisciplinary resources and collecting user feedback and suggestions;
- Providing interactive platforms for the consultation of strategic planning documents, urban planning documents and climate transition policies (during their elaboration and after approval)
- preparation and facilitation of participatory processes structured according to the objectives pursued in each planning and/or awareness-raising approach - information campaigns, data and information gathering tools, consultation tools, workshops, debates, etc;
- services to engage and activate urban citizens and stakeholders in their local ecosystem;

— promoting dialog between decision-makers and relevant actors in urban planning and contributing to increasing the level of knowledge and proactive attitudes.

The way the establishment and functioning of the planning agency is set up and run is necessary to ensure work per program or project (approach/deliverable) and interdisciplinary collectives of specialists: urban planners, economists, mobility engineers, geographers, architects, environmental specialists, sociologists, public policy specialists, as well as documentation specialists, GIS and Databases, communication specialists, graphic editing, etc.

As a form of organization, the urban planning centre/agency can be a public institution of local interest, a company or a community development association (or a department within it, if it also provides other shared services), as a public service and public utility provider[10], thus having the advantage of being neither a decision-making authority, nor a technical department of a local authority (integrated in the organizational chart and subject to inflexible procedures), nor a consultancy firm that disappears after the service has been provided.

Example:
Prague Institute for Planning and Development[11] develops and manages Prague's geographic data and carries out, among other things, spatial analysis of traffic accessibility, property relations in the city and the structure of built-up areas. The activities of the 105 employees include the collection, updating and use of data and information in the field of applied research and expert cooperation with universities, scientific research institutions and non-profit organizations, both nationally and internationally. The Prague Geoportal (https://geoportalpraha.cz/en) and the "Prague Maps" and "Online Map" applications allow searches on various topics.

In France there are 50 urban planning agencies at the metropolitan level, organized as associations of local authorities and their groupings (communes and inter-municipal departments, regions, mixed unions), the State, represented in particular by the prefect or sub-prefect, local economic actors (consular chambers, ports, etc. energy, housing, environment), higher education (universities, etc.) and other associated members interested in local issues.

As tools for observation, forecasting, reflection and dialogue, urban planning agencies work at all levels, from neighbourhoods to regions and cross-border areas, on issues that affect the future of territories: urbanism, planning, economic development, transport and mobility, housing or urban projects, environment, culture and heritage, health, research, digital technology, etc. An example is the Besançon urban planning agency[12] centre franche-comté, which manages the territory around the city of Besançon with around 120,000 inhabitants.

For large-scale urban regeneration operations, there may be a need for agencies set up specifically for that area and process, with planning powers, and legal public-private partnership operations, and public procurement (some by competitive negotiation, others by tender), as well as complex financial design for funding from multiple sources and mechanisms.

An example of such agencies are the **metropolitan development corporations (MDCs) in some UK cities**, known as mayoral development corporations, which are statutory public bodies owned by local government at the metropolitan level to deliver regeneration in a defined geographical area. Under the statutory provisions of the *Localism Act 2011*[13], an MDC has general powers to do "all such things as it thinks fit for the purpose of achieving its objective (regeneration of the area). MDCs can then assume several specific powers to:

- taking planning responsibilities from the local authority or authorities, including powers to prepare plans and powers to deal with planning applications;
- Land purchase, either by agreement or compulsory purchase order (CPO) if necessary; the Secretary of State for Housing,

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Cf. Art 92 of Emergency Ordinance No 57 of 2019 on the Administrative Code

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https://iprpraha.cz/en/

12

https://www.audab.org/contenu/l-association

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"An Act relating to the functions and procedures of local authorities and certain other authorities; relating to the functions of the Local Government Commission for England; enabling the recovery from local and public authorities of financial penalties imposed on the United Kingdom by the Court of Justice of the European Union; relating to local government finance; relating to land use planning, the Community Infrastructure Levy and the licensing of infrastructure projects of national importance; relating to social and other housing; relating to the regeneration of London; and for connected purposes." - Introductory text of the Localism Act 2011: https://www.legislation.gov.uk/ukpga/2011/20/contents

Communities and Local Government and the Mayor may also transfer MDC's publicly owned assets;
— the regeneration, development and more efficient use of land, including construction works;
— providing (or facilitating the provision of) infrastructure, such as water, electricity, telecommunications and other transportation, health, educational or social facilities;
— financial assistance in the form of grants, loans or investment;
— granting exemptions from the payment of commercial taxes.

It is argued that MDCs offer several advantages over other regeneration models. While local authorities have the same powers, MDCs benefit from budgets that are not subject to the same financial pressures faced by local authorities. They also offer the advantage of being able to operate across the boundaries of more than one local authority (or sub-unit of government) - theoretically allowing them to regenerate areas at the territorial scale required.

For example, **The Old Oak and Park Royal Development Corporation (OPDC)**[14] set up in 2015 by the Mayor of London to deliver the regeneration of the Old Oak area, which encompasses land in three London boroughs - Ealing, Brent and Hammersmith & Fulham and includes the Park Royal industrial estate, the Old Oak development area around the new High Speed 2 Old Oak Common station and the Wormwood Scrubs conservation area, is governed by a board of directors made up of "industry and community leaders with skills and experience in the following areas: Business, Transportation, Local Government, Regeneration, Finance, Marketing, Education". The Old Oak and Park Royal Development Corporation's powers include planning, land assembly, housing delivery and infrastructure, including compulsory purchase powers, which enable the purchase of its own land and the provision of "clean title"[15] to support regeneration.

14

https://www.london.gov.uk/who-we-are/city-halls-partners/old-oak-and-park-royal-development-corporation-opdc

15

A "clean title" is a title deed that does not contain elements that could jeopardize ownership, such as boundary disputes (encroachments) or easements.

Fig. 2

Model of The Old Oak and Park Royal Development Corporation (OPDC) headquarters and view of the railroad, December 2024

Another example is the Copenhagen City and Port Development Corporation, which, by combining strategic zoning, land transfers and revenue-generating mechanisms, has helped stimulate a remarkable transformation of Copenhagen over the past 25 years from a struggling industrial city into one of the world's wealthiest cities. This model has transformed Copenhagen's industrial port into a vibrant, multi-functional harbour area, while channelling revenues from land sales, redevelopment and development to finance the construction of an expanded metro public transport system.

A well-known example is HafenCity Hamburg GmbH which, since 1995, has managed the assets and overseen the urban redevelopment of HafenCity in Hamburg, Germany. The agency finances urban regeneration through property sales and loans, focusing on infrastructure and public facilities such as roads, parks and promenades, sports and play areas, as well as housing and job creation. The company ensures quality urban development through urban planning and architectural competitions in coordination with the Urban Development and Environment Department and clients. The company also generates innovation pathways for urban development, with relevance to sustainability - innovative thermal energy supply, own sustainability certification for buildings and sustainable mobility concepts, as well as flood protection and the development of a sustainable urban structure in the whole. A company wholly owned by the City of Hamburg, HafenCity Hamburg GmbH benefits, among other things, from a very strong technical capacity with employees from the fields of engineering, urban planning, spatial planning, economics, cultural management, humanities and social sciences, geography and landscape architecture.[17]

4 Financial instruments

Even though the EU and its Member States are currently the largest contributors to public climate finance globally, the European Green Deal emphasized the need to mobilize private financial resources and capital inflows towards green investments to ensure financial sustainability in terms of sustaining medium and long-term action with own efforts as well as covering maintenance costs for investments initially financed by attracted EU funds.

4.1 Examples of Financial Instruments directly dedicated to the transition to climate neutrality

Local, metropolitan or regional governments across Europe are using innovative tools to finance and maintain the investments needed to mitigate the effects of climate change and reduce emissions, to respond to local needs, such as:

— **Local green bonds** work like normal municipal bonds, (being debt that will be repaid over a certain well-defined term, usually medium or long, with a certain interest rate, depending on the characteristics of the bond) but specifically designed to finance their sustainable energy, sustainable transportation and climate resilience projects; such green bonds have been issued by the city of Gothenburg[18] in Sweden (since 2014, being the first city in the world with such bonds), Paris (first time in 2017), Amsterdam or London, to attract capital from interested investors focused

16

https://www.brookings.edu/wp-content/uploads/2017/05/csi_20170601_copenhagen_port_paper.pdf

17

https://www.hafencity.com/hafen-city-hamburg-gmbh

18

Green Bonds 2022 framework (to be updated 2025): https://goteborg.se/wps/portal/enhetssida/investor-relations/green-bonds/green-bond-framwork;
Green bond investments: https://goteborg.se/wps/portal/enhetssida/investor-relations/green-bonds/investment-projects

on sustainable development while addressing climate action at the local level.

In Romania, Resita was the first city to list the first issue of green bonds on the Bucharest Stock Exchange in 2024, with a value of 8.8 million euro and a maturity of ten years, to co-finance the project to reintroduce the electric tram in Resita, respectively the renewal of the rolling stock of the transport operator (13 trams and 10 electric buses) and the development of the transport infrastructure[19].

— **(internal) energy performance contract (EPC)**/revolving fund: a form of financing that allows financing energy retrofits from reduced consumption costs. Under an EPC agreement, an external organization (ESCO) implements an energy efficiency or renewable energy project and uses the revenue stream from the cost savings or renewable energy produced to repay the project costs, including investment costs. The ESCO will not receive payment unless the project generates energy savings as expected[20].

The City of **Stuttgart** has done something similar[21], except that it has done in-house contracting to finance energy efficiency and energy-saving projects for its owned buildings and to significantly reduce its CO2 emissions as part of Stuttgart's climate protection program - in-house contracting is financed through a revolving fund, which is a stable fund that operates without any fiscal year limitation: it is replenished by repayment of the money used from the account, no interest payments or bank fees are required for these investments, and projects can be started more quickly. In this case, the money used to replenish the fund was the savings from renovations. Between 1995 and 2013, the value of the fund increased from €9.5 million to €11.8 million. It is estimated that the program resulted in total energy cost savings of €18 million in the period 1995-2013 alone.
The Department of Energy, part of the Office of Environmental Protection, manages this fund and finances energy efficiency projects that would otherwise have to be contracted out. From the investment in energy savings, to the actual costs that are saved by reducing energy consumption, all these financial flows remain under the control of the municipality. The main steps in the process are as follows:

— To determine which properties are suitable for in-house contracting, the energy department has conducted data analysis and energy audits and monitors what construction or renovation plans are in place for public buildings;
— The energy department then calculates the costs with the building department and contracts with the facilities department, which owns the housing fund, for the building department to implement the renovation or energy-saving project;
— Finally, the buildings department repays the investment to the energy department's revolving fund.

Examples of the implementation of internal contracts range from lighting control to the construction of a new heating and power plant for a public swimming pool. A key element for internal contracts is a well-coordinated administrative process, well-defined roles and responsibilities and communication between the parties involved.

The Stuttgart model has been implemented in several cities: Udine (Italy), Águeda (Portugal), Koprivnica (Croatia) and Almada (Portugal) for financing energy renovation of residential buildings through low-interest loans and third-party investment schemes [22].

— **Public-private partnerships (PPPs) for sustainable infrastructure**: enable local authorities to pool public funds with private sector investment, mobilizing additional skills and

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https://m.bvb.ro/AboutUs/MediaCenter/PressItem/Municipiul-Resita-listeaza-prima-emisiune-de-obligatiuni-municipale-verzi-la-Bursa-de-Valori-Bucuresti/5988

20

https://www.ae3r-ploiesti.ro/en/press-releases/96-de-ce-sunt-contractele-de-performanta-energetica-utile-pentru-majoritatea-cladirilor-publice-existente Templates of the framework contract for energy performance and design services for UAT- uri and sectors of Bucharest municipality (ESCo) are available here: https://energie.gov.ro/ministerul-energiei-a-postat-pe-site-cele-2-modele-ale-contractului-cadru-de-servicii-de-proiectare-si-performanta-energetica-pentru-uat-uri-si-sectoarele-municipiului-bucuresti-esco/

21

https://energy-cities.eu/wp-content/uploads/2018/11/Stuttgart_Intracting_2017_en.pdf; https://www.stuttgart.de/leben/umwelt/?loc=en

22

https://energy-cities.eu/wp-content/uploads/2019/01/PUBLI_infinite_solutions_guidebook_softloans_2017_en.pdf capital to deliver large-scale, green infrastructure. PPPs spread the financial risk and contribute to faster project delivery by combining public policy objectives with private sector efficiency. PPP arrangements either aim for private funds to be provided as equity and/or debt contributions to infrastructure projects, with returns secured through future revenue streams directly linked to these projects, or for funds to be indirectly borrowed for projects and repaid from general municipal/utility company revenues through specific fee arrangements.

In the UK, the **Greater Manchester Combined Authority**[23] has used a PPP to develop a 'Green Investment Fund' to finance low-carbon infrastructure projects such as renewable energy, energy efficient buildings and sustainable transport. Formed in 2021 through a partnership between Greater Manchester Combined Authority, Lancashire Wildlife Trust and Finance Earth - the first of its kind in the UK, the 'Green Investment Fund' has brought in over £5 millions of funding to deliver projects, with one of the first successful applications being for £1.8 million to support 'Northern Roots' - the UK's largest urban farm and eco-park, spanning 160 acres of green space.

— **local tax incentives for energy efficiency investments in buildings**: these tax incentives encourage private owners to invest in green technologies such as solar panels, energy-efficient installations and improved thermal insulation. Local tax incentives help reduce the financial burden of the transition to a low-carbon economy by encouraging private sector participation in climate action.

As of January 1, 2023, every house sold in the **Flemish Region** with an E or F label according to energy performance certificates be made energy efficient within five years, failing which Flemish Energy and Climate Agency will impose a hefty fine. It is also mandatory to insulate the roof to an R-value of 0.75 kilowatt-hours per square meter. If the housing inspectors notice that this insulation is not provided, a severe penalty (of 15 points) is imposed, which can lead to a ban on using the dwelling, following a procedure before the local authority.

— **crowdfunding and community investment schemes**: crowdfunding platforms or campaigns enable residents and small investors to pool resources and invest directly in positive climate projects that benefit their community, which increases the involvement of local communities in taking responsibility for their climate action and generates additional capital for projects.

In **Barcelona**, local community-led crowdfunding initiatives were used to fund renewable energy projects, such as solar installations on public buildings or community centres. Citizens' cooperatives allow citizens to act together in renewable energy or energy efficiency projects, where members buy shares and profit from local projects, often gaining the opportunity to purchase electricity at a fair price. Online crowdfunding platforms also pool resources for sustainable energy projects, offering donations, rewards, loans or equity.

Energy cooperatives refer to a business model where citizens jointly own and participate in renewable energy or energy efficiency projects. In energy cooperatives, citizens are involved in decision-making as well as financial and economic participation. Once they buy a share in the cooperative and become members or co-owners of the respective local projects, members share in the profits and often can buy electricity at a fair price. In addition, members can actively participate in the cooperative: they can decide in what and where the cooperative should invest and are consulted when setting the energy price [24].

23

https://gmenvfund.org/ ; https://www.local.gov.uk/pas/topics/environment/nature-recovery-and-biodiversity-case-studies/generating-investment-natural; https://gmgreencity.com/; https://www.ukgbc.org/wp-content/uploads/2021/07/Investing-in-a-Greener-Greater-Manchester-A-nature-based-solutions-investment-guide-for-local-authorities.pdf

24

https://eu-mayors.ec.europa.eu/en/resources/funding_guide

4.2 Land-based financing/Land value capture (LVC)

A particular group of instruments that cities can use to raise revenue or in-kind benefits (utilities or public facilities) is "land-based financing" also called "Land Value Capture" (LVC). The land on which such instruments can be applied may be owned by the state, local authority or private sector and is usually located in urban or urbanizing areas.

Value capture schemes provide and recover some of the benefits of public investment to offset the costs of the investment itself. Value capture strategies start from the premise that public investment often increases the value of private land and real estate. "By 'capturing' the subsequent increase in value, local authorities can recoup funds that can be used to generate additional value for communities in the future. People are looking to live in areas that are well connected to the areas where they work and that are equipped with schools and recreational facilities, as well as those areas with good air quality, moderate temperatures, and renewable energy sources that will save them money.

The instruments differ according to their policy objectives, such as efficiency, equity or practicality, can be development-based or extra tax or fee-based, can be categorized as 'direct' vs. 'indirect', or can be categorized according to how they can contribute to climate infrastructure. They help in different ways to capture the economic benefits generated by public investment and reinvest them in further community development, and it seems natural and equitable that users of land whose value is enhanced by urban infill or regeneration should contribute to the financing of such infrastructure and services.

In addition to the land taxation applied in Romania, which, if applied at market value, can be considered as a method of capturing land value, there are other tools used in cities in Europe and around the world, briefly described below.

- **Property (real estate) tax** is levied on land and buildings and is payable by the owners of real estate. Local property tax has many advantages:
  - is generally accepted because it respects the most important principle of taxation, i.e. payment is charged in exchange for essential municipal services (not user charges), creates greater awareness of these services and increases local accountability;
  - can encourage the productive use of land by putting pressure on owners of vacant land and underutilized real estate, notably through additional local policies;
  - tax objects are identifiable and the tax base is broad;
  - is a stable source of income under normal economic conditions.

  If based directly on property value, the tax could also have the advantage of capturing some of the increase in property value over time, with the disadvantage of increasing administration costs through additional assessment costs. It is expected that by the end of 2025, a system for automatically determining taxable values will be in place to generate "market value" as the taxable value for all residential buildings in Romania[25]. As it is currently legislated in Romania, the real estate tax is not applied to the value of the property but as an indicator of the approximate value, by area, according to a grid based on the type of structure and the existence of utilities, adjusted according to the tax zoning and age of the building. Local authorities may update the taxable value in line with inflation, may increase tax rates within the margin provided by law and may establish certain reductions or exemptions.

  Even before implementing the system of setting taxable values that generate "market value", we recommend updating the

25 OUG 124/2024 which provided for these changes will apply from 2026 and also provided for the establishment of a structure within the Ministry of Finance to manage this process of automatic determination of taxable values.

tax zoning based on specific policy criteria (and rigorous scoring) that take into account, for example, the existence of utilities, neighbourhood/neighborhood amenities, parks, public transit stations, but also certain unfavourable conditions such as high noise or poor air quality, combined with rebates to incentivize desirable initiatives (e.g. for eco-neighbourhoods;

— **improvement/enhancement taxes**: A tax or fee imposed on property owners who benefit from infrastructure improvements (such as new transit lines) that increase the value of their land, a direct land value capture tool that seeks to collect a portion of the financial gains, in the form of a one-time fee, from property owners who have benefited from a public investment; although a conceptually simple mechanism, the difficulty or impossibility to identify which part of an increased value should be attributed to public infrastructure and which to other factors (e.g. general inflation of real estate values/prices), the difficulty to define a boundary between the area benefiting and not benefiting from infrastructure, and relatively high administration costs compared to the revenues collected, may prevent local authorities from making wider use of this instrument; In addition, to avoid exacerbating housing costs, this method needs to be combined with other measures, such as requiring developers to provide a percentage of affordable or social housing, sampling of payments for vulnerable owners, exemptions for certain categories of housing, the creation of a special fund from the proceeds of these taxes to be used exclusively for the construction, maintenance or energy efficiency and retrofitting of affordable housing;

— **Development fees**: developers are obliged to pay fees for new developments, which contribute to the financing of public infrastructure projects such as roads or utilities; the modality is also foreseen in the draft law on the Code on Spatial Planning, Urban Planning and Construction[26], as follows:

"For the purpose of equipping with transportation, technical and public utilities, educational, social, health, health, cultural, environmental infrastructure necessary for the area on which the PUZ has a direct impact, by Law no. 227/2015 on the Fiscal Code, as subsequently amended and supplemented, **will establish local taxes for equipping the territory, applicable to individuals or legal entities initiators of zonal urban plans that provide for the transfer of land from outer buildable bounds to inner buildable area for the realization of real estate development projects, functional reconversion[27], modification of urban indicators provided by the PUG.**"
Development charges are widely used in OECD countries as burdens or requirements imposed by local governments on developers to be approved to initiate land development, requiring them to pay at least a share of the costs of public facilities. It is very important that the circumstances in which these charges can be applied are clearly defined so that they do not run counter to the objectives of sustainable land consumption and can only be applied in conjunction with planning instruments that encourage and attract desirable activities in locations of strategic interest, such as regeneration of former industrial sites, heritage (including industrial) conservation and restoration, and those designed to protect the natural environment that would otherwise not occur.

The choice of the appropriate mechanism will depend on the nature of the project as well as the ownership of the land, but more importantly, the social and political context in which the mechanism would be implemented. Often, it is easier to apply LVCs to greenfield projects (new projects or developments that are built from scratch). In addition, land

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As tabled by the initiator and adopted by the Senate in June 2023: https://www.cdep.ro/pls/proiecte/upl_pck2015.proiect?cam=2&idp=21012

27

Art, 63, para. (2) of the draft law on the Code on Spatial Planning, Urbanism and Constructions, form submitted by the initiator and adopted by the Senate in June 2023 ownership adds another layer of complexity, as local authorities must convince individual landowners to accept a redevelopment/ rezoning of their land. Most often LVCs are used in relation to the extension of transport networks (the examples related to the newly rail-equipped areas of London being a good example), but even in these cases the method is not easily applicable as transport investment and land value increase do not occur at the same time. Thus, to use such a tool effectively, it is necessary to articulate several financing instruments and to integrate area and transport development into a single and coherent approach.

4.3 Public policy and regulatory funding methods

Having substantial control over land use through planning (zoning of urban interventions/operations) and regulation, local authorities can supplement capital or fiscal sources by harnessing this decision-making power to encourage or discourage certain aspects of development within an area and to promote private sector input into the design, construction, operation and maintenance of public infrastructure.

It is very important that the use of this method of supplementing the necessary public resources is carried out under conditions of maximum transparency and prior study of the most suitable options to ensure that the community is assured of the impartiality of the process and the fairness of the chosen option. It is necessary that these measures are anticipated in the Local Urban Development Regulations for the General Urban Development Plan and that the possible options are set out in the regulations and then studied in detail during the urban regeneration planning process, thus ensuring that impacts that could hinder the proposed objectives or 'throw' dysfunctions into other areas or the whole city are avoided.

The draft law on the Spatial Planning, Urban Planning and Construction Code provides in this regard:

"The local public administration authorities may negotiate, through a negotiating committee established by a decision of the Local Council, with the natural or legal person who initiated the elaboration of the PUZ, urbanization or urban restructuring contracts, relating to the **financing from private funds** of the infrastructure referred to in paragraph. (3) or to the transfer of land areas by the natural and/or legal persons initiating the zonal urban development plan."[28], and "The action plan for the implementation and the program of public investments proposed by the zonal urban development plan shall highlight the actions, the name of the investments, their estimated value, **the possible sources of financing**, the phasing of the investments, the stage of their implementation at the time of the program and the parties responsible for their implementation." [29]

Such incentives or bonuses can be:

— **density bonuses (conditions)**: allow developers to build to a certain land use ratio (or influx of users) if they contribute to social housing, create public parks or neighbourhood centres, education centres, educational institutions, medical centres, social housing, renovate existing valuable buildings, or apply green building practices or use renewable resources; examples of application include **Amsterdam**, where developers who integrate green solutions such as low energy buildings or additional green spaces can benefit from flexibility in terms of density and building height, **London**, where developers can receive density increases for projects that include a significant proportion of affordable housing or contribute to urban regeneration, similar to **Madrid**, where urban regeneration projects are promoted that allow density increases in exchange for the inclusion of social housing or improvements to public infrastructure, and **Barcelona**, where policies have been implemented that provide

28

Art, 63, para. (3) of the draft law on the Code on Spatial Planning, Urbanism and Constructions in the form submitted by the initiator and adopted by the Senate in June 2023.

29

Art, 74, para. (6) of the draft law on the Code on Spatial Planning, Urbanism and Constructions, the form submitted by the initiator and adopted by the Senate in June 2023.

flexibility in building density for projects that include additional green space or adopt energy efficiency measures[30];

— **Transfer of Development Rights (TDR) or Climate Bonds**: allows developers to acquire unused development rights from low-density or protected areas for use in designated high-density areas, with the goal of preserving certain open space, historic sites, or environmentally sensitive areas while allowing growth in urban centres. Administering a program - including any prior negotiations with a developer over specific conditions - requires a high level of technical expertise from a municipal team, which translates into a "cost" as well.

In conclusion, it should be emphasized that climate change does not change the preconditions for cities to use such financial instruments for investment in general, only that in this context it is about financing more sustainable infrastructure projects that can reduce emissions or increase resilience. To use these instruments, in addition to completing national legislation (in terms of the applicability of some of them), there is a need for internal local capacity to prepare and link projects, increased contracting capacity and a good link between strategic, operational and financing plans. Without these fundamentals, private investors will lack confidence, no matter how well a project responds to climate challenges.

30 https://climate-adapt.eea.europa.eu/en/metadata/case-studies/barcelona-trees-tempering-the-mediterranean-city-climate

5 Public procurement procedures

By harnessing their purchasing power, cities can stimulate demand for green products and services, stimulate innovation and promote sustainable economic growth. This approach, known as Green Public Procurement (GPP), involves integrating environmental criteria into procurement decisions.

General implementing measures for green procurement include

— Setting (climate-neutral) standards - clear criteria for public procurement processes so that the goods and services procured contribute to climate objectives, specifying requirements on energy efficiency, emission reductions and materials in tenders and contracts;
— Promoting circular economy practices by prioritizing products that are sustainable, repairable and recyclable;
— Developing comprehensive policies, procedures and guidelines requiring local authorities to take environmental impacts into account, with guidance on life-cycle costing and favoring products with low environmental footprints.

GREEN PUBLIC PROCUREMENT

The built environment incorporates greenhouse gas emissions from the design stage, continuing into the construction stage and then into the operational stage. A real analysis of the impact of a building should take all these stages into account and focus on mitigation at each stage. In this context, local and national public administrations are a major player in the construction market and can have a decisive influence on the transition towards the climate objectives set. This requires a range of public policies, instruments and measures to guide towards the common goal of reducing greenhouse gas emissions.

Law no. 98 of May 19, 2016 on public procurement, with subsequent amendments and additions, provides the legal framework for establishing evaluation factors that include qualitative, environmental and or social aspects.

In the light of the legal provisions concerning the establishment of environmental criteria in the design and execution of construction works, we present below a series of recommended criteria to be used in public procurement. To facilitate their integration into contracting strategies they have been structured in the following order:

1. *Criterion name*
2. *Wording*
3. *Calculation algorithm*
4. *Recommended scores*
5. *Justification*

A

1. *Evaluation factor name*: ENVIRONMENT factor - use of products and materials with low environmental impact;
2. *Description*: The number of products and materials certified by the international EPD Environmental Product Declaration system incorporated in the technical offer. In the field of public procurement it is essential to ensure a uniform assessment of technical offers and the EPD - which is an international standardized document according to ISO 14205 and EN 15804 - provides the framework to ensure such a uniform assessment. The EPD is a standardized document through which manufacturers assess the sustainability of products in a standardized way. Tenderers shall fill in an annex in which they shall record the items in the quotation containing the EPD certified products and materials accompanied by the EPD and the verification link..
3. *Weighting*: a weighting between 10 % and 20 %, or between 10 and 20 points, is recommended to ensure that the criterion is efficient and does not distort the result..

4. *Calculation algorithm*: For the highest number of EPD certified product/material types offered, the maximum score of n points (10-20 points) will be awarded, and for the rest, the score will be calculated using the formula: number of materials to be scored multiplied by n points and divided by the highest number of EPD certified product/material types.

5. *Justification*

Several environmental impact studies have been carried out at EU level. They show that construction materials, through their entire manufacturing process, are among the most significant factors which have an increased impact on the environment through the emissions generated. These materials end up being incorporated into buildings, and thus the impact on the total emissions generated by buildings is all the greater, given the impact of the materials and products incorporated into them. It is therefore essential that products and materials with a low carbon footprint are used to reduce the carbon footprint of a building and to reduce the environmental impact. This means minimizing the environmental impact throughout the entire manufacturing process, starting from the extraction of raw materials, including processing to the finished material/product and ending with transportation. In public procurement it is essential that the assessment is based on a standard, and that standard is provided using the EPD - Environmental Product Declaration - an internationally standardized document in accordance with ISO 14205 and EN 15804. Its use is in line with green building certification standards such as LEED and BREEAM and the use of EPD ensures:

— **Environmental responsibility**: EPDs, being drawn up according to a uniform international standard, provide information on the environmental impact of products and materials and these can be verified. The more environmentally friendly the materials and products are, the less environmental impact the public authority will have by carrying out the construction works, and the more environmentally responsible the public authority will be by reducing the environmental impact.
— **Resource efficiency and cost savings**: Selecting materials that have certified green performance, standardized through EPD, can lead to long-term building cost efficiencies due to lower energy consumption. In the total lifecycle of the building, it is evident that the environmental impact is significantly reduced.
— **Green Procurement Compliance**: Law No. 98 of May 19, 2016 on Public Procurement, as subsequently amended and supplemented, provides the legal framework to use environmental factors as a component, in addition to the price factor, for awarding public procurement contracts. Through this process, the public authority, guarantees compliance to a standardized document, a document that assesses the environmental impact of products and materials.
— **Green building certification**: EPDs are recognized in the certification process as a green building and can be a key contributor to certifications such as LEED or BREEM. Such certification would be an international recognition of the public authority's responsibility for environmental impact.
— **Stimulating innovation**: The use of environmental criteria in public procurement in our country is still at an early stage and its promotion would lead to a stimulation of innovation in the materials manufacturing process. The use of EPDs in the public procurement processes leads to a familiarization of this standard among the industry and thus it will act as a stimulus for innovation, innovation in improving the process, production flow of materials to decrease their environmental impact.

In conclusion, the use of the technical evaluation factor - ENVIRONMENT - the use of products and materials with low environmental impact and ensuring a standardized/unitary evaluation procedure for all bidders through the use of EPD, ensures both compliance with the legal provisions on green public procurement and supports environmental commitments, resource efficiency and long-term sustainability of public authorities.

B

1. *Evaluation factor name*: Factor MEDIUM - use of a short supply chain;
2. *Description*: The transportation distance between the place of production of the materials (the factory) and the place of commissioning (the construction site) is used for the assessment. The shortest distance ensures the least impact on the environment, especially for material categories that have a higher environmental impact. To ensure a uniform framework for evaluation, tenderers must provide information on the location of the plant. Locations shall be expressed in geographical coordinates to facilitate the verification of distances. The shortest resulting distance between the location of the factory (place of production of the material), indicated by the tenderer, and the location of the construction site, indicated by the public authority, shall be evaluated. The shortest distance between the production site and the construction site will be used to calculate the transportation impact. The place of production will be related to the location of the construction site, specified by the public authority in the procurement data sheet. As a recommendation: evaluation to be carried out for 5 categories of materials. These 5 categories should be selected from the categories of materials that require transportation of more than 25 km from the factory to the site and from those that are in considerable quantity (e.g. concrete). The material categories will be selected based on the principle of significant impact - based on quantity and weight - the greater the weight and quantity of the material, the more significant the environmental impact.

   Technical sub-factors per material category are used for the evaluation, depending on the place of production and thus providing objective criteria. Each technical evaluation sub-factor is given a score and calculated individually. A number of 5 assessment sub-factors are recommended with a total score of 20-40 points depending on the environmental objectives set by the public authority.

   Examples of material categories (sub-factors):

   — Ballast works (procurement of ballast products): The quantity of material (ballast products) in the works estimate and the shortest distance from the ballast works of origin to the site will be considered. The tenderer shall indicate the location of the quarry and the maximum distance to the nearest quarry included in the tenders shall be given.
   — Nursery (procurement of trees and plant material): The trees specified in the bill of quantities and the distance from the production nursery to the site will be considered. The bidder shall indicate the location of the nursery and the distance to the nearest nursery included in the bids shall be maximized.
   — Concrete production station: Consider the quantities of concrete required in the works estimate and the shortest distance from the concrete production station to the site. The tenderer shall indicate the location of the asphalt production plant and the distance to the nearest asphalt plant included in the tenders shall be maximized.
   — Insulating materials factory (procurement of thermal and/or acoustic insulation materials): The quantities of insulating materials required in the works estimate will be considered and the evaluation will be based on the transportation

distance from the production factory to the site. The tenderer shall indicate the location of the insulating material factory and the distance to the nearest factory included in the tenders shall be maximized.

— Precast concrete plant (procurement of precast concrete products) or Precast metal plant (procurement of precast metal products, reinforcing bars, structures, metal fabrications): The quantities of precast products in the works estimate will be considered and the evaluation will be based on the shortest distance from the location of the production plant to the site. The tenderer shall indicate the location of the precast concrete or precast metal factory and the distance to the nearest factory included in the tenders shall be maximized.
— Brick production plant (procurement of bricks and ceramic products): The quantities of bricks in the works estimate will be considered and the evaluation will be based on the shortest distance from the location of the production plant to the site. The tenderer shall indicate the location of the brick production plant and the distance to the nearest plant included in the tenders shall be maximized.
— Ceramic tile production factory (procurement of tiles): The quantities of tiles in the works estimate will be considered and the evaluation will be based on the shortest distance from the location of the production factory to the site. The tenderer shall indicate the location of the ceramic tile production plant and the distance to the nearest plant included in the tenders shall be maximized.
— Production plant for paving stones (procurement of paving stones and slabs, kerbstones, etc.) The quantities of paving stones, slabs, kerbstones, kerbstones, kerbs, etc. in the works estimate will be considered and the evaluation will be based on the shortest distance from the location of the production plant to the site. The bidder shall indicate the location of the paver production plant and the maximum distance to the nearest plant included in the bids shall be scored.
— Asphalt production plant. Se vor lua în calcul cantitățile de mixturi asfaltice din devizul de lucrări, iar evaluarea se va face pe baza distanței celei mai scurte de la locația stației de producție la șantier. The tenderer shall indicate the location of the asphalt mix production plant and the distance to the nearest plant included in the tenders shall be maximized.

3. *Weighting*: It is recommended that the maximum score should be set between 20 - 40 points. This is divided over the 5 technical environmental sub-factors, each of the sub-factors receiving a score between 2 and 15 points, the weighting being set in correlation to the impact of the material category (quantity and weight).
4. *Calculation algorithm*: For the calculation of the distances to the indicated locations, the Google Maps application freely available online at https://www.google.ro/maps/dir/ or other similar applications (the application shall be determined by the public authority in the tender notice) shall be used. In the application, each proposed location (GPS coordinates) for the above shall be entered, in turn, as starting point the place of origin and the destination (investment objective) expressed in GPS coordinates. To ensure a unified assessment framework, the location in GPS coordinates will be taken into account the reference point being ... N and ... E.

Based on the distances in the technical offer (a separate appendix form is recommended), the score per sub-factor is calculated. The shortest distance from each sub-factor receives the maximum score awarded to that sub-factor. For the remaining distances the score is calculated according to the rule: PO = Ds (Shortest Distance) / Do (Distance Bid) x PM

(Maximum Score), where Maximum Score = PM; Bidder Score = PO; Shortest Distance = Ds; Bidder Distance = Do

The final score for the MEDIUM Factor - use of short supply chains is determined by aggregating the scores for each of the 5 sub-factors.

Example: If the location of the quarry is point X (latitude Y, longitude Z) and the construction site is at point A (latitude B, longitude C), calculate the distance between the two points using Google Maps.

Example: GPS site reference point.

5. *Justification*

Several environmental impact studies have been carried out at EU level. They show that construction materials, through their entire manufacturing process, are among the most significant factors which have an increased impact on the environment through the emissions generated. These materials end up being incorporated into buildings, and thus the impact on the total emissions generated by buildings is all the greater, as is the impact of the materials and products incorporated into them. Given that it can be a short or significant distance from the place of production of a material to the place where it is put into use, the transportation of materials has a significant environmental impact. It is well known that building construction involves a significant number of materials and that these need to be transported to the construction site. Transport is usually carried out by motorized trucks, which leads to significant emissions. The impact of transportation is reflected in the total carbon footprint of the building and therefore mitigating the impact of transportation by ensuring a short supply chain leads to a reduction in the overall environmental impact of the building. A short supply chain for building materials has both environmental and ecological benefits, contributing both to reduced environmental impacts and to the development of the local economy. Such advantages are significant for public projects, which can act as a vector for development with firm commitments to sustainability and environmental protection. The main advantages are:

— **Increased quality of life**: Decreasing transportation, by ensuring a short supply chain, leads to less pollution from vehicles and thus leads to a better quality of life for residents by reducing air pollution.
— **Reducing carbon emissions**: Building-embodied carbon emissions include emissions from the transportation of materials from the place of production to the construction site, and consequently a shorter distance leads to a reduction in building-embodied carbon emissions. Materials from short supply chains play a key role in reducing the carbon footprint of buildings.
— **Reduced consumption**: The shorter the distance from the place of material production to the construction site, the lower the fuel consumption and thus the lower the consumption of exhaustible resources.
— **Cost reduction**: Logistical and transport efforts are considerably higher when materials are brought in from thousands of kilometres away and consequently securing them through a short supply chain leads to cost savings. It also leads to reduced planning and construction time, as materials can be procured more easily and do not require significant temporary storage space.
— **Green Procurement Compliance**: Law No. 98 of May 19, 2016 on Public Procurement, as subsequently amended and supplemented, provides the legal framework to use environmental factors as a component, in addition to the price factor, for awarding public procurement contracts. Through this process, the public authority, guarantees compliance to a

standardized document, a document that assesses the environmental impact of products and materials.
— **Green building certification**: EPDs are recognized in the certification process as a green building and can be a key contributor to certifications such as LEED or BREEM. Such certification would be an international recognition of the public authority's responsibility for environmental impact.

In conclusion, the use of the technical evaluation factor - ENVIRONMENT - the use of short supply chains, ensures both compliance with the legal provisions on green public procurement and supports environmental commitments, resource efficiency and long-term sustainability of public authorities.

Example:
— Procurement initiated by contract notice: [CN1046948] - Execution works for the investment objective "INTEGRATED TRANSPLANT CENTER CLUJ-NAPOCA AND OUTDOOR FACILITIES"
— Procurement initiated by public tender: [CN102424214] - Execution of construction works within the investment objective "PARK and RIDE" Cluj-Napoca"

National Agency for Public Procurement (2024, August 9). Order No. 1.946 of August 9, 2024 for the approval of the ecological criteria applicable to the categories of products that have an impact on the environment during their entire life cycle, set out in Annex No. 2. https://anap.gov.ro/web/ordin-nr-1-946-din-9-august-2024-pentru-aprobarea-criteriilor-ecologice-aplicabile-categoriilor-de-produse-care-au-impact-asupra-mediului-pe-durata-intregului-ciclu-de-viata-prevazute-in-anexa-nr-2/

National Agency for Public Procurement (n.d.). Green Public Procurement in the EU. https://anap.
Law No. 98 of May 19, 2016 on public procurement, as amended and supplemented, provides the legal framework for establishing evaluation factors that include qualitative, environmental and or social aspects. In section 7-a Award criteria, we find art. 187 which states:
— Para. (1) Without prejudice to the legal or administrative provisions concerning the price of certain products or the remuneration of certain services, the **contracting authority shall award** the public procurement contract/framework agreement **to the tenderer who has submitted the most economically advantageous tender.**
— Para. (2) For the purposes of the provisions of para. (1), the contracting authority shall determine the most economically advantageous **based on the award criterion and the evaluation factors** set out in the procurement documents.
— Para. (3) In order to determine the most economically advantageous tender in accordance with the provisions of paragraph (3), the contracting authority shall select the most economically advantageous tender in accordance with the provisions of paragraph (3). (2), the contracting authority is entitled to apply **one of the following award criteria**:
  a. **best value for money;**
  b. **best value for money;**
  c. lowest cost;
  d. lowest price.
— Para. (4) For the purposes of para. (3) (a) and (b), the best value for money/quality/cost shall be determined based on **evaluation factors including qualitative, environmental and/or social aspects** related to the subject matter of the public procurement contract/framework agreement.
— Para. (4^1) For the award of public procurement contracts having an **environmental impact during their entire life cycle**, the contracting authority shall include in the award criteria referred

to in paragraph. (3) (a) and (b) evaluation factors relating to environmental protection.

— Para. (5) The assessment factors referred to in para. (4) may cover, inter alia:
  a. quality, including technical advantages, aesthetic and functional characteristics, accessibility, design concept for all users, social, environmental and innovative characteristics and its marketing and conditions;
  b. the organization, qualifications and experience of the staff appointed for the execution of the contract, where the quality of the staff appointed is likely to have a significant impact on the quality of the contract performance;
  c. after-sales service, technical support and delivery conditions, such as delivery date, delivery process and delivery or completion date;
  d. the tenderer has a collective bargaining agreement with a trade union organization at establishment level or a collective bargaining agreement at sector level of collective bargaining is applicable to it.

— Para. (8) With the exception of the application of the negotiated procedure without prior publication of a contract notice referred to in Article 104 para. (1) letter b), the contracting authority shall not use the lowest cost/lowest price as an award criterion in the case of:
  a. of categories of public procurement contracts/framework agreements for works or services having as their object intellectual services;
  b. public procurement contracts / framework agreements for design and execution or services that are related to trans-European transport infrastructure projects, as defined in this law, and county roads;
  c. certain categories of public procurement contracts/ product framework agreements that have a life-cycle environmental impact.

Moreover, the same Law 198/2016 is detailed in art. 188, as follows:

— Para. (1) The evaluation factors referred to in Article 187 para. (4) shall be directly related to the subject-matter of the public procurement contract/framework agreement when they relate in any way to the products, services or works to be supplied/ performed under the public procurement contract/framework agreement and at any stage of their life cycle, even if those factors do not form part of the material substance of the products, services or works concerned.

— Para. (2) For the purposes of the provisions of para. (1), the contracting authority may take into account evaluation factors in relation to:
  a. the specific process of production, supply or marketing of works, products or services;
  b. a specific process for another stage in the life cycle of works, products or services.

— Para. (3) For the purposes of the provisions of para. (1), for the categories of public procurement contracts/framework agreements referred to in Art. (8) lit. c), the contracting authority shall take into account at least evaluation factors in relation to:
  a. **the contribution of the manufacturing process to environmental protection**;
  b. **supply chain - short supply channels**;
  c. **the shortest distance from the place of production to the place of consumption**.

Article 191 of the Law states "Life-cycle costing shall cover, as far as relevant, all or part of the following costs during the life cycle of a product, service or work:
  a. b) costs incurred by the contracting authority or other users, such as procurement costs, user costs such as energy and other

resource consumption, maintenance costs, end-of-life costs such as collection and recycling costs;

b. costs caused by environmental externalities in relation to the product, service or works during their life cycle, provided that their monetary value can be determined and verified; these costs may include the cost of greenhouse gas and other pollutant emissions and other costs of mitigation of the effects of climate change.

As can be seen, there is a fairly well-developed legal framework in place to encourage the achievement of climate objectives. However, the number of green public procurement in the construction sector is still quite low.

Procurement criteria in the rehabilitation of the built environment

The restoration of buildings is an obligation and a duty, which involves a complex process, consisting of specialized interventions and detailed studies, with the main aim of preserving, restoring, consolidating and enhancing them. In this context, quality-based tender documentation is essential to ensure that the design services are carried out to the highest standards, respecting the fundamental principles of restoration, namely minimum intervention, reversibility and material compatibility.

The restoration of a building involves a detailed analysis of its state of conservation, based on baseline studies; the design of compatible solutions to ensure that the architectural, artistic and structural values of the building are protected; the respect of the principle of reversibility and minimum intervention, so that any modification can be removed or adapted in the future without damaging the original elements.

Law no. 98/2016 on public procurement, together with its implementing rules (H.G. no. 395/2016 with subsequent amendments and additions) establishes the principles and procedures for awarding public procurement contracts, emphasizing transparency, non-discrimination and efficient use of public funds.

The elaboration of a tender documentation for the public procurement of design services must be carried out in accordance with the design theme and concept note (elaborated in compliance with the provisions of HG no. 907/2016). These documents provide a clear and coherent vision of the needs, defining technical requirements, accepted methodologies and performance indicators. An essential component is also the establishment of the estimated value, with the contracting authority having the obligation to ensure that it is covering all phases of the design (or the phase/phases subject to the respective procedure), that it is up to date and has to ensure that the duration of the project preparation is appropriate. These aspects are essential to guarantee the quality, feasibility and sustainability of the project, preventing the risks of incomplete, superficial or non-compliant documentation.

According to the legislation in force on public procurement, for the award of a public procurement contract, the institutions/entities that set themselves up as a contracting authority are obliged to consider a number of aspects, as follows:

— establishing the type of procurement procedure that will be carried out to award the contract (according to the provisions of Article 7 of Law no. 98/2016 with subsequent amendments and additions).
— determination of an estimated value, correctly calibrated to the required design services
— the elaboration of a contracting strategy (for public procurement procedures - not to be drawn up in the case of direct award of contracts), where, inter alia, the estimated value, the chosen procedure, the qualification requirements, the award criterion, the evaluation factors, etc. are duly justified.
— publication in SEAP (Electronic System for Electronic Public Procurement), initially of the tender documentation and, subsequently, of the contract notice, simplified contract notice or the notice for the call for tenders.

— establishing a committee to evaluate the bids received.
— After the evaluation committee has completed its work, it will draw up a Report of the procedure, which establishes the winning tender, approved by the head of the institution and then published in SEAP, together with the notifications on the outcome of the procedure, sent to the participants in the procedure.
— Finally, the contracting authority publishes the award notice in SEAP.

The contracting authority has the right to establish qualification requirements (which may concern the technical-professional and financial capacity, but will necessarily take into account the grounds for exclusion provided for in Articles 164, 165 and 167 of Law no. 98/2016, as amended and supplemented) for economic operators, provided that they are objective, justified and proportionate to the nature and complexity of the procurement.

The award criteria are the mechanism by which the contracting authority evaluates and compares the tenders submitted. According to the legislation, several award criteria are foreseen for the evaluation of tenders, either best value for money or lowest price/cost, but in the case of design services, criteria strictly related to price or cost are not applicable, as a balance between price/cost and the technical and qualitative value of the tender must be ensured. Determining the winning bid based on price/cost alone could irremediably affect the final result (the project), since compromising the quality of the human and technical/material resources involved in the various phases of the design process will have repercussions on the results of the entire design process.

Quality-based award criteria involve the evaluation of the technical and professional factors of tenderers, not only the financial component. In this respect, the following key aspects should be considered in the evaluation of tenders:

a. experience and qualifications of team

In the field of design, the quality of work is directly proportional to the experience and specialization of the team involved. Therefore, it is essential that the tender documentation provides clear criteria on: the team's experience in similar projects (through the number and complexity of similar projects previously carried out); competence in the use of modern technologies (e.g. 3D laser scanning, laboratory analysis, etc.),.

These requirements will be justified in the Procurement Strategy, the document that defines how the contracting authority will carry out the procurement procedure, arguing in this case the importance of similar experience for the quality of the services to be contracted.

The contracting strategy must demonstrate that experience in architectural design is not an arbitrary requirement, but an objective necessity based on the specific requirements of the interventions.

The minimum requirements regarding the experience and qualifications of the project team are a qualification criterion, failure to meet which automatically leads to the tender being declared unacceptable and to its rejection.

The qualification requirements are eliminatory criteria designed to ensure that economic operators have the technical and professional capacity to carry out an architectural project. These requirements must not be discriminatory or restrictive but must guarantee a minimum level of competence.

In order not to restrict competition and to respect the principles of public procurement, the minimum qualification requirements must be:
— clear and proportionate to the complexity of the project;
— objective and measurable;
— set according to project needs, not arbitrarily.

Example of minimum qualification requirement:

"*Tenderers shall provide proof that, in the last 3 years, they have provided similar services, i.e. architectural design services for civil constructions, for one or more contracts, for a total value of at least .... lei excluding VAT, which is close to the estimated value of the present procedure, and which is relevant in relation to the complexity of the contract.*"

This requirement does not eliminate from the competition operators who have carried out at least one similar project/service, does not introduce excessive restrictions, such as imposing many similar projects/contracts, which could reduce competition, and ensures minimum eligibility of bidders by guaranteeing that they have a minimum experience in architectural design.

Given all the aspects involved in architectural design work, an economic operator without similar experience cannot guarantee compliance with quality standards and may propose inadequate solutions.

By way of exception, in the case of competitions for solutions, proof of similar experience is not mandatory because:

— evaluation is not done at team level, but at the level of the solution offered;
— the quality of the tendered solutions is assessed by a professional jury based on quality-based award criteria.

When drawing up the tender documents for the procurement of architectural design services, it is essential to make a clear distinction between the minimum qualification requirements - requirements which determine the eligibility of economic operators - and the quality-based award criteria, which determine the level of excellence of the tenders and allow their ranking based on objective evaluation factors.

This differentiation must also be clearly defined in the Procurement Strategy, so that the documentation complies with the principles of public procurement, ensures real competition between tenderers and allows the selection of the most competent operator.

While the qualification requirements determine who can participate in the procedure, the award criteria determine which offer is the most valuable, based on quality factors.

In the evaluation of bids, similar experience can be used as a differentiating factor between bidders but should be weighted according to the quality of experience demonstrated. This can be done by giving a higher score to projects that have received professional recognition (awards, nominations). This gives a competitive advantage to operators with a relevant portfolio and encourages professional excellence by scoring recognition in the field.

In order to avoid misinterpretation and to comply with public procurement rules, the award documentation should explicitly state that qualification requirements are only a minimum threshold for access to the procedure, while the award criteria allow for the ranking of tenders.

b. technical quality criteria

In order to ensure a qualitative selection of tenders for architectural design services, it is mandatory to include technical criteria in their evaluation. These criteria must be clearly defined and allow differentiation between intervention methods that comply with the principles of sustainable design and those that do not.

In the evaluation process, it is recommended to use criteria that reflect key aspects of design quality, such as:

a. methodological approach proposed for interventions on an existing objective:
   - assessment of the compatibility of the proposed materials and technologies with the specific building and intervention principles;
   - proposals for reversible and minimal interventions and solutions for preserving authenticity in the case of interventions on heritage buildings.

b. the level of detail and substantiation of the technical solution:
   — presenting a comparative study of possible intervention options
   — justifying the choice of the optimal solution through objective criteria (sustainability, compatibility, sustainability)
c. strategy for integrating the results of the preliminary studies.
d. low weight of the "price" criterion
   — the award documentation must set out a clear scoring system in which price has a lower weighting and technical criteria have a significantly higher weighting.

For a transparent and objective assessment, the criteria should be clearly quantified through a scoring algorithm that reflects the differentiation between the proposed interventions, such as: proposed building system, team experience, sustainability and efficiency (principles of energy efficiency and responsible use of resources).

By introducing mandatory technical criteria and a detailed scoring algorithm, the Contracting Authority ensures that the selected design services meet quality and sustainability requirements.

In the public procurement of architectural design services, several recurring vulnerabilities can compromise the quality of projects and the efficient use of funds. These vulnerabilities are mainly caused by insufficient time allocated to design, underestimation of costs and award criteria that favour price over quality.

a. Insufficient deadlines for drawing up documentation:

Contracting authorities often set unrealistically short deadlines for project preparation, which affects the quality and feasibility of the technical solutions proposed.

For example, an assignment documentation foresees **a deadline of 60 days for**:
— elaboration of technical expertise, topographic study with O.C.P.I. visa, geotechnical study with AF requirement, energy audit;
— D.A.L.I.;
— documentation for obtaining the Certificate of Urban Planning, including documentation for required permits/approvals;
— P.A.C. (project for authorizing the execution of construction works), including P.O.E. project for the organization of the execution, the schedule of the investment;
— documentation to obtain the building permit;
— technical execution project (including execution details, visas of certified verifiers in the designed fields).

This delay will lead to superficiality in carrying out studies and technical-economic documentation, the choice of quick solutions, the impossibility of obtaining opinions from specialized institutions, delays.

b. Underestimation of the costs of preparing documentation:

Unrealistic cost estimates for architectural design can have serious consequences on the quality of the design and implementation of the investment. This can lead to:
— submission of tenders that do not reflect market realities, tenders with low prices that compromise the quality of the projects, or no tenders at all (unattractive contracts for experienced designers)
— Incomplete or non-compliant documentation, as tenderers, constrained by a tight budget, may be tempted to lower quality standards, limit necessary investigations or omit essential studies;
— Subsequent need for revisions and updates, leading to additional costs, longer implementation time and delays in starting implementation;

— Difficulties in the execution phase of the works, as a poorly documented project leads to implementation problems, requests for clarifications and even possible disputes between the beneficiary and the contractor;

c. Choice of award criterion "lowest price"

The Methodological Norms of Law no. 98/2016, respectively H.G. no. 395/2016 with subsequent amendments and additions establish that for service contracts having as object intellectual services, such as consultancy, studies, design or supervision, the award criterion must be "the best value for money". The price factor may not exceed 40%. Article No. 187 of Law No. 98/2016 specifies that: - the "lowest price" criterion may NOT be used for contracts for intellectual services, a category which includes design services. The prohibition is also confirmed by ANAP which has emphasized in several guides and interpretations that design is an intellectual service and that it cannot be awarded exclusively on price guard.

According to the provisions of Law no. 98/2016 and GD no. 395/2016 with subsequent amendments and additions, any requirement that can be considered restrictive or excessive, including in terms of turnover, similar experience, contract duration or estimated value, must necessarily be justified by a clear and objective analysis, correlated to the complexity and risks of the contract, so as to respect the principle of proportionality and not to unduly restrict competition.

To prevent these vulnerabilities, it is essential that Contracting Authorities develop soundly based tender documents, set realistic deadlines for fulfilling contractual obligations and use award criteria that favour quality. The introduction of concrete measures such as budget to market reality - based on detailed cost analysis before the launch of the procedure - and realistic timeframes for project preparation can help to improve the procurement process and achieve higher quality services. The estimated value of design services should also be realistically based on appropriate reference costs, considering the specificity and complexity of each project. There must also be a clear correlation between the estimated value, the quality requirements imposed, and the resources needed to produce complete and compliant documentation.

Compliance with the legal provisions in force in the procurement of design services is important to ensure transparency, proportionality and fair competition in the award of contracts. Analysis of the documents (fiches) reveals several weaknesses, including the use of non-compliant award criteria, excessive financial weightings, unjustified restrictive requirements (given the data analysed and not having access to the contracting strategies) and under- or over-estimation of estimated costs.
In order for the procurement process to be legal and efficient, they must be respected:

— proportionality: any requirement imposed on tenderers - turnover, similar experience, duration of contract, estimated value - must be objectively justified and proportionate to the complexity of the contract;
— Transparency: all documents and award criteria must be clearly formulated in a way that leaves no room for interpretation and allows genuine competition between tenderers;
— legality - the correct use of the award criterion for intellectual services such as design, i.e. "best value for money", with a maximum price weighting ceiling of 40%;
— economic efficiency: the estimated value of the services must be in line with market reality, based on reference costs and cover all the studies and investigations necessary for complete and quality documentation.

In the absence of a correct application of the legal provisions in force, there is a risk that projects will be affected by delays, bottlenecks, appeals and even cancellations, which leads to loss of resources and administrative inefficiencies. Contracting Authorities must therefore ensure rigorous alignment with the legal provisions, avoiding any practices that could limit competition, affect the quality of design or jeopardize the implementation of (public) investments.

6 Architecture competition

6.1 Recommended procedure for public administrations to maintain the quality of the built environment in the context of climate neutrality

A design competition is a procedure for the public procurement of design services for a specific investment, which - as international experience has shown - is the most reliable guarantee of architectural and urban quality. It recommends the competition as the most appropriate procedure for public architectural and urban-planning investments, on the essential condition of good organization, from the grounding and preparation of the basis to the actual conduct of the procedure. The specific nature of the competition (as opposed to procurement by tender) stems from the fact that any architectural or urban planning solution is also an act of creation, which involves the translation into artistic form of rational (constructive and functional) responses to the situation in question. The competition for solutions aims, through a specific professional procedure, to identify, evaluate and highlight precisely this artistic dimension, which is the only one that can give the built environment a quality in addition to functional and constructive solutions.

In the context of investments aiming to achieve climate neutrality, the solutions competition is indispensable due to its ability to attract and select the most innovative and sustainable proposals that can respond to the complexity of technical and environmental requirements, integrating architectural creativity with energy-efficient and environmentally friendly solutions. The procedure thus guarantees a long-term vision that contributes to the development of cities in a sustainable way, in line with European and global objectives to reduce the carbon footprint.

6.1.1 What is an architectural competition?

An architectural design competition is the selection procedure aimed at finding the best solution for the investment that a contracting authority would like to develop. A well-organized solutions competition provides a framework of good professional practice through which better architecture can be achieved conceptually, aesthetically and technically. Competitions can be organized for a new building or for the rehabilitation and extension of an existing one, for a group of buildings, for public spaces, parts of towns or whole cities. The architectural design competition tool can also be used to solve situations requiring maximum innovation.

In the context of climate neutrality objectives, the solutions competition becomes an essential tool for selecting the most efficient and innovative design proposals. This procedure ensures the integration of sustainability concerns from the conceptual phase of the project, supporting the development of solutions that combine energy efficiency, sustainable materials and design adapted to the requirements of carbon reduction. In doing so, the competition contributes to the identification of proposals capable of addressing the complex challenges of climate change and sustainable urban development.

Organizing a solutions competition involves coordinating several elements, the most important of which are:

— a correct assessment, through a transparent and justified cost analysis, of the resources required - a correctly assessed contract and award value in relation to the contract requirements,

- a well-prepared competition brief, accompanied by background studies, which comprehensively describes the objective,
- a jury composed of a majority of nationally and internationally recognized architects, as well as professionals with complementary specializations, who analyze the projects comparatively, establishing a final ranking and a winner,
- a procedure that is clear, fair and transparent at all stages, from the launch of the competition to its completion,
- anonymity of the participants in the procedure,
- Integrate sustainability requirements into the competition theme and evaluation criteria so that the selected solutions reflect the objectives of climate neutrality using innovative technologies, energy efficient solutions and low carbon footprint materials.

6.1.2 6.1.2Benefits of the design competition

It represents a huge image capital and indirect economic development.

A successful design competition not only brings architectural and urban design benefits, but also produces social, economic and cultural added value. The completion of a well-organized competition sends a strong public message underlining the authorities' commitment for innovation, sustainability and quality. This visionary commitment attracts the support of public and private actors, generating trust and building partnerships for the future. *In the context of climate-neutral projects, the competition helps to promote cities and communities as leaders in the green transition, while stimulating private investment and local economic development.*

Brings community value

Prin organizarea unor consultări transparente și incluzive, concursul de soluții permite tuturor actorilor interesați să contribuie la procesul de decizie, oferind o platformă pentru discutarea avantajelor și dezavantajelor diferitelor abordări. Acest proces asigură o viziune integrată, în care interesele comunității sunt prioritizate și aliniate la strategiile de dezvoltare urbană. *În cazul investițiilor pentru neutralitatea climatică, concursul devine o oportunitate de a educa și implica comunitatea în tranziția către soluții sustenabile, promovând adoptarea unor măsuri ecologice prin consens public.*

The competition offers trust and political capital

By organizing transparent and inclusive consultations, the design competition allows all stakeholders to contribute to the decision-making process, providing a platform to discuss the pros and cons of different approaches. This process ensures an integrated vision in which community interests are prioritized and aligned with urban development strategies. *In the case of climate neutral investments, the competition becomes an opportunity to educate and involve the community in the transition towards sustainable solutions, promoting the adoption of environmentally friendly measures through public consensus.*

Ensure transparency in the public procurement procedure

Design competition is perceived as a fair procedure, eliminating suspicions of bias. It gives public authorities a credible tool for implementing investment projects while demonstrating confidence in the expertise of professionals. *In the context of climate neutrality, the choice of sustainable and innovative architectural solutions through a transparent process confers legitimacy to projects, contributing to building political capital based on accountability and long-term vision.*

Provides visibility

Transparency is the cornerstone of the design competition. At all stages - from the elaboration of the brief and the selection of the jury to the evaluation of the projects - the procedure is regulated to ensure an equal opportunity for all participants. *For climate-neutral projects, this transparency is essential, ensuring that the selection of the winning project reflects the strategic objectives and sustainable criteria set out in the competition brief.*

"You have a choice"
By its very nature, the design competition brings together a multitude of approaches and creative responses to the proposed brief. This diversity allows the jury to select the optimal solution that combines aesthetics, functionality and sustainability. *In the case of climate-neutral investments, this approach ensures that a solution is chosen that responds innovatively and efficiently to technical and environmental requirements, integrating the ecological vision in every detail.*

Relies on the expertise of professionals
Another key advantage of the design competition is the collaboration with a jury of recognized experts. This jury gives the client (contracting authority) the assurance of an informed and well-founded decision. *In the context of climate neutrality, the presence of specialists in fields such as energy efficiency, sustainability of materials or green urbanism is vital for choosing a viable long-term solution.*

Generates performance
The selection process, based on the quality of the architectural design, guarantees not only the best solution, but also working with a design team capable of implementing it to the highest standards. *For climate-neutral projects, this performance is the key to implementing sustainable solutions that address both technical and climate challenges.*

Attracts professionalism
Concursul de soluții deschide comanda publică către o gamă diversă de The design competition opens up public procurement to a diverse range of architects, both young innovators and established practitioners. It encourages competition based on excellence and creativity, which becomes essential in the development of climate neutral projects. *Fresh approaches and innovative ideas can redefine architectural and urban standards, contributing to the transition towards a sustainable built environment.*

6.1.3 Architecture competition vs conventional tender procedures

In the field of public procurement for architectural design, the legislation in force requires the use of the "best value for money" criterion for the selection of the winning bids. This criterion reflects a concern to ensure high standard projects, avoiding situations where selection solely on the basis of price may compromise the quality of the results.

Nevertheless, practical experience shows that the use of design competitions generally produces significantly better results than traditional tenders. Design competitions emphasize creativity, innovation and the architectural value of the proposals, while tenders, even with a quality-based criterion, are often limited by the formalism of the procedure and the lack of in-depth assessment of conceptual and aesthetic aspects.

6.1.3.1 Limitations of conventional tendering

1. Restricting genuine competition: Tendering procedures can discourage innovative architectural practices from participating because of high bureaucratic requirements and an emphasis on previous experience over creativity. This system, based on conformity and standardized procedures, limits the diversity of proposed solutions and inhibits the innovation needed in complex projects.
2. Standardized evaluation: In many cases, the technical evaluation tends to be less detailed, prioritizing compliance with minimum requirements rather than looking at the added value of proposals. This reduces the chance to identify and select solutions that optimally address the specific project challenges.
3. Risks to architectural quality: The lack of a jury process based on creative expertise often favors conventional solutions, which may satisfy formal requirements but do not respond in an

innovative and contextually appropriate way. Complex projects that require an interdisciplinary approach and integrated vision are particularly vulnerable in this system.

6.1.3.2 Climate neutrality and sustainability in tenders and competitions

The integration of climate neutrality and sustainability criteria is essential in the selection process of architectural projects. In the context of the climate crisis, both tenders and competitions must promote solutions that reduce environmental impacts and prioritize projects that support the transition towards climate neutrality.

Specific criteria in tenders: In conventional tenders, the inclusion of requirements related to energy performance, the use of sustainable materials and the reduction of carbon emissions can encourage the adoption of more environmentally friendly solutions. However, their application is often limited by difficulties in the thorough assessment of these issues within a rigid framework.

Added value through competitions: Concursurile de soluții permit evaluarea aprofundată a aspectelor legate Design competitions allow in-depth evaluation of sustainability aspects such as integration of renewable energy, optimization of natural resources and circular design. These elements can be analyzed in detail by a qualified jury, ensuring that the winning design meets current environmental requirements.

Adopting a procedural framework that combines architectural excellence with climate neutrality objectives ensures not only aesthetic and functional results, but also makes a significant contribution to the sustainable development of communities.

6.1.4 OAR standards: minimum requirements for organizing a fair procedure

A. Purchase of design services on the basis of the design competition

Just the terms "design competition" for architecture is no guarantee of the quality of the result. In addition to the important cultural charge that the design competition has, the path from idea to implementation must respect a series of requirements. The role of these requirements, which the OAR calls standards, is not only to promote good practice in the organization of design competitions, but also to support the framework of good professional practice after the winning design has been established.

Awarding of the contract / Adapted clauses / Contract value / Prize values:

— The contract for the design services to implement the objective which is the subject of the procedure will be awarded to the winner of the competition. The terms of the contract must be fair, appropriate for the design services and correlated with the Competition Dossier (brief, rules, financial proposal, etc.).

— The contract value for design services must be appropriate to the complexity of the objective, properly assessed in relation to the requirements of the contract and competitive on the market, to be a motivating argument for participation in the competition. In order to have wide participation in international competitions, the value should be attractive to all participants, regardless of the country in which they operate.

— The value of the prizes should correspond to the requirements of the competition and the complexity of the objective, to be attractive for participation in the competition, regardless of the country of origin of the prospective participants. In order to ensure generous participation, a minimum of 3 prizes will be awarded, preferably also honorable mentions, with correctly weighted values.

B. Professional and independent jury

Professional / Independent / Appointed before the competition launch / Compliance with their decision:

— The Jury will be composed of nationally and/or internationally recognized professionals, will be independent, autonomous and sovereign, in order to guarantee a high-quality result and to give participants confidence in the professionalism of their assessment. The composition of the Jury will necessarily be appointed before the launch of the procedure, as it contributes decisively to attracting participants and giving them confidence in the fairness of the procedure. Changes to the composition of the Jury after the launch of the procedure are not allowed, as they may lead to situations of incompatibility with potential participants, invalidating the efforts made by them up to that point.

— Compliance by the Contracting Authority (CA) with the hierarchy of quality established by the Jury is mandatory and is the result of a selection process in which a representative of the CA, in addition to the professionals, also takes part.

— Confidence in the professionalism of the jury and avoidance of incompatibility situations with potential participants.

— It is mandatory that CA complies with the hierarchy of quality established by the jury.

C. Competition brief built on a deontological foundation

Deontological objective / Good professionals / Thoroughly substantiated:

— Built on a deontological foundation. Not every architectural subject can become the brief of a competition and not every brief fits every type of competition, an aspect that the professionals in charge of the brief have to signal to the CA.

— Developed by good professionals. They will translate the CA's intentions into a formula that is as correctly adapted as possible to the given situation and aiming at a real collective benefit in the long term.

— Thoroughly substantiated by carrying out studies, technical expertise, surveys, clarifying the legal situation of the plots, which are essential to obtain quality proposals in the competition, but also to provide a correct starting point, that is anchored in reality, to begin the design.

D. Ensuring anonymity

Competition rules / Specific procedures

— The anonymization procedure must be rigorously followed in compliance with the procedures of the Reception Secretariat and the Technical Commission and clearly mentioned in the Rules of the competition.

— The anonymity will be raised only after the Jury members sign the Jury Report, by opening the sealed envelopes (according to Art. 109 para. (3) of Law no. 98/2016 on public procurement).

E. Correctness of the competition procedure

Conditions for participation / Transparent procedurese

The quality of a competition and thus the quality of the received (and winning) projects depends on the correctness of the conditions for participation such as: adequate time for project conception (minimum 60 days), clear eligibility conditions, respect of specific procedures, etc.

6.1.5 About competitions

6.1.5.1 Types of competitions

The competitions recommended by the OAR are those where the winner signs a design services contract with the CA in order to achieve the objective.

A. **Design competition open** (in one or two phases) to all architects, planners and professionals working in association with them. **OAR specifically supports this type of competition.**

B. **Ideas competition** which is organized only when the Contracting Authority **does not intend** to implement the winning project, but to use it to prepare the steps of a future development strategy, to stimulate debate on the problems of a particular site, etc.

6.1.5.2 Context – legislative framework

THE EUROPEAN EXAMPLE. Competition-based procurement has a long history in Europe, proving its effectiveness in selecting the best solutions over time. For example, between 2000 and 2011 in the UK, 57% of winning RIBA-organized competition projects built between 2000 and 2011 won an architectural award.

LEGISLATIVE FRAMEWORK. From a legislative point of view, the organization of competitions in Romania is subject to the following local and European regulations and legislation in force:

— The International Union of Architects' Guide for International Competitions in Architecture and related fields

— Law No. 98/2016 on how to carry out public procurement, the procedures for tendering public procurement contracts and organizing design competitions, specific instruments and techniques that can be used for issuing public procurement contracts

— Decision No 395/2016 of June 2, 2016, for the approval of Methodological Norms for the application of the provisions on the award of public procurement contract/framework agreement of Law No 98/2016 on public procurement.

6.1.5.3 The 3 main conditions to organize a competition

DEFINING THE OBJECTIVE. The organization of a competition can only start after the clear definition of the investment objective. The CA will prepare a document with preliminary briefing data describing the investment objective. These should present a clear idea of what the client wants to achieve through the competition and form the basis for the development of the competition documentation.

For the proper preparation of a design competition, both the cost estimate for execution and design, as well as the Design Brief, will be prepared in collaboration with the Competition Organizer, which includes in the team professionals with expertise in the field.

A REALISTIC BUDGET FOR THE COMPETITION ORGANIZATION AND INVESTMENT. The success of a design competition is fundamentally dependent on the judicious estimation of the maximum design and investment ceiling. It is important that the budget or financial scheme set according to CA's aspirations is realistic and in line with international professional practice, measured against similar investments. Competitors will base their proposals on this budget, in the sense that it becomes a criterion in the choice of certain technical solutions or formal and functional concepts.

The total estimated budget for the procurement of design services through a design Competition consists of three main chapters: the budget for the organization of the competition, the award fund, and the cost of design services.

A WELL-DEVELOPED BRIEF. The success of a competition is largely influenced by the quality of the competition brief. The brief should be well written, free of vagueness, contain all the necessary information and state the requirements clearly and in a way that gives the competitor freedom of interpretation. The studies accompanying the competition brief must also provide the necessary information to support professionally developed solutions that will not be hindered at later design stages. This step is essential both for the smooth running of the competition and for the implementation of the winning project.

6.2 From idea to implementation – methodology

ORGANIZING A COMPETITION, IN A NUTSHELL:

6.2.1 Preparing the competition documentation

In order to define more clearly the roles in the process of organizing the competition procedure, we will use the terms "contracting authority" for the decision-making part of the contracting authority and "organizer" for the department within the authority designated to manage the organization of the procedure, or the separate subcontracted entity specialized in organizing competitions.

Contracting Authority:
- carries out the preliminary studies (geotechnical study, topographic survey, urban planning documents, landscape studies, surveys, etc.) and delivers them to the team organizing the competition,
- provides the model design service contract to be concluded with the winner of the competition;

The Organizer (which may be a dedicated CA department or a separate sub-contracted entity):
- Advises the Contracting Authority on the documents and documentation required for the preparation of the Brief,
- Elaborates the competition Brief,
- Elaborates the Rules of the competition,
- Prepares the application forms for participants in the competition,
- Proposes the list of members of the jury of the competition,
- Designs the official website of the competition, which is the official means of communicating the competition in the professional environment. The competition website contains the overview of the competition in Romanian and English (as required), allows competitors to register electronically and submit questions, and facilitates the publication of answers to these questions, of relevant announcements, and of the results of the competition.

6.2.2 Launch preparation

The organizer:
— prepares the complete competition documentation and its translation, required in the case of an international competition, for uploading on the official website of the competition and on the electronic platform for public procurement (SEAP),
— draws up the justification for the attribution criteria necessary for the approval of the competition by the National Agency for Public Procurement (ANAP)

Contracting Authority:
— after completing the Brief and the rules of the competition, the CA publishes the competition on the SEAP platform and awaits approval from ANAP.

6.2.3 Launching the competition

The duties of the Organizer include the following activities:

A. Uploading and publishing on the official website of the competition the announcement, the competition dates and all the documents: brief, rules, annexes - the complete competition dossier, in Romanian and, if applicable, in English.

B. Organizing the competition secretariat with the following duties:
— Registration in a log of all contestants who subscribe to the competition through the official competition page,
— Correspondence related to the competition handling (notices, information from the competition secretariat, etc.) and provision of technical assistance,
— Management of the "Question and Answer" (Q&A) rounds.

C. Organizing the site visit:
— Contestants participating in the site visit have the opportunity to take pictures (personal photographic documentation for the competition) and ask questions directly to the Professional Consultants,
— All questions and answers given during the site visit are listed and are part, together with the questions received via the official competition website and the corresponding answers, of the "Questions and Answers" document, round 1.

D. Managing the rounds of questions and answers:
— The "Questions and Answers" document is posted on the official competition website and emailed to all competitors who have submitted questions or registered for the competition,
— The 'Questions and Answers' document is an official competition document and becomes an integral part of the competition documentation. The organizer sends the 'Questions and Answers' document to the Contracting Authority for publication on SEAP.

E. Ensuring the public communication component of the competition during all the stages described above.

6.2.4 Project submission

All activities required for this stage are the responsibility/obligation of the Organizer.

A. Reception secretariat:
— registers the received projects (assigns each project a registration number),

— removes distinctive marks from the packages,
— may automatically reject a project, under the conditions provided for by HG 395/2016, if it does not respect the deadline set in the procedure calendar, has not paid the participation guarantee (in case participants are required to pay a participation guarantee) or has delivered the secretized envelope in a non-compliant manner (separate submission or sticking it outside the packaging / tube). In this case, the reception secretariat issues a report of elimination from the competition and notifies the eliminated candidate within 24h,
— draws up a report on the receipt/delivery of the packages and hands them over to the Technical Committee.

B. Technical Committee:
— Sets competition numbers and deletes registration numbers,
— Checks formal compliance with the competition brief and rules,
— Detaches the sealed envelopes from the competition materials (competition sheets, Financial Proposal and, if applicable, any other materials required by the brief and the rules)
— Draws up a report on the compliance of the projects submitted to the competition with the brief and the rules and forwards it to the jury (which is the only authority entitled to decide on the possible disqualification of a competitor based on the Technical Committee's work).

6.2.5 Jury assessment of the competition

A. The Jury approves the Technical Committee report and decides how many projects enter the Jury procedure.

B. The organizer facilitates the Jury session:
  — Provides the Jury with a secretary (architect) for the duration of the jury process, who assists the Jury in preparing the Jury Report (the report details the proceedings of the Jury and includes the Jury's comments/conclusions on the awarded projects, recommendations offered to the awarded projects, the ranking and scoring),
  — Ensures the presence, at the Jury's disposal, of the technical advisors and the Brief elaborator - the Professional Advisor of the Competition.

C. After the jury session, the envelopes with the identity of the contestants shall only be opened after all members of the Jury have signed the Jury Report and its annexes.

6.2.6 After the jury assessment phase

The Contracting Authority is in charge of:
— Organizing the press conference, with the presence of the Jury, for the official announcement of the winners, and the exhibition of the projects submitted to the competition,
— Uploading the results of the competition in SEAP
— Inviting the winner into the negotiation procedure and closing the design contract,
— Paying the prizes.

The organizer must carry out the following activities:
— Opens the envelopes containing the identity of all competitors,
— Creates a correlation table between registration number, competition number and project identity symbol,
— Publishes this table on the competition website,
— Compiles a table with the identity data of the competitors.

— Processes the images of the competition entries to be included in the virtual competition gallery together with the data of the authors (those who have given their consent),
— Prepares the press pack containing the press release, images of the winning entries and extracts from the Jury Report.

6.3 Competition brief

6.3.1 What is a competition brief?

The Brief is the key document of a competition, it aggregates and synthesizes all the relevant information for the development of a proposal. By all the elements it contains, the Competition Brief appeals for high quality participation - besides the material stakes of the design contract and the prize fund - and motivates competitors to seek innovative solutions that are as much in the spirit of time and place as possible.

1.1. It must contain the following categories of information:
— objectives aimed by the CA through launching the competition,
— complete information/data on the site where to intervene through the project,
— complete information/data on the specific "object" proposed by the competition: functional, structural, heritage, artistic, environmental, and/or any other specific requirements, as the case may be,
— content and presentation mode of the proposed solution,
— evaluation/ award criteria.

1.2. It is not just a collection and listing of precise information; the brief is also a narrative, a story that can convey a compelling architectural message to competitors!

1.3. The quality of a Brief is an essential condition for the success of a competition and is based on:
— The accuracy and comprehensiveness of information,
— The expertise and professional culture of the person writing the Brief.

6.3.2 Who writes a competition brief

The Brief is written by the Professional Advisor (a specialist or a team).

Compiling a quality Brief requires from the Professional Advisor:
— A comprehensive understanding of the situation
— Knowledge of national and international practice ("theory of programs / building types")
— Prioritization of information concerning the site requirements: functional, structural, heritage, artistic, and any other relevant requirement.
— Synthetic and clear transmission of the above to the participants

The choice of Professional Advisor must be made with great care!

The CA may decide to have the Brief put together externally by contracting an architect/team or internally, in which case we recommend that an external consultant/expert should be contracted anyway, for two reasons:
— The CA may be so focused on a particular solution that it restricts more inventive solutions to the given problem; and in this way, the competition does not really achieve its purpose.
— The CA may not have a specialist with expertise on any type of program/building, something that would also damage the Brief and undermine the purpose of the competition.

6.3.3 What do participants need to understand from a brief?

The range of architectural subjects (buildings, urban interventions, landscape) that can be the object of a competition is very wide, but in principle, the following logical sequence should be expected from a Competition Brief:

6.3.3.1 What is at stake:

The first thing that needs to be understood from the brief, from the very beginning, is what the CA is trying to achieve with the competition, which is also related to its opportunity:

— It depends on the type of intervention required at the site.
— It is followed by a statement of what the CA will contract following the selection.
— It should communicate a simple and succinct introductory picture to the competitors.
— It should provide the chance to develop a variety of proposals and the opportunity for innovative ideas to emerge.

6.3.3.2 Site of the future intervention:

The second thing that the competitors must understand is the site of the intervention, the existing site that will be modified by the project:

— The site must be described in an organized but also selective way: the image of the site, its character, its qualities and potential, its difficulties...
— illustrations (plans, historical plans, photographs, etc. as appropriate).
— The technical data necessary for the project, with reference to various aspects (land parcels, form of ownership, nature of soil, vegetation, etc.). This information is derived from the previously collected baseline studies (discussed above).
— The Professional advisor needs to make an intelligent selection of the information that he/she presents to the contestants in order to understand the context.
— The site description should be 'neutral', conveying possible environmental requirements and constraints, but not 'steering' towards a single solution, as the competition would lose its meaning.

6.3.3.3 Requirements to be met by the competition design:

This is the part of Brief which clearly clarifies the functional and technical requirements to be met by the competitors.

— May include: the purpose of the building, spatial requirements, number of persons, special conditions and mandatory connections, special equipment, lighting/illumination and climate control needs, etc.
— The way they are presented can be very varied.
— But regardless of the presentation mode, all the information should be displayed from the most to the least relevant regarding the nature of the project and taking care NOT to overwhelm with unnecessary details or to orient the solutions in one direction, so that the participants in the competition can have the opportunity to interpret the shaping of the spaces and the relationships between them. The ways of displaying information may vary.
— If the use of the building is very complex and complicated, it is advisable to summarize the main data in tables,
— Any of the functional/spatial requirements described may be accompanied by some specific conditions (lighting, climate control, structure, obligatory access, etc.)
— In those situations where the competition concerns an ensemble or a complex contractual object, it is recommended to define

separately both the specific issues and requirements to be addressed by the participants in the competition proposals and the specific contracting tasks for each objective. This approach will be coherently and clearly defined in the documents made available to participants.

— Definitions of the different objectives subject to the design service contract will be defined separately according to:
  — The nature of the intervention: the same design competition may require participants to carry out interventions of a different nature within an area of implementation - for example: architectural design "from scratch", restoration and/or re-functionalization of an existing building, its enlargement, development of an adjacent public space, development of adjacent green areas. In this case, the different nature of the interventions covered by the same contract may lead to different implementation paths (design-permit phases, and execution phases), which will be defined by a clear and transparent phasing of the tasks contracted for each objective.
  — Architectural program (different use of buildings within a built ensemble): the same competition may cover an ensemble of several buildings, the uses of which may be complementary - for example: an educational building for secondary school and a kindergarten building, with a community center; or - a scientific research center and a museum. In case the contenders must provide an integrated solution for an ensemble of buildings with different purposes, the specific requirements and contracted tasks for each objective will be detailed according to the architectural program.
  — Separate Contracting Authorities: two different Contracting Authorities may be associated for the award of the same design service contract following a call for design competition. Depending on the nature of the association and the tasks of each associated CA (may relate to financing, implementation, administration, etc.), the separation of the objectives covered by the contract will be clearly and transparently detailed in the competition documentation.

6.3.3.4 Design guidelines and recommendations

Contestants should be given guidance on general design directions.

— They can range from technical to stylistic,
— They may be mandatory, others only indicative,
— They do NOT describe a specific solution but give general guidance to the competitors in developing the solution, indicate a meaning (which may be materialized in many ways) and convey an important professional message on which the quality of the solutions (and their appreciation by the jury) will be based.
— The clearer, more essential and succinct this part of the competition Brief is, the more appealing the competition will be and the more varied and interesting the solutions are likely to be.

6.3.3.5 Cost estimate

This is the procedural step by which the design services value of the contract being the subject of the competition is based.

The design services value is calculated as a percentage of an estimated investment value for all the investment objectives included in the competition. The investment value shall be calculated based on a comparative study, by reference to the investment values of similar projects, both in Romania and abroad

The investment value estimated in the competition phase is indicative and is not a substitute for the investment value and the technical and economic indicators of the project. These will be defined in the stages following the closure of the competition, through the elaboration of the feasibility study / authorization documentation for intervention works (DALI), by the winning team, based on the contract awarded through the competition.

The estimation of the investment value – the split into investment objectives will consider the following aspects:
— Nature of the intervention and functional program,
— The project approval period,
— The sources of financing to be accessed for the implementation of the project,
— Type of Contracting Authority and how the project will be implemented.

Cost estimation of design services value and prize fund:
— The design services value is determined by relating a percentage to the investment value resulting from following the steps above.
— As with the investment value, the design services value will be calculated for each individual investment objective. The value of design services will take into account the complexity of services related to the realization of each investment objective. As a result, different percentages will be allocated, reflecting both the nature of the intervention (urban or landscape vs. architectural) and the functional program.
— The prize fund will include the amounts for the second and third prizes and, optionally, several mentions. The third-place prize will be calibrated to cover the costs necessary for an architectural office to define the solution and realize the deliverables requested in the competition phase.
— As a general rule, the total amount of the prize fund must be 5% of the value of the contract put out to competition.

6.3.3.6 Subject of the contract

It details the stages and services to be covered by the contract signed between the Contracting Authority and the winner of the competition, along with the maximum time-limits for completion.

The contracted services will be related to the investment objectives and will cover both the design stage (preparation of the feasibility study, urban planning documents, technical design and execution details) and the implementation stage, i.e. technical assistance during the execution of the works.

6.3.3.7 Graphic content of the competition solution

Once all the requirements set out above are clear, participants should be given clear guidance on the items they are required to submit:
— These must be tailored to the specific requirements and vary from competition to competition.
— They must be correlated with the time allowed for competitors to work on their solutions and the value of the prizes
— The number of pieces requested should be limited to the minimum necessary for an informed Jury decision
— The Professional Consultant must ensure that:
  — The required drawing materials are explanatory for a good understanding of the solution,
  — There is a correct relationship between the required items and the number, size and orientation of the sheets;
— Competition sheets must comply with the mandatory anonymization requirements set out in the competition rules.

6.3.3.8 Evaluation criteria

Once all types of requirements (and recommendations) have been presented, the participants must learn about the Evaluation Criteria for the projects they will submit in the competition. These criteria guide also the Jury's evaluation: the results of their assessment are noted in the

Jury's Report and in the annex to the Report - the Jury's Table with the scores awarded.

In the case of an "architectural object", the selection cannot be based solely on mathematically quantifiable, objectively measurable data, as when procuring implementation services, or exclusively technical projects.

The criteria are in relation to:

— Descriptive statement of the situation,
— The stated requirements (objectives and indicated directions of approach),
— Required drawings and written materials.

6.3.4 Professional/ architectural significance of the brief

The Brief contains some of the same precise information found in a tender Specification Dossier, but unlike it giving exhaustive indications on the characteristics that the "procured product" must have, a competition Brief must also leave the participants a space for qualitative (aesthetic, cultural, imaginative) interpretation of the quantitative data and requirements.

Also, unlike a tender Specification Dossier, the Competition Brief must be able to transmit to the participating architects an appealing and intelligible message concerning a broad range of expectations - from professional to cultural and even emotional.

— In practice, all types of information found in the ANAP's Framework Form for the preparation of a Specification Dossier for services related to the development of technical and economic documentation for new investment objectives/projects financed by public funds are found in the Competition Brief of an architectural competition (in the Competition Brief, Competition Rules, Design Contract, etc.).
— Moreover, the National Authority itself says in the Annexes to this form that: [The Annexes included in this section comprise a minimum set of information and are presented to provide Contracting Authorities with guidance in structuring the documents. They do not have to be included as such in a Specification Dossier, their content must be adapted to the specific subject matter of the Contract].
— In an open design competition, the Competition Brief should provide the opportunity for the development of varied proposals and the opportunity for innovative ideas to emerge, as recommended by the International Union of Architects (UIA) Good Practice Guide for the organization of design competitions.

6.4 Good practice

București	Lacurile Colentinei
Constanța	Litoral Mamaia
Timișoara	Menajare și modernizare Piața Operei (Victoriei)
Constanța	PARC DN3C
București	Parc Lacul Morii
Cluj-Napoca	East Park
Timișoara	Centrul pentru artă, tehnologie și experiment Multiplexity
Cluj-Napoca	Amenajare urbană Str. Kogălniceanu, Str. Universității și străzile adiacente
Cluj-Napoca	Parcul Feroviar
Cluj-Napoca	Rethinking Someș
Cluj-Napoca	Turnul Pompierilor

Colentina Lakes

2nd District, Bucharest

Procurement procedure: Architectural design competition

Contracting Authority: The 2nd District of the Municipality of Bucharest

Estimated investment value: 198.561.160,17 EURO excluding VAT

Estimated design contract value:

Lot 1 - 2.191.813,84 EURO excluding VAT
Lot 2 - 1.848.580,65 EURO excluding VAT
Lot 3 - 3.107.252,49 EURO excluding VAT

Value of prizes and mentions:

Lot 1 - 2nd prize - 45.000 EURO, 3rd prize - 25.000 EURO; 1st mention - 10.000 EURO, 2nd mention - 10.000 EURO, 3rd mention - 10.000 EURO
Lot 2 - 2nd prize - 45.000 EURO, 3rd prize - 25.000 EURO; 1st mention - 10.000 EURO, 2nd mention - 10.000 EURO, 3rd mention - 10.000 EURO
Lot 3 - 2nd prize - 45.000 EURO, 3rd prize - 25.000 EURO; 1st mention - 10.000 EURO, 2nd mention - 10.000 EURO, 3rd mention - 10.000 EURO

Competition launch year: 2024

Composition of the jury: full members – Landscape arch. Mary BOWMAN (United Kingdom), Landscape. arch. Iris CHERVET (France), urb. hydrologist Christian PIEL (France), arch. urb. Toader POPESCU, arch. Vlad Sebastian RUSU, arch. Ștefan GHENCIULESCU, arch. urb. Alina-Alisa BRATU – chief architect 2nd District (AC representative), urb. Andreea NECȘULESCU; deputy members – arch. urb. Elena STOIAN, arch. Felicia-Daniela MUNTEANU (AC representative)

Number of participating teams:
Lot 1 - 23; Lot 2 - 16; Lot 3 - 16

Participating countries: Lot 1 - Romania, Spain, Belgium, Germany, Netherlands, USA; Lot 2 - Romania, Spain, Belgium, Germany, Netherlands, USA; Lot 3 - Romania, Spain, Belgium, Germany, USA

Implementation status: ongoing

Community involvement: public consultation, roundtable discussions

Authorship

Main authors: PELINU PROJECTS SRL (Laura Cristea, Raphael Zuber) - BEROS ABDUL ARHITECTI ASOCIATI SRL (Christian Beros)

Co-author(s): Maurus Schifferli Landschaftsarchitekt

Architecture collaborator(s): Edyta Filipczak, Michał Starzyński, Erich Babă, Ana Brebeanu, Mădălina Dobre, Bianca Dumitru, Ana-Maria Marțiș, Raluca Mihăilă, Andreea Stah, Adi Bratu (visualisation)

Project Description

"The premise of this proposal is based on the need to consider water as a finite and essential resource. Without water, there is no border, and any future development opportunity becomes meaningless. (...)

Thus, we analysed the urban boundary of lakes from the perspective of water itself, emphasizing the importance of protecting and maintaining it as a fundamental element of local ecology. This approach resulted in three complementary strategies: cleaning and conservation, recreation, and cooling and CO_2 capture mechanisms.(...)

The proposal aims to restore water to a central role in the future development of Bucharest, reactivating historical ideas from the inter-war period, when these lakes were conceived as spaces for recreation, navigation and improving the quality of urban life

(...) These directions are only the beginning of a long-term effort, which requires the contribution of architectural engineering and, above all, advanced ecological studies. In this context, our proposal is of a surgical nature: interventions that are small in number but extremely precise, targeting the nerve centers in order to achieve maximum impact with minimum resource consumption. However, we consider it essential to have a broader debate on how Bucharest can build its future in a global context marked by climate change and the increasing scarcity of water as a vital resource." - Excerpt from the project text

Energy and Resources

Cleaning and conservation

Without water there is no life. Without cleaning up the water in lakes and securing their future, any intervention is futile. To achieve this, a number of strategies are being implemented at local level to clean lakes naturally and improve their water quality.

Lot 1

The water, being regulated to feed the northern lakes, faces problems such as stagnation, algal growth and debris buildup, which need to be treated. This stage serves as an invitation to consider a regenerative approach, where ecological restoration can be established through interventions both in the water and along its edges.

The ecological objective is to establish filtration 'peninsulas' and 'islands' - interventions using floating devices along the lake's edge, planted with specific species to facilitate natural water purification.

Lot 2

In the long term, the abandoned and dried up fish ponds between Plumbuita Lake and the A3 highway represent an opportunity for revitalization through the ancient Aztec water culture technique, Chinampas.

This system of alternating water channels and planting islands offers multiple benefits, including filtering water and enriching land for agriculture. The area could serve as a tree nursery for the entire corner of the lake (...).Its strategic location between the Saulei Valley and Plumbuita Lake positions it as a potential central clearing station in a future water management strategy in which the interconnected lakes could support each other.

Lot 3

In the area where the lake begins to widen, the lake edge is renaturalized following a stratification system based on water depth, using plants necessary for water purification. This can also be done by maintaining a stable waterward edge where technically necessary

The topography of the South Colentina embankment is preserved as much as possible, creating a reduced path suspended on the concrete beam, making the intervention as minimal as possible and avoiding large excavations or retaining walls." - Excerpt from the project text

Mobility, Accessibility and Public Space

Lot 1

"Currently under development, the proposal suggests the creation of an urban trail well connected to existing streets, with a long-term vision of connecting the new neighbourhood

city and to Tei South by water, possibly via pedestrian quays or a cable ferry. The urban promenade will vary in width and shape according to the anticipated future density, (...)." - Excerpt from the Jury Report

Lot 2

"The Plumbuita Natural Area extends with a double connection under Petricani Street to the Plumbuita area. One arm of this connection leads to the wild landscape on the north bank of the Plumbuita, currently unstructured and underutilized. (...) The new developments in Plumbuita North on the east bank will be connected by an urban-like promenade with a wide strip of newly planted trees providing large canopies. The supermarket, as a neighbourhood focal point, will be linked to an exploration and fishing pier, possibly with a boat or cable ferry connection to Monastery Island." - Excerpt from the Jury Report

Lot 3

"The proposal includes a public beach - an interesting idea that needs to be studied to ensure it doesn't affect the watercourse. The location of the beach close to Cosmos Park and other sports and leisure activities is appropriate.

The new bridges with integrated long benches become not only a link, but also a meeting place for locals and ideal spots for fishing. The boards sometimes turn into steps, creating a more intimate relationship with the water. The promenade along the canal is lined with accent species such as fruit and flowering trees." - Excerpt from the Jury Report

Green Infrastructure

Densification of vegetation

To create a strong blue-green corridor as a three-dimensional body, the existing vegetation is densified and complemented as much as possible by various planting strategies. In addition, carefully selected and arranged native fruit trees, flowers and berries are planted along the entire belt. These flowering species create special moments in the landscape or townscape, give neighborhoods their specific identity and connect areas into a larger spatial unity." - Excerpt from the project text

Lot 1

"The proposal provides a good connectivity between the Verdi Park and this bathing area through a new alley of ornamental flowering trees. Otherwise, the park enjoys a flexibility in landscaping that can be finalized in collaboration with the contracting authority (...) a series of vegetation palings are proposed that constitute an intermediate landscape between the water surface and the banks." - Excerpt from the Jury Report

Lot 2
"The authors refer to the historic use of "Chinampas" or floating farm gardens as a way to utilize the articulation of the Willo Valley in this lot. The proposal would provide an interesting experiment in floating urban food production and would also create nesting areas for birds. The proposed reedbed areas can contribute to water purification and could be explored right from the water, possibly by kayak" - Excerpt from the Jury Report

"The anthropogenic activities they imagine in nature contrast with the organic forms of natural habitats or the proposed afforestation solution. The team thought about the high, medium and low vegetation structure and suggests a simple yet poetic wildflower intervention for a meadow cut between trees." - Excerpt from the Jury Report

"The second section of lakes takes on the characteristics of wetlands, where efforts to restore and regenerate the aquatic environment are intensified through the use of ancient techniques such as Chinampas. These aquatic agricultural units not only enable efficient local fruit and vegetable production, but also help to filter, purify and enrich water biodiversity." - Excerpt from the Jury Report

Lot 3
"The last section of the lakes is the wildest and has enormous potential in rebuilding consistent ecological value. From the renaturalization of brownfields, islands and lake margins, to a controlled urban delta in the restricted level lake of Dobroești." - Excerpt from the Jury Report

Mamaia Seaside

Mamaia, Constanța

Authorship

Main authors: Studio 82 SRL and Vlad Sebastian Rusu Birou Individual de Arhitectură

Co-author(s): Arch. Vlad Sebastian Rusu, Arch. Octav Silviu Olănescu, Arch. Andra Vlădoiu, Arch. Andrada Pinte, and Arch. Petrică Maier-Drăgan

Specialty Collaborator(s): landscaper Alexandru Mexi

Procurement procedure: Architectural design competition

Contracting Authority: The National Administration ”Romanian Waters” in association with the Bazinal Water Administration Dobrogea-Litoral

Estimated investment value: 27.402.860 EURO excluding VAT

Estimated design contract value: 1.545.612 EURO excluding VAT

Value of prizes and mentions: second prize - 37.500 EURO, third prize - 17.500 EURO; first mention - 5.000 EURO, second mention - 5.000 EURO, third mention - 5.000 EURO

Competition launch year: 2023

Composition of the jury: full members – Arch. Urb. Irina Popescu-Criveanu, Landsc. Arch. Ana-Maria Horhat, Arch. Igal Ahad Tartakovsky, Arch. Saša Begović (Croatia), Arch. Rodrigo Perez de Arce Antoncich (Chile), Arch. Silviu-Virgil Aldea (Romania), Radu Răzvan (AC representative)

deputy members – Arch. Dan Petre Leu, Adrian Abrudan (AC representative)

Number of participating teams: 19

Participating countries: Romania, Spain, Norway, Canada, Georgia, USA

Implementation status: ongoing

Community involvement: public consultation, roundtable discussions

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Project Description

In the context of the accelerated anthropization of the Romanian Black Sea coastline in recent decades, the project aims to reconnect with the natural environment, leveraging the immediate proximity of the site to the protected avifauna area. Given the mixture of anthropic elements present in the Mamaia resort, the proposal seeks to restore visual clarity and recognition based on the natural landscape, at the expense of developments relying on built elements and over-design. At the same time, the objective of the proposal is to establish a short-, medium-, and long-term intervention and maintenance strategy, ensuring the sustainability of installations and their compatibility with the surrounding natural environment. - Excerpt from the project text

Energy and Resources

" Participants should aim to strike a balance between landscaped and natural areas. They are required to propose sustainable, future-oriented design solutions that ensure cost-effectiveness and the highest architectural quality, with balanced energy and resource consumption. (...) For landscaped areas, the use of region-specific species with minimal maintenance and low water consumption is recommended, wherever possible. (...) The use of natural, biodegradable, and recyclable materials should be prioritized. Technical solutions must be of high quality, robust, durable, easy to maintain, and replaceable. The reversibility of interventions must also be taken into consideration." - Excerpt from the Competition Brief

Sustainability and maintenance strategy

Given the project's size and the intensive level of use, its sustainability relies on the use of landscaping and vegetation plantings that require minimal physical intervention and maintenance. Considering the site's particularities, tree and shrub plantings are proposed with species that have a wide ecological range and high adaptability, as well as tree species that can be grafted directly onto the site. The remaining landscaping elements and urban furniture follow the same principles, using materials with high durability over time, such as metal, stone, and concrete. - Excerpt from the project text

Beach erosion control as an opportunity for renaturalization

The phenomena of erosion and sand transfer from the beaches to the resort are addressed in the project through the creation of a protective strip, formed by sand dunes with heights varying between 1 and 1.5 meters. The vegetation of the dunes, using native species, ensures their consolidation over time and contributes to the renaturalization of the beach. (...). These dunes are sustainable over time, with a high capacity for self-regeneration and require minimal maintenance. - Excerpt from the project text

Efficient and Modular Constructions

The proposal focuses on providing a visual identity for the new temporary beach constructions. This identity is derived from the modular construction system, which allows for a varied construction typology, flexibility in use, and efficiency in transportation and installation. The modules, measuring 5×5 meters, are proposed with metal and wooden structures, based on a reversible mechanical fastening system. These modules can be assembled in various configurations, providing the necessary space for different facilities serving beach activities. The proposal also offers the potential for future reuse and recycling of these modules when the original structure is replaced or extended from season to season. - Excerpt from the project text

Mobility, Accessibility

"(...) particular attention will be given to connecting the intervention area with the immediate surroundings and creating coherent pedestrian access routes. This will take into account the predominantly recreational character of the area, as well as ensuring accessibility for all categories of users." - Excerpt from the Competition Brief

The existing waterfront promenade is extended in the northern part, where it is currently missing, with the help of a wooden pedestrian bridge, reaching the northern boundary of the project. This will allow for a potential connection and continuation of the route toward Năvodari Beach. (...) The bicycle path along the seafront is also extended following the same logic as the pedestrian route (...). Both in the landscaped area with specific vegetation and on the sandy beach area, wooden walkways are provided to ensure better accessibility for all categories of people.

The hierarchy of access points is determined based on the integration with the existing built environment and the interest generated by the waterfront route in terms of pedestrian circulation. Thus, every 400 meters (about 5 minutes), there is an access marked by a light structure resembling an entrance pavilion (...).

These access pavilions are modular, based on a standard module used for general access. More significant access points (linked to key areas of the resort), typically located at intervals of approximately 800 meters (about 10 minutes on foot), are customized according to the character of the surrounding area: a Cartesian orthogonal organization in areas with modernist ensembles, and an organic layout toward the north, where the landscaping is more natural. - Excerpt from the project text

Green Infrastructure

"To seek the integration of existing public spaces along the beaches into the dynamics of the project, promote the diversity and flexibility of the developments and uses, and ensure their suitability to the natural ecosystem of the beach in the medium and long term." - Excerpt from the Competition Brief

The current project evokes this strip of vegetation, proposing a green area to articulate the beach with the porous boundary of the new waterfront.

This strip composes a landscape dominated by native species of trees and shrubs, which is divided into four subzones with distinct identities (determined by the built environment), corresponding to the four existing subzones of the beach. By selecting species and configuring plant compositions, the four zones create a transition from the landscape of an urban park in the southern part of the beach to a natural park in the northern part, near the protected area. Each new arrangement is personalized both through the proposed formal configuration and the choice of plant species. - Excerpt from the project text urban în zona de sud a plajei, la un parc natural în zona de nord, în vecinătatea zonei protejate. Fiecare nou aranjament este personalizat atât prin configurația formală propusă, cât și prin alegerea speciilor de vegetație propuse. – Extras din textul proiectului

Development and Modernization of the Opera Square (Victoriei)

Timișoara

Authorship

Main authors: arch. Radu GOLUMBA (STUDIO ARCA) + arch. Șerban STURDZA (PRODID)

Co-author(s): arch. Mihaela RUSULEȚ, arch. Luminița PASCU, arch. Daniel URSU, arch. Alexandra STAN, arch. Lucian CĂRĂBAȘ, arch. Andrei SIMONESCU, arch. Ligia GHERMAN, arch. Cristian MOȚIU, arch. Doina STURDZA, arch. Dan CIOCLU, arch. Ioana CIOCLU, arch. Mika NILICH, arch. Ovidiu SERGHE, arch. Daria PETRAȘCU, arch. Mihnea TUDOR, arch. Ruxandra VASILE

Architecture collaborator(s): arch. Felix PANTALICI, arch. Florin GHERMAN, arch. Claudiu OPRIȚA, arch. Alex BARBU, stud. arch. Adela MUSTAȚĂ, stud. arch. Alexandru TUDOROIU

Specialty Collaborator(s): landscaper Nicolas TRIBOI, landscaper Andrei CONDOROȘ, engineer Cornel FARCAȘ, engineer Sergiu TAMAȘ

Procurement procedure: Architectural design competition

Contracting Authority: The Municipality of Timișoara

Estimated investment value: 29.250.000 EURO excluding VAT

Estimated design contract value: 1.500.000 EURO excluding VAT

Value of Prizes and Mentions: second prize - 30.000 EURO, third prize - 15.000 EURO; first mention - 7.500 EURO, second mention - 7.500 EURO

Competition launch year: 2023

Composition of the jury: full members – arch. Ana Sverko (Croatia), arch. Maria Chiara Pozzana (Italy), arch. Maruša Zorec (Slovenia), urb. Gruia Bădescu, arch. Dragoș Oprea, arch. Ciprian Silviu Cădariu, arch. Titus-Gabriel Almăjan (representative of the contracting authority); deputy members - arch. Monica Sebestyen, Vice Mayor Ruben Lațcău (representative of the contracting authority)

Number of participating teams: 30

Participating countries: Romania, United Kingdom, Italy, Hungary, Spain, Switzerland, Austria

Implementation status: ongoing.

Community involvement: public consultation, roundtable discussions

Project Description

Opera Square is a completely mineral space, which has become known as the place of civic expression par excellence, the central space of the 1989 Revolution and of all subsequent civic manifestations. It has an elliptical shape, well defined by the Opera building to the north and the palaces to the west. To the south, it continues with the Corso, and to the west, it is bordered by the undefined/ambiguous spaces around the Huniade Castle

The Corso continues south from Opera Square and retains much of its original boulevard character. It is organized axially, with pedestrian traffic along the east and west frontages and centrally located planted islands in line with the facades of the palaces. To the south, it abruptly terminates with a wide automobile traffic, leaving the Cathedral outside the square and interrupting the pedestrian links with the green-blue corridor of the Bega River.

The approach involves three pillars of intervention: reinforcing the character of the two existing spaces, the Opera Square and the Corso; connecting the ensemble to the green-blue corridor and thus bringing its elements inside the square; recovering and integrating the Castle space into the spatial system of the Victoriei Square. - Excerpt from the project text

Energy and Resources

"The idea of reusing parts of the marble extracted from the existing paving, which is in line with the general approach of building on the present structures, rather than removing them, is commendable (positively remarked)" - Excerpt from the Jury Report

Mobility, Accessibility

"In addition to innovative solutions on the scale of finishing details and planting, the main problem to be solved is the pedestrian and cycling circulation from Victoriei Square to the cathedral and to the urban gardens along the north bank of the Bega"

"motorized traffic on King Ferdinand I Boulevard will cross this stretch at reduced speed and on a roadway redesigned in terms of circulation and configuration in favour of pedestrians and activities in the vicinity of the cathedral and the square."

"The totality of the proposed designs will take into account the general trend, shared

large cities of post-industrial societies, to give back to pedestrians as much as possible of the urban." - Excerpt from the Competition Brief

The connection to the green-blue corridor and the reclamation of the Castle's space lead to an ensemble of the Victoriei Square structured in four distinct spatial entities: the Opera Square, the Corso, the Cathedral Square and the Castle Square. They form a unitary whole, providing at the same time connections, neighborhoods and perspectives for the future development of the territory.(...) A traffic management system in the urban space in front of the Cathedral ensures traffic flow, while providing optimal pedestrian access to the Victoriei Square. A complex signalling system is also planned to give priority to pedestrians - Excerpt from the project text

Green Infrastructure

"The success of the approach will depend on achieving a balance between conservation and innovation, between mineral and vegetal, between the needs of contemporary urban life and the energy and biological sustainability of the ensemble."

"the proposals will consider the great diversity of events that can take place in this space, but also the tendency to "green" as much public space as possible." - Excerpt from the Competition Brief

"From an ecological point of view, the project emphasizes the existing character of the Garden Square and, in line with contemporary ecological considerations, celebrates biodiversity and demonstrates a high level of ecological sensitivity." - Excerpt from the Jury Report

"Huniade Square brings together all the fragmented spaces around the Castle and becomes a unitary space. The paving is uniform and discreetly oriented towards the blue-green circular cutout around the Castle." - Excerpt from the Jury Report

"Corso - Retains its axiality, its succession of cultural landmarks and its traditional promenade character but increases in complexity. The double row of trees, placed on both sides of the square, provides the necessary convenience for navigating the space and terraces. Retaining the location of the existing greenspace, a large opening in the paving creates a 'pocket of biodiversity' that brings back the historic landscape around the former fortress." - Excerpt from the Jury Report

"Cathedral Square is an extension of the existing space at the southern end of the urban carpet placed between the Opera House and the Cathedral. A green ring composed of 12 oak trees provides an appropriate setting for traditional ceremonies and also a significant addition to the green-blue corridor to the south along the Bega River." - Excerpt from the Jury Report

PARC DN3C

Constanța

Authorship

Main authors: Florian Stanciu, Roberta Iulia Frumușelu, Eduard Dumitru Untaru, Cosmin Gălățianu, Octavian Bîrsan, David Sebastian Mihai

Co-author(s): Maria-Iulia Stanciu, Alexandru Cristian Beșliu, Nela Andrieș, Adelina Marin, Andrei Dobriță, Tudor Stănilă

Specialty Collaborator(s): landscaper Alexandru Gheorghe

Procurement procedure: Architectural design competition

Contracting Authority: The Constanța Municipality

Estimated investment value: 36.500.000 EURO excluding VAT

Estimated design contract value: 1.460.000 EURO excluding VAT

Value of prizes and mentions: second prize - 25.000 EURO, third prize - 15.000 EURO; first mention - 8.500 EURO, second mention - 7.000 EURO, third mention - 5.000 EURO

Competition launch year: 2022

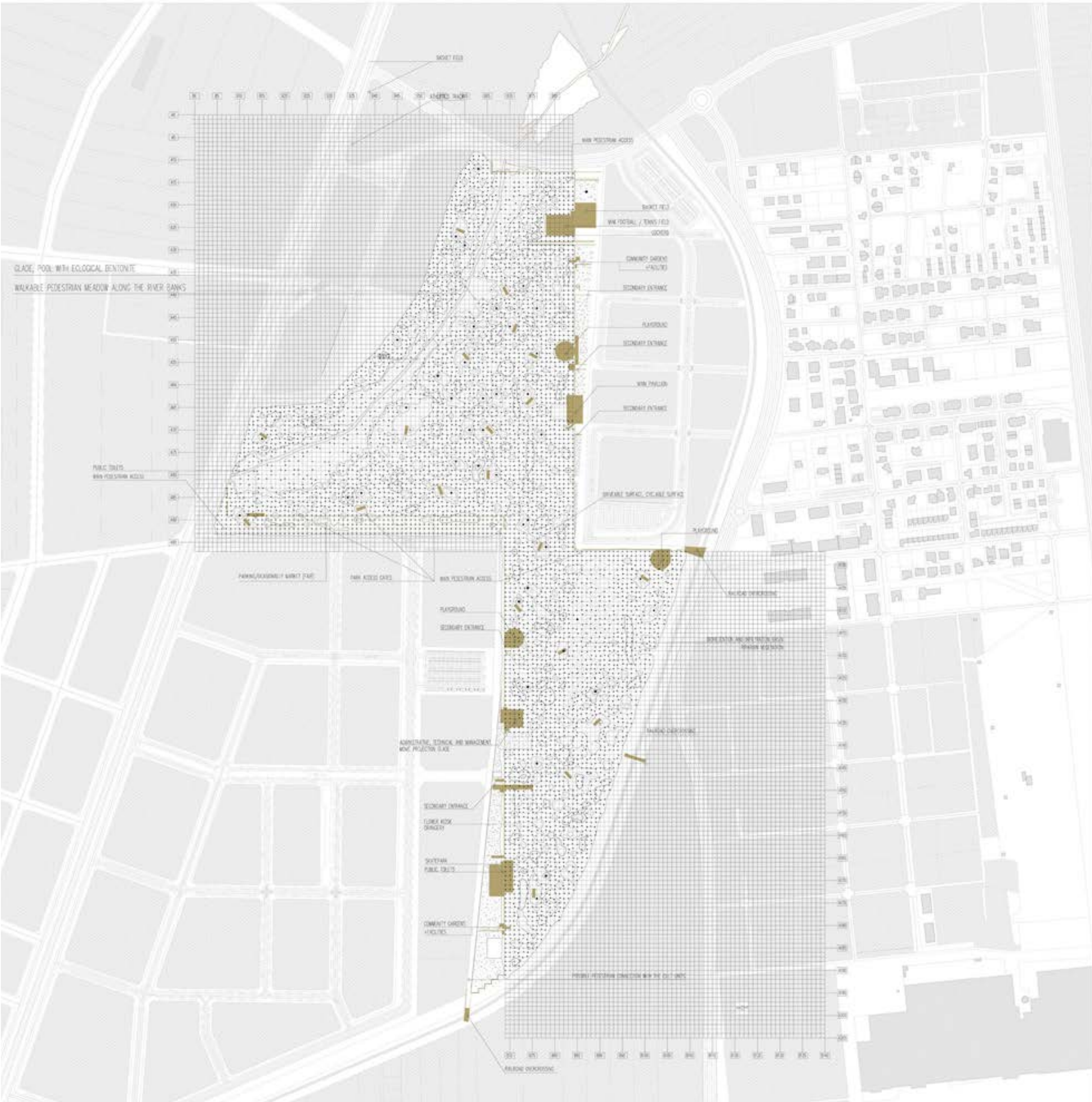
Composition of the jury: full members – landscape arch. Elli Pagkalou (Greece), arch. Esenghiul Abdul, landscape arch. Victor Dijkshoorn (Netherlands), arch. Mircea Munteanu, arch. Irina Băncescu, urban arch. Sorin Manea, arch. Răzvan Calotă (representative of the contracting authority); deputy members – urb. arch. Andreea Tănase, arch. Marius Șocarici

Number of participating teams: 23

Participating countries: Romania, Spain

Implementation status: ongoing

Community involvement: public consultation, roundtable discussion


GLADE, POOL WITH ECOLOGICAL BENTONITE
WALKABLE PEDESTRIAN MEADOW ALONG THE RIVER BANKS

C8

OP

Project Description

Our proposal aims to draw the boundaries of this piece of territory where there are no pre-existing geographical or infrastructural boundaries - the river (west) and the railroad (east)

The new boundaries are found to the north and south of the study area in the form of two continuous linear parapets that break at a 90° angle near the junction of Area A and Area B - two geometrically precise "elbows".

Outside these boundaries are the things that are close to people's daily lives and activities - community gardens with orchards, vegetables and flowers.

(...) inwards, there is obviously the park. However, most importantly, these boundaries are more than just a separation between two things - the "elbows" act as a kind of buffer zone with indoor and outdoor rooms, discrete/intimate squares with drinking fountains and playgrounds, summer kitchens and winter gardens/greenhouses, administrative spaces, bicycle rental areas and sports fields (basketball, soccer, tennis, skatepark, etc.), an outdoor movie theatre, multi-purpose hall and even a place for public markets and fairs (...)

The city and the park merge with each other through this permeable boundary that anchors everything that is eminently artificial by attaching it to a continuous and living sequence of everyday adventures. - Excerpt from the project text

Energy and Resources

"Through differentiated management, the future park aims to calibrate the available resources, with the aim of improving the urban microclimate, providing comfort safety in use for all residents. In this context, the aesthetics of the proposed landscape

(...) the project will propose a solution for the development of a bio-retention and purification system for water management and for the natural integration of the stream of the Peștera Valley into the future development." - Excerpt from the Competition Brief

"The proposal provides a sensible integrated approach to sustainability based on natural processes and landscape ecology. The tree canopy gives a clear identity to the overall scheme and provides a high degree of functionality and support for biodiversity." - Excerpt from the Jury Report

Each of the two so-called "reservoirs" is located in one of the two main sub-regions of the intervention area (Area A - the watershed "reservoir", Area B - the depression/valley "reservoir"). The controlled flooded areas near the river and valley (north of Area B) are found within the "forest" as wetlands/wetlands and wild meadows of a different type than the usual ones, populated by artifacts and winter gardens/greenhouses. - Excerpt from the project text

Mobility, Accessibility and Public Space

"Whatever crossing solution is proposed, a continuity of the road, pedestrian and light mobility routes on FN26, FN32 and FN33 must be ensured at the same time (...)"

"The future park must be easily accessible to as diverse and numerous a public as possible. In this respect, particular importance will be attached to the possibility to access the park in an undifferentiated way via the road, pedestrian and alternative means of transportation."

"Green corridors are links that generate added value for the urban space stimulate economic activity, improve movement for pedestrians and cyclists contributes to better health through active living" - Excerpt from the Competition Brief

Given the needs indicated by the competition brief, the point where the two "elbows" come closest to each other can be crossed by both pedestrians and vehicles, but in order to maintain the undisturbed integrity of the park, our proposal suggests that cars should only cross this area occasionally. On the other hand, we propose the creation of three green routes linking different strategic points in the urban structure, these being either parks or green recreational areas with development potential.(...) The first such route (the red route) is the railway that tangentially touches the DN3C park, creating a green corridor that descends southwards towards the city, including a series of green spaces in the vicinity of the port. There is also the possibility of creating a route (green route) along the DN3C road, following a bend at the junction with the E87 European Road until it meets the Tăbăcăriei Park, from where the road descends to the seafront, joining the green spaces scattered along the coast. At the same time, it is also possible to create a route (the blue route) along the European road E87 that enters the city, descending from the north towards the port - Excerpt from the project text

Green Infrastructure

"The vision incorporates an urban forest, a welcoming place for residents and at the same time a dynamic evolving ecosystem. This proposal is both consistent and powerful, responding to the pressing issue of climate change and the current discourse of connecting humans with nature, as expressed in the New European Bauhaus initiative

This new urban forest will impact and enrich the lives of residents while providing a sustainable framework for future developments." - Excerpt from the Jury Report

A comprehensive approach to biophilic design underpins the proposal for a healthy urban environment shaped by the park-forest. The direct experience of nature is also an essential element of the landscape design concept, providing a genuine connection between citizens and the park's natural environment, with direct recreational, economic, public health and educational benefits.

(...)

The overall concept uses a diversity of species and nature-based solutions as the basis of the overall approach, which will also be able to promote a high level of biodiversity. Trees, shrubs and especially herbaceous vegetation come together to form a healthy ecosystem for the park, as well as to provide an engaging visitor experience while supporting a clearly defined integrative direction. - Excerpt from the project text

Lacul Morii Park

6th District, Bucharest

Authorship

Main authors: Metapolis Architects (Belgium) through its subsidiary Metapolis Architects (Romania): Mircea Munteanu, Cristian Panaite

Architecture collaborator(s): Metapolis Architects: Diana Sava, Mihai Șom, Laura Dinu, Bogdan Stoicescu

Specialty Collaborator(s): Studio de Peisaj Ana Horhat: Ana Horhat, Ivona Svinți, Claudia Uglea

Procurement procedure: Architectural design competition

Contracting Authority: City Hall of 6th District, Bucharest

Estimated investment value: 20.840.000 EURO excluding VAT

Estimated design contract value: 541.847,14 EURO excluding VAT

Value of prizes and mentions: second prize - 30.000 EURO, third prize - 15.000 EURO

Competition launch year: 2022

Composition of the jury: full members – landscape arch. Dimitra Teochari (Greece/Germany), landscape arch. João Nunes (Portugal/Switzerland), urban arch. Benjamin Kohl (Germany/Romania), arch. Mihai Munteanu (representative of the contracting authority), arch. Rudolf Gräf, arch. Sorin Istudor, arch. Radu Ponta

deputy members – biologist Ioana Mihaela Georgescu, arch. Răzvan Vasiu

Number of participating teams: 11

Participating countries: Romania, Belgium, France, Canada

Implementation status: ongoing

Community involvement: public consultation, roundtable discussions

Project Description

"The project aims to reconcile urbanity and ecology, generating a new hybrid environment that celebrates each specificity along the river. New places of intensity are thus taking shape, points of reference that (re) create the history of the place and break the monotony of the overhanging embankment, while preserving the quality of its vastness." - Excerpt from the project text

Energy and Resources

"The following will be scored:

— Solutions for plant material recycling and waste management with graphical representation in plan (technological equipment and flows)
— The quality of the materials used in terms of sustainability and how these relate to the idea of 'natural setting'
— Solutions for using renewable energy in park operation, graphically identified/represented;" - Excerpt from the Competition Brief

"The Jury considers that the exceptional quality of this proposal ensures a durable and sustainable investment over time, with the potential to become a benchmark in the development and management of open space resources" - Excerpt from the jury report

Mobility, Accessibility and Public Space

— "- Landscaping of the area, including the buffer zone, to mediate the relationship between neighborhoods and the natural element of water
— - Landscaping of urban park functions, with all facilities and the necessary equipment (walkways, resting and belvedere places, places for socialization, playgrounds, sports facilities, street furniture, public lighting etc.)" - Excerpt from the Competition Brief

"From the accessibility point of view, the project addresses in a strategic key the need to develop and modernize the road network in step with the evolution of the city, but in balance with the possibility and importance of opening up the light mobility networks quickly. In this respect, while the road network is essential for the future development of the areas adjacent to the park, the accessibility of the park relies more on alternative modes of transportation, public and pedestrian transport." - Excerpt from the Jury Report

"The dam was developed as a sharp boundary between the city and the river, a clear line oriented against the water, with almost no connection to the inhabited city 'behind' it. (...)

But the dam can become a metaphor for a meandering line that can link different destinations, just as the river itself links different conditions along its length. By creating specific points of interest along the dam line, this linear infrastructure takes on a new meaning, evolving into a dynamic link between different intersections of the neighborhood. We define this intersection/crossing between the dam and the different streets as "stations", stopping points along the new linear urban infrastructure.

From the very dense part near the Crângași Park to the neglected upper part of the Dâmbovița River, different stations appear around the embankment in response to the local intensity of the related part of the neighborhood. These stations are equipped according to their role in the neighborhood, with facilities, small sports facilities, small seatings immersed in a rich palette of vegetation, admiring the lake and offering the possibility to get close to it, one can go quickly by bike or more slowly on foot, sit with friends or alone. The park thus becomes both a destination and an urban connector, interweaving existing and future urban dynamics." - Excerpt from the project text

Green Infrastructure

— "Protecting, enhancing and capitalizing on the existing natural environment as the main attractive element of the area;
— Finding the best solutions for physical and visual interaction between residents and the existing natural environment without destroying it;" - Excerpt from the competition brief

"The project also demonstrates a great sensitivity towards the landscape character in its entirety - with its different degrees of anthropization - by treating a wider area than the one proposed by the brief, where the ecological and landscape rehabilitation and consolidation interventions gradually reverberate throughout the entire District 6: the park and the Crângași neighborhood, the Marin Preda Park, the entire polder area in the north-east, the southern shore of the lake, the canalized course of the Dâmbovița - a first and important step in the development of an integrated green-blue system at the level of the northern pole of Bucharest.

The contribution to the development of the biodiversity of the area is made through three strategies - the development of the polder area into a semi-wet forest, increasing the area and complexity of aquatic vegetation and a complex plant palette of native flora.

The vegetation structured on four height levels with a gradual transition from the lowest step - the promenade area - to the highest - the perimeter street alignments - generates a dynamic spatial succession in all directions of travel." - Excerpt from the Jury Report

East Park

Cluj-Napoca

Authorship

Metapolis Architects S.P.R.L. in association with S.C. Studio de peisaj Ana Horhat S.R.L. and S.C. Atelier Mass S.R.L.

Procurement procedure: Architectural design competition

Contracting Authority: Municipality of Cluj-Napoca

Estimated investment value: 58.833.360 EURO excluding VAT

Estimated design contract value: 1.300.000 EURO excluding VAT

Value of prizes and mentions: second prize - 120.000 RON (approximately 24.000 EURO), third prize - 60.000 RON (approximately 15.000 EURO)

Competition launch year: 2021

Composition of the jury: full members – landscape arch. Catherine Mosbach (France), Dr. geographer Catherine Zaharia Franceschi (France), landscape arch. Peter Veenstra (Netherlands), arch. Radu Ponta, arch. Ligia Subțirică (representative of the contracting authority), urban arch. Toader Popescu, Șerban Țigănaș – representative of the OAR Transylvania Territorial Branch

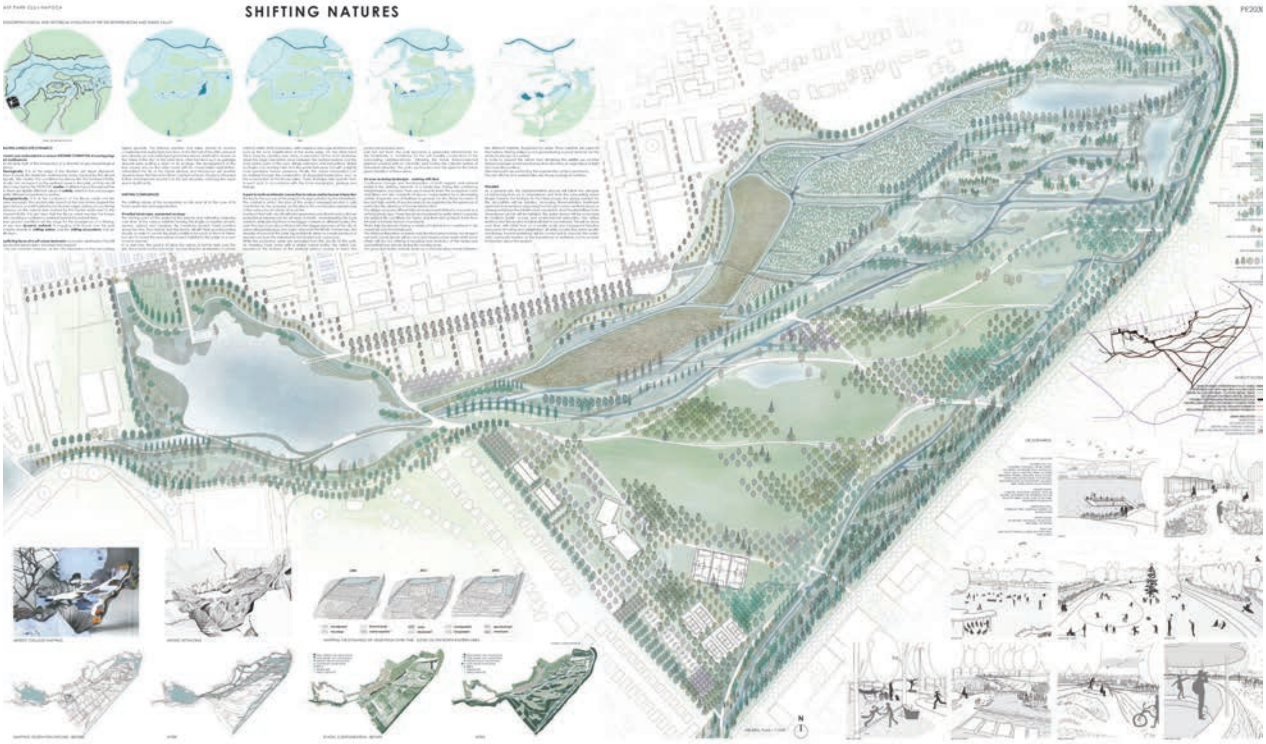
deputy members – arch. Tamina Lolev, Cristian Domșa - biodiversity specialist

Number of participating teams: 27

Participating countries: Romania, Belgium, Italy, Netherlands, Hungary, UK, France

Implementation status: ongoing

Community involvement: public consultation, roundtable discussions



C8

OP

Project Description

"SHIFTING NATURES proposes Parc Est as a continuous space that makes a gradual transition from a protected wetland to a tranquil park with generous open spaces. The design cleverly combines the fluidity of the wetland with the orthogonal layout of the nursery planting to achieve a coherent design. It is a project built with minimal means - topography, water, vegetation and pathways - and the result brings an impressive richness and diversity of atmospheres, open to evolve over time and absorb future needs. Considering that wetlands have been drastically reduced over the centuries, the project amplifies the space for wetland biotopes and restores some of the capacity of the original hydrologic system. Although the wetland is protected, it is not static. The team mapped how the site has developed over the past two decades and is taking it as inspiration for future development. The water and wetlands in the protected biotope are being expanded to create an accessible buffer space where park visitors can enjoy the wildlife without disturbing sensitive wildlife. The Becaș stream is provided with new meanders and a wide, gently sloping bed. From an ecological point of view, the expansion of the associated forest gallery is an advantage. Also, the planned extension of the wetlands into the park spaces is beneficial for the characteristic biodiversity." - Excerpt from the Jury Report

Energy and Resource

"The site's changing ecosystems must be at the center of its future protection and regeneration. Unveiled landscape, extended ecology: the starting point of the project is to map over time the different habitats that make up this fragile ecosystem (marsh, upland, wet meadow, dry meadow, riparian woodland corridors along the river, scrub and small woodland, all with their fauna), to create the best conditions for each of them, but also to reveal to the public the true nature of each habitat in a non-invasive way.

In the next phase, the aim is to allow nature to continue to take control of the site. This is achieved by enriching the biodiversity of certain habitats within their boundaries, such as local amplification of the water's edge, or by creating new expansion zones in large buffer zones between the biotope reserve and the most active parts of the park. Ecologies similar to those in protected areas can develop here, but with a slightly more permissive human presence. Finally, the regeneration of nature can be achieved through the renaturation of degraded landscapes, such as the re-expansion of the Becaș valley." - Excerpt from the project text

"As a general rule, the implementation process will go from upstream to downstream and from the surrounding urban edges to the biotope. In the initial phases, necessary pipelines will be installed for reconditioning, enhancing phytoremediation treatment upstream of the wetland, thereby enhancing the site's native wetlands. In subsequent phases, infrastructure will be installed to divert treated effluent to downstream ponds, the shoreline will be rehabilitated to facilitate public access and environmental education, and native wetlands and riparian habitat will begin to be restored. All of this will be accomplished over time, with initial small-scale testing and subsequent iterative processes of fine-tuning and adaptation, all in parallel with water quality monitoring. Several workshops will be held to educate the public and community leaders about the importance of wetlands and provide information about the project." - Excerpt from the project text

Mobility, Accessibility and Public Space

"It slips into the front line of the Northern Neighborhood's infrastructure and introduces a strong connection between the city and the park. Also, the network of alleys to the commercial area on the west side of the park has been strengthened, allowing citizens to connect with nature." - Excerpt from the Jury Report

"The only built development within the natural habitat protection zone will consist of visitor trails, preferably by suspended walkways, realized with the least invasive and slender construction systems, minimally shading the territory of the reserve. Public lighting will not be installed inside the nature reserve - Zone A, where night access will not be allowed. The remainder of the planned trail network should consist of a multitude of varied routes, offering visitors a constantly changing range of perspectives and views. The pathway system will take account of specific climatic conditions and be suitable for all visitor groups, including children, the elderly and those with limited mobility." - Excerpt from the competition brief

Green Infrastructure

"The project transforms the current topography by simultaneously considering hydrologic and environmental conditions. The vegetation proposal is precise and is always linked to soil conditions and the wildlife it might attract. All existing valuable vegetation is integrated into the new scheme." - Excerpt from the Jury Report

"The park becomes a blue-green infrastructure for residents, a backbone for the low mobility connections of the surrounding neighborhoods, following the future interconnected planted corridors free of car traffic and hosting the collected stormwater collection system. The park can thus become the backbone of the future ecological transition of these areas" - Excerpt from the project text

"The continuous change and transformation of the organic and mineral world is the defining dynamic of a landscape. During these processes of continual transformation, there are times when the ecosystem is rich and diverse, but also times of degradation characterized by a decreasing variety of species. These moments of low and high species diversity appear to be regulated by the presence of water and the absence of human intervention.

Our project proposes different island environments linked into one park as a unifying landscape. These islands are bordered by water, which regulates perfect living conditions for flora and fauna and protects them from intrusion.

Water connects the islands providing a variety of habitats, from marshes to dry meadows and riparian landscapes. This initial configuration of islands and situations proposed by our project is not static, some islands will occasionally be submerged while others will dry up, providing a surprising evolution of the landscape and inviting new species in the coming years.

The proposed water network functions as communication vessels between the different habitats. Regulated by the water, these habitats will balance each other, providing resilience and ensuring good dynamics for the whole landscape ecosystem. To keep visitors from disturbing wildlife, we have provided hidden passages, soundproofed by dense vegetation or light structures such as pavilions. Raised walkways protect the regeneration of flora and fauna. Wet ditches and water bodies are strong ecological corridors." - Excerpt from the project text

Center for Art, Technology and Experiment Multiplexity

Timișoara

Authorship

B.I.A. ȘERBAN I. DANIEL LUCIAN

Andrei Bacoșcă, Mădălina Doroftei, Ruxandra Grigoraș, Lázár Csaba, Mădălina Perju, Daniel Șerban

Procurement procedure: Architectural design competition

Contracting Authority: Municipality of Timișoara

Estimated investment value: 9.527.588,53 EURO excluding VAT

Estimated design contract value: 523.688 EURO excluding VAT

Value of prizes and mentions: second prize - 50.000 RON (about 10,470 EURO); third prize - 35.000 RON (about 7,328 EURO)

Competition launch year: 2020

Composition of the jury: full members – arch. Ana-Maria Zahariade, arch. Marius Miclăuș, arch. Constantin Gorcea, arch. Liviu Zăgan, arch. Ștefan Ghenciulescu, cultural manager Sorina Jecza, Deputy Mayor of Timișoara Municipality Dan Diaconu (representative of the contracting authority)

deputy members – arch. Sorin Ciurariu (representative of the contracting authority), arch. Daniela Calciu

Number of participating teams: 28

Participating countries: Romania

Implementation status: ongoing

Community involvement: public consultation, roundtable discussions

Project Description

"Architectural and heritage concept: in accordance with the principles of interventions on built heritage, the approach to the brief is unequivocal, namely the enhancement and reuse of the depot complex, starting from the spatiality and architecture of the built volumes, going down to the specific details of industrial heritage, but no less preserving the characteristics of the courtyard, with the sharp but so smooth intercutting of the rails on the land, sometimes mineral, sometimes abundant in vegetation. The unnecessary butaphoria and decoration are set aside in favor of self-expression, rich and still relevant in the context of the new function

The accommodation of the arts and technology center here is in the spirit of the reuse of industrial architecture, in which programs of this kind have found their own expression today. The conversion therefore seems natural, the spaces easily receive and nobly accommodate the new functions, in a layout that responds to the various functional groups with their usage regimes. The relationships useful to the internal organization of an exhibition and production center are allowed, but more than that, the representative composition of a program open to the public is offered, with its spatial hierarchies, ample dimensioning and intuitive configuration of routes and access areas." - Excerpt from the project text

Energy and Resources

"The reuse of industrial buildings often implies lower energy requirements, which remains true in this case. The proposed measures are aimed at ensuring reduced energy consumption by sectioning spaces into zones with different thermal regimes, depending on the type of use, and allocating these sections to independent heating/cooling units with lower complexity and short networks. Energy consumption, both electrical and thermal, is reduced by combining spaces with extensive use in the same sector.

Rainwater harvesting from extensive roof surfaces, which is easy to achieve, produces water reserves collected in buried reservoirs, which are used to irrigate mainly plantations on less permeable mineral surfaces. In rainy periods, excess water is directed to the water mirror, which acts as an evaporation surface. It is also proposed to use rainwater as domestic water in the sanitary facilities. Additional equipment, e.g. photovoltaic panels, which are easy to introduce in terms of sun-exposed supporting surfaces, may be introduced at a later stage, subject to the allocation of additional budgets." - Excerpt from the project text

Mobility, Accessibility and Public Space

"Access into the buildings is facilitated by the original relationship to the land, which is preserved throughout the remodeled spaces. Level access in most spaces and ample passageways between spaces are complemented by a functional scheme that allows barrier-free access to all functional components. In this sense, the overhead areas contain only extensions of some of the ground floor level functions. At the same time, the flexible utilization scheme allows the relocation of activities organized there to ground floor spaces.

At the macro level, orientation is favored by the presence of the tram lines, which lead from the street to the main access point in the buildings, despite the vegetation screens. The pavements used and the signage elements positioned in the area of the gate and the entrances to the various functional components facilitate orientation and emphasize the spatial hierarchies within the ensemble (...) To facilitate the physical connection between them, the option of a pedestrian crossing relocated here is a sufficient measure, also justified in the wider circulation scheme of the area. The outdoor space strategy aims on the one hand to clarify some of the access areas into the buildings and the relationships between the existing areas, and to introduce new spaces where necessary. The main new intervention in the external spaces is the small courtyard, realized by demolishing the body of the thermal power plant, a measure that enhances the old archive building, the chimney, but above all, brings a representative space to the rear of the enclosure

The area of access to the halls, adjacent to crossing paths to the rear of the site and to the neighboring housing complex, is reduced and better delimited to the west. Adjacent to it is a large space, more precisely physically delimited and anchored in the middle by the water mirror inserted between the monumental trees on the site. The permeable boundary, the awning introduced on the north side of this pocket space, further contours this place and at the same time provides shelter from the rain." - Excerpt from the project text

"All spaces will be easily accessible to all categories of users. Considering also the educational character of the center, the focus will be on creating a safe and friendly environment for all age groups, without physical and psychological barriers, with a visual and tactile guidance system for people with sight, hearing or motor disabilities.

In this regard, the inclusion of a concept and accessibility solutions on the entire site, both in the interior and exterior spaces, will be treated with major interest and will also be reflected in the proposal on the route connecting the two subareas, separated by Bd. Take Ionescu, which form the site." - Excerpt from the Jury Report

Green Infrastructure

"The pavements used emphasize the dynamic or static character of the mineral spaces: the main access paths and holding spaces are paved with cubic stone, and the collateral areas are provided with stabilized sand and gravel surfaces, which preserve the naturalness of the site and reduce the extension of the sealed areas at ground level.

The retained vegetation, considered an asset of the site, is supplemented to balance the ratios between the various open spaces and to lessen the site's exposure to the urban ensemble to the west. At the same time the grid area located at the back configures a multifunctional surface, less exposed to the sun and to the neighborhoods.

The grassy areas are punctuated by layered plantings of tall grasses and flowering perennials, which complement the atmosphere of the courtyards - industrial prairies." - Excerpt from the project text

Urban Development of Kogălniceanu Street, University Street and Adjacent Streets

Cluj-Napoca

Authorship

Main authors: MOSSFERN SRL

Co-author(s): Lázár Csaba, Perju Mădălina Simona, Macalik Arnold Ernő, Vass Dániel, Pop Vlad Bogdan, Vajna Botond Szilárd, Molnár Attila, Szilágyi-Bartha József

Procurement procedure: Architectural design competition

Contracting Authority: Cluj-Napoca Municipality

Estimated investment value: 5.511.895 EURO excluding VAT

Estimated design contract value: 162.114 EURO excluding VAT

Value of prizes and mentions: second prize - 60.000 RON (about 12,000 EURO); third prize - 30.000 RON (about 6,000 EURO)

Competition launch year: 2018

Composition of the jury: full members – arch. Rudolf Gräf, arch. Pieter Uyttenhove (Belgium), arch. Stefano D'Avino (Italy), arch. Ligia Subțirica, arch. Kazmer Kovacs, arch. Johannes Bertleff, arch. Raluca Munteanu

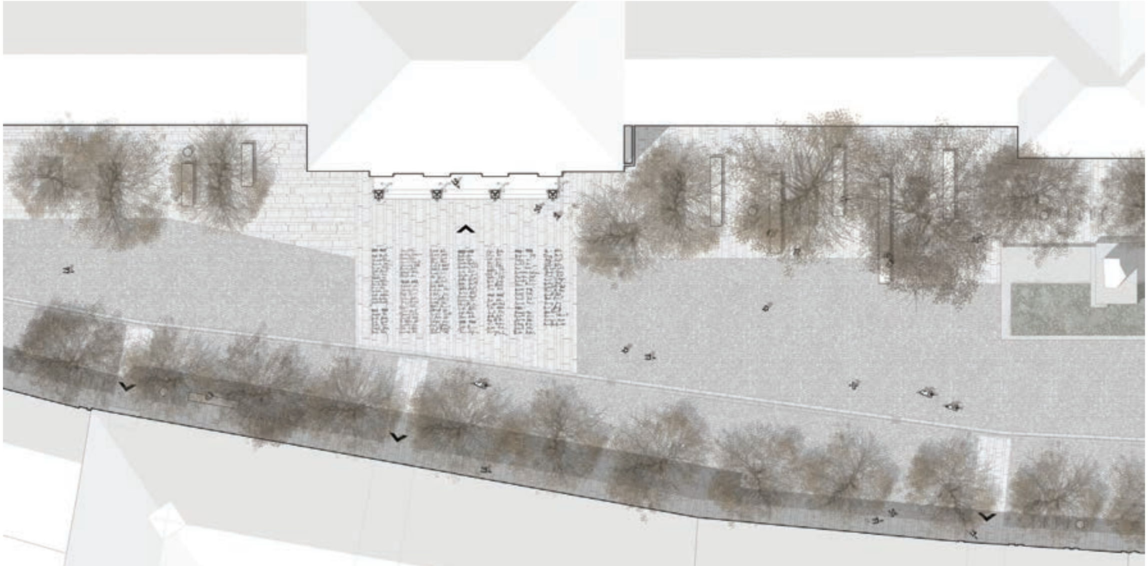
deputy members – arch. Andrei Cebotaru, arch. Matei Bogoescu

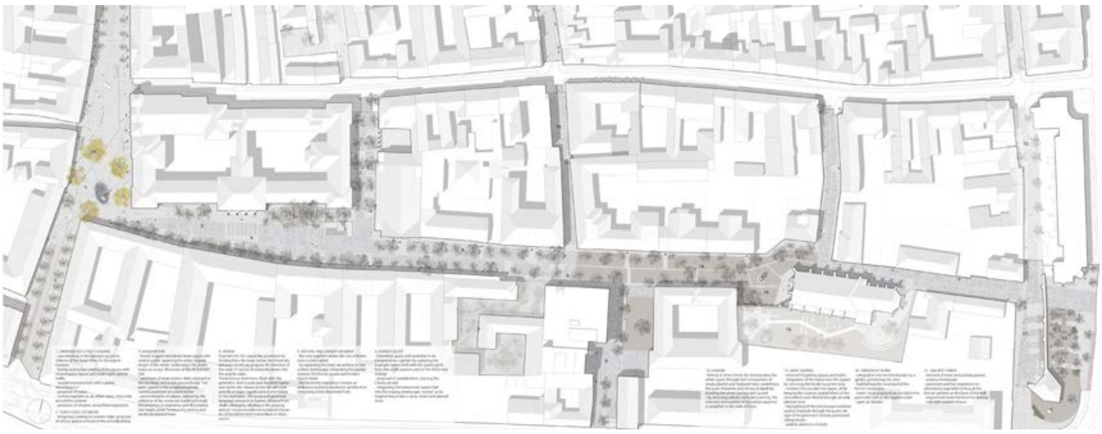
Number of participating teams: 11

Participating countries: Romania, Spain, Bulgaria, Belgium, Greece, China

Implementation status: completed

Community involvement: public consultation, roundtable discussions





Project Description

"The winning design is an integrated reflection of the complex site issues and specific requirements associated with the architectural competition. For the concept, the authors start from the metaphor of the hopscotch: (...) The different layers of the submitted work - written, drawn, sketched or rendered - represent the complete and coherent documentation of the proposed solutions. The result is a successful attempt to address all major problems with minimal interventions. Each sequence of the proposed "urban hopscotch" is illustrated by detailed architectural representations and well supported historical and cultural descriptions. The history of Kogălniceanu Street is well responded to in the interior circulation scheme that effectively connects it to the rest of the urban fabric, while keeping the study area relatively quiet. The spatial configuration of the site is rich and expressive. The project reinforces the specificity of each particular site by appropriately addressing the built and institutional context; it creates an interface between the public realm and the life of a range of cultural institutions: school, university, academy, church. At the same time, it evokes the principles of children's play, providing places with reduced car traffic, shared space and places to rest. Thus, the perennial life of the city is integrated with the individual experience of passers-by." - Excerpt from the Jury Report

Built Heritage: Energy and Resources

"The street is recovered from its unsatisfactory present status as a transit space for a succession of varied, multiple experiences. It becomes a composite set of particular urban states in different places. There appears an effective gradation from the University Square, with its restored statue of St. Mary Protector to the classicist facade of the University, then to the brutalist Academy Library and the new adjoining square, with the backdrop of the neoclassical "temple" facade of the gymnasium. This newly opened plaza is an important addition to the " hopscotch". The climax of the route is reached with the neighborhood of the reformed church, transformed into an intimate and peaceful place by vegetation and a differentiated treatment of the pavement. Finally, a coda to the composition is provided by the last and narrowest street sequence leading to the medieval fortifications. The overall approach is respectful of the built heritage in terms of visibility and emphasis on its more valuable components. The means used are discreet and measured. The design provides added value to the existing monuments and is careful to refer to the architectural and urban history of the sites (...). Only three paving materials are used in a differentiated way depending on the site and the desired effect. Spatial continuity is ensured by a central ruler, another reference to historic structures." - Excerpt from the Jury Report

"PAVEMENT, PATTERNS, RAINWATER COLLECTION: We propose permeable pavements made of natural stone, combining pavers and large granite slabs. The latter aids barrier-free pedestrian traffic, continuing the design of the main square, with the height of the newly restored spaces being extended to the most valuable landmarks highlighted by the presence of this material. Also, the central gutter is made of the same material of appreciable dimensions (40/150-200cm), as well as the carpets in front of the portals that segment the gutter, defining surfaces paved with andesite "Brad" of 15x28cm. We propose to fill the pavement joints with small sized stone chips from the same rock. Manhole covers are recessed tray covers, regardless of the utilities they house. Gratings, drainage channels and vent covers, and tree grates are metal, comb-type grates whose joints are filled with the same gravel as the pavement." - Excerpt from the project text

Mobility, Accessibility and Public Space

"Local public and professional debates in recent years have revealed the need to be able to experience the city, especially its center, at a slow, walking pace. The intention is to pedestrianize M. Kogălniceanu Street and adjacent streets extensively, but not exclusively. The area may become pedestrianized at certain times of the day or occasionally during community events. Permanent pedestrianization will be possible when all aspects of motorized traffic diversion are resolved for the entire area. Riverside access will continue to be possible, excluding the possibility of parking in public spaces.

The design of the intervention area as a "shared space", where traffic rules are not physically marked by road markings and road signs, has been successfully experimented in many European cities (in England, the Netherlands, Spain, Belgium) and is considered optimal in the given context. The solution can be implemented within the current legislative framework in Romania, with a speed limit of 20km/h and a warning to drivers that pedestrians can freely use the road surface." - Excerpt from the Competition Brief

"Diversifying the everyday functions of the street will provide that minimum level of activity to provide safety and convenience. Significantly reducing the amount of transit in the area should be complemented by the integration of recreational, recreational, educational and commercial activities.

The reduction in the number of parking spaces for cars will be compensated by the creation of bicycle parking spaces to encourage this mode of transport.

The recreation function requires street furniture designed for rest and sitting, both in spaces sheltered from wind and sun and in exposed areas, each appreciated in different seasons. This furniture shall be sited so as not to obstruct traffic, possibly preventing motorized traffic from monopolizing the space and parking vehicles." - Excerpt from the Competition Brief

Green Infrastructure

"One of the major merits of the proposal is the treatment of existing and proposed vegetation. Planting is an additional tool for shaping the urban space, controlling perspectives and creating intimate environments. A careful choice of botanical species and location is made. Trees emphasize the cycle of the seasons, and carefully designed lighting marks the cycle of days and nights..." - Excerpt from the Jury Report

"The quality of central urban public space is improved more by the existence of trees than by low and medium vegetation. The shade of trees lowers the temperature of the environment and radiant surfaces, provided that they occupy a minimum ground area. Trees provide habitat for numerous small and very small creatures that enhance the natural vitality of the plants in the area and delight children of all ages (birds, squirrels, insects, etc.). Tall vegetation has a much higher rate of air purification than small vegetation. Trees have great potential as easily accessible teaching material (as a whole or by component: twigs, leaves, flowers, fruit) and for play (climbing, hanging, inscribing, etc.)" - Excerpt from the Competition Brief

Feroviarilor Park

Cluj-Napoca

Authorship

Main authors: arch. Vlad Sebastian Rusu, arch. Octav Silviu Olănescu, arch. Anamaria Olănescu, arch. Anda Gheorghe

Specialty Collaborator(s): Structure – engineer Ovidiu Rusu, Landscaping – landscape engineer Alexandru Cotoz, horticulture engineer Valentin Sebastian Dan, hydrotechnical constructions – engineer Monica Gheorghe

Procurement procedure: Architectural design competition

Contracting Authority: Cluj-Napoca City Hall

Estimated investment value: 7.916.630 EURO excluding VAT

Estimated design contract value: 119.200 EURO excluding VAT

Value of prizes and mentions: second prize - 35.000 RON (approx. 7.510 EURO), third prize - 20.000 RON (approx. 4.290 EURO)

Competition launch year: 2018

Composition of the jury: full members – arch. Jose Mayoral Moratilla (Spain), arch. Ligia Subțirica, arch. Vlad Gaivoronschi, arch. Elisabeta Dobrescu, arch. Cristian Borcan

deputy members – arch. Anca Cioarec, landscape engineer Alexandru Ciobota

Number of participating teams: 14

Participating countries: Romania, France, Italy, Belgium

Implementation status: completed

Community involvement: Sociological study: participatory urbanism workshop, consultative picnic, interviews with the community / professional environment

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credit foto: Cosmin Dragomir

Project Description

"Located on the north-western edge of the city center, on the banks of the river Someș, the revitalization proposal for the "Feroviarilor" Park is based on the principles of sustainable urban development. The project aims to reintegrate natural elements (aquatic and vegetal) into the city, as well as to provide diverse facilities for the neighborhood and city-wide communities. The means necessary to accomplish this intervention have been designed to be non-invasive and reversible. The proposal seeks to balance resources and quality public spaces that meet community needs within the landscaped landscape and proposed buildings." - Excerpt from the project text

Energy and Resources

"The objects designed in the park (entrance gates, functional core, pavilions, technical spaces) are discreet and disguised, based on reversible construction techniques and structures. The built elements are designed in a unified architectural language using wood and metal as materials, giving vegetation a key role in the design process. Together with the notable elements of existing and proposed vegetation, the main built elements contribute to the identity of the different places in the park.

Some of the existing anthropogenic features are intended to be used for wetland slope hardening and waterproofing (existing concrete slabs and platforms) or for various wildlife facilities (railroad ties). Also, vegetation proposed for replacement (trees and shrubs) is processed and used as compost." - Excerpt from the project text

"Consequently, the design solution must offer more than a "landscaping" applicable to the present situation, but must provide a "prototype" of a public green space, adapted to the present and at the same time adaptable to future circumstances, economically, landscape, ecologically and socio-culturally sustainable" - Excerpt from the competition brief

"The project skillfully utilizes a stormwater management system with retention ponds and biological filters. The project also proposes a system of controlled flooding of the waters of the Someș, which may have the potential to generate biodiversity in the area." - Excerpt from the Jury Report

Mobility, Accessibility and Public Space

"The functional zoning of the park proposes a network of four lanes parallel to the river Someș, each with its own name and specificity: Someș Strip, Ecological Strip, Cultural Strip and Social Strip. Each of the four lanes presents progressive intensities of human activities, ensuring their gradual hierarchization from the Someș River to the built-up neighborhoods. The design envisaged thirty possible use scenarios, which can be realized in different combinations, depending on the season or time of day. They are spatially distributed according to the intensity of human activities, taking into account the general scenario of human activity gradually calming down from the built-up area to the green area." - Excerpt from the project text

Green Infrastructure

"The proposal integrates the river Someș as the ecological axis of the park, which thus becomes a component of the green ecological system. This concept of re-naturalization of the banks of the river Someș is followed by proposals for the wetlands, which become the main attraction of the park. Integrated into a simple rainwater harvesting system, the wetlands together with the river become the dynamic elements of the park, encouraging the emergence of specific vegetation and fauna. By their natural character, these places aim to evoke the atmosphere and intrinsic qualities of the existing spaces along the Someș

The proposal incorporates a substantial amount of existing vegetation and notable trees have been integrated into the new design. The selection and layout of the new vegetation follows the overall design concept by creating areas of vegetation complementary to each of the four functional zones. Thus, the area in the immediate vicinity of the Someș river and wetlands (ecological strip) has vegetation native to the geographical area of the Someșul Mic (including the Someșul Cald). It has been grouped as ecotopes found along the course of the river from the source to the confluence with the river Someș (near the town of Dej). The flora of the other vegetation zones was selected to be specific to natural wetlands, meadows and hills." - Excerpt from the project text

"Through principles of sustainable development, an ecological approach is proposed that enhances the biodiversity of the space and creates balanced zones. The integration of existing vegetation into the proposed solution and the selection of local species with high potential for adaptability to pedostationary conditions and low maintenance over time was appreciated." - Excerpt from the Jury Report

Rethinking Someș

Cluj-Napoca

Authorship

Main author: PRACTICA / Jose Mayoral, Jaime Daroca, Jose Ramon Sierra

Architecture collaborator(s): Raul Brito, Sofia Valdivia, Gonzalo Cortes

Procurement procedure: Architectural design competition

Contracting Authority: Municipality of Cluj-Napoca

Estimated investment value: 5.511.895 EURO excluding VAT

Estimated design contract value: 349.936 EUR excluding VAT

Value of prizes and mentions: second prize - 60.000 RON (approx. 12.000 EURO), third prize - 30.000 RON (approx. 6.000 EURO

Competition launch year: 2017

Composition of the jury: full members – arch. Ildiko Mitru, arch. Ligia Subțirică (AC representative), arch. Claudiu Salanță, landscape arch. Nicolas Triboi, urb. Alexandre Sorrentino (France), arch. Darko Polic (Serbia), arch. Dietmar Steiner (Austria), arch. Alfonso Vegara (Spain); deputy members – arch. Vlad Rusu, Teișanu Ștefan

Number of participating teams: 11

Participating countries: Romania, Spain, Italy

Implementation status: completed

Community involvement: roundtable discussions with relevant stakeholders

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photo credit: Practica

Project Description

"This proposal for the redevelopment of the river Someș is heterogeneous and diverse in order to respond to the multiple conditions of the river that crosses the city of Cluj-Napoca. It outlines a flexible system for the Someș with the capacity to offer a wide range of solutions for the river." - Excerpt from the project text

"The project is built around the fundamental idea that the River Someș is a living element capable of energizing the whole community. The proposal harnesses the transformative power of the natural landscape and relies on community involvement in the development of the project and succeeds in emphasizing the complexity of the landscape, going beyond the limits of conventional urban solutions. The project brings innovative solutions for Romania and proposes a new way of managing the relationship between the built and natural environment and invites all urban actors to relate to the natural setting with respect through sustainable practices." - Excerpt from the Jury Report

Energy and Resources

"This project can become a model of best practice in addressing urban waterways. The approach in our cities is usually aggressive towards rivers: concrete walls, dams, affecting wildlife and the natural ecosystem. This proposal can be a true national manifesto, inviting Romanian cities to rethink their attitude towards the watercourses that flow through them." - Extract from the Jury Report

"Participants will be asked to propose design solutions that are as sustainable and future oriented as possible, ensuring cost-effectiveness and maximum architectural quality with a balanced use of energy and resources." - Excerpt from the Competition Brief

Mobility, Accessibility and Public Space

"This proposal has two main goals: to bring the river closer to the city and the city closer to the river. A system of terraces widens the riverbank and allows the river to enter the city. The section of the river is widened, allowing the river to become more accessible and a recreational space where numerous activities activate the riverbanks. The river Someș is no longer understood as a line, but as a thick strip of the city that absorbs other public spaces in the city. The city is brought to the river by inserting several programs and activities on the banks of the river Someș that are connected by pedestrian and bicycle paths. The Someș is re-envisioned as an urban connector for the proposed network of public spaces and green areas and as the main circulation route for pedestrians and cyclists. The Someș River becomes a focal point of activities, a waterway of urban activities. This project incorporates many uses along the riverfront to provide a wide range of activities and programs along every mile of the Someș River." - Excerpt from the project text

"The functions, landscaping and character that competitors will propose for these areas will depend on their overall vision. Depending on the design, competitors will present details regarding the characteristic atmosphere, smaller or larger scale amenities planned, street furniture, paving, etc. In addition, the landscaping of the banks and the improvement of direct access to the water in coherence with the functional layout and ambience proposed for these areas will be the subject of specific cross-section proposals." - Excerpt from the Competition Brief

Green Infrastructure

"Protecting the natural ecosystem and biodiversity, and slowing down the river flow, are seen as sustainable solutions to preserve the river's natural character.

The project uses multidisciplinarity to work 'as a team' with the natural ecosystem, not against it. This is the clear vision the draft proposes.
(...)
The jury appreciates the variety of environments that the project proposes to create along the river. These new spaces, remodelled on both banks, will allow the evolution of the river of the natural ecosystem. " - Excerpt from the Jury Report

"A system of diagonal paths aims to connect the river and its immediate context. These paths redefine existing paths by giving them continuity and allowing them to reach the water, building a visual connection between the urban fabric and the city. When they reach the water, these elements extend to create a platform for water contemplation and a social gathering space very close to the water. The last component, vegetation, is used as a tool to create a wider system of green areas.
(...)
The edge of the river is redefined to allow the citizens of Cluj-Napoca to reach the water more easily. The height difference is reduced, and the existing hard boundary is transformed into a gentler and more natural environment by inserting natural rocks, local vegetation and sand." - Excerpt from the project text

Firefighters' Tower

Cluj-Napoca

Authorship

Author: arch. Vlad Sebastian Rusu

Co-authors: Anamaria Cornelia Olănescu, Anda Gheorghe, Octav Silviu

Specialty collaborators: eng. Ovidiu Rusu, prof. dr. eng. Ludovic Kopenetz

Procurement procedure: Architectural design competition

Contracting Authority: Municipality of Cluj-Napoca

Estimated investment value: 1.349.700 EURO excluding VAT

Estimated design contract value: 81.030 EURO excluding

Value of prizes and mentions: second prize - 22.000 RON (approx. 4.400 EURO), third prize - 13.000 RON (approx. 2.600 EURO)

Competition launch year: 2017

Composition of the jury: full members – arch. Ligia Subțirică (AC representative), arch. Șerban Țigănaș, arch. Szabolcs Guttmann, arch. Irina Meliță, arch. Justin Baroncea, Florin Moroșanu, arch. Oana Bogdan; deputy members – arch. Ionuț Radu Filip, arch. Adi Hagiu

Number of participating teams: 25

Participating countries: Romania

Implementation status: completed

Community involvement: public consultation, roundtable discussions




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photo credit: Cosmin Dragomir




Project Description

"The tower, built in successive layers, used to defend and then to look out over the city, remains through our proposal an urban observatory, a place of contemplation and reading of the urban development. The third age is materialized through a discreet, integrated and unitary intervention, which aims, through simple and reversible means, to obtain a consistent activation of the tower, while also offering a reading of the city of the past and future. The diorama becomes part of the expression of this reading, both on the scale of an emerging reality (the proposed new level) and of past realities, captured at different stages of the city's evolution." - Excerpt from the Competition Brief

Energy and Resources

"Projects must express the optimization of the operation and future maintenance of the tower and the adjacent public space.

This requirement is expressed by the following parameters:

— Good choice of materials, technical solutions and equipment - robust, durable, easy to maintain and replace
— optimal use of all spaces;" - Excerpt from the Competition Brief

"Participants will be asked to propose design solutions that are as sustainable and future-oriented as possible, ensuring cost-effectiveness and maximum architectural quality with low energy and resource consumption." - Excerpt from the Competition Brief

"All exterior carpentry, plastering and ceramic tile cladding shall be refurbished or replaced with identical elements that retain similar materials, textures and construction techniques to the original." - Excerpt from the project text

Mobility, Accessibility and Public Space

"At ground level the project adds a new quality, suggesting the possibilities of coupling with adjacent buildings and realizing a transition between the old intra and extra muros through a small courtyard-like public space. The proposed arrangement for the pedestrianization of Tipografiei Street is both subtle and pragmatic." - Excerpt from the Jury Report

"(...) the proposed vision aims to implement phased transformations at the level of an extended urban area, which also includes Mihai Viteazul Square, which is directly linked to the studied site. These transformations aim to create a unitary and connecting concept between the territory inside the former medieval enclosure, proposed for development, and the territory of the square, which will work together through an ample pedestrianization of all streets and the calming of car traffic. (...)

One of the solutions for revitalization may be its inclusion in a route with points of interest on the east-west axis, by opening the Morii canal and its assumption as an element of structuring pedestrian trails along its course.

The pedestrianization of Tipografiei Street, together with the opening of the existing inner courtyard on the north side of the tower, aims to make the visit of the Firefighters` Tower more accessible and to create a link with A. Șaguna." - Excerpt from the project text

Green Infrastructure

"The proposed solutions are restrained, aiming primarily at the choice of materials that ensure a beautiful patina over time, together with a few pieces of urban furniture and vegetation that identify and activate places with particular characters: the entrance to the tower, the existing park at the eastern end of the street and the inner courtyard with the northern access from the Morii canal." - Excerpt from the project text

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Mirror Mission
Cities Hub Romania

Possible Cities

Integrated toolkit
for climate neutrality

Participatory governance

Strategic approach — stakeholder communities,
levels of involvement and forms of organization
Transparency and inclusion

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Participatory governance

Strategic approach - stakeholder communities, levels of involvement and forms of organization. Transparency and inclusion

Contents

1 Why is community involvement important?

Public budgets have never been more strained by the ever-increasing demands of the public, and the evolution of climate change calls for complex, convergent, coordinated measures, sometimes difficult for the general public and business to understand and accept. The way public money is spent therefore requires a judicious prioritization, understood and owned by the community as a whole.

Each place is unique in its combination of tangible (geographic, biological, etc.) and intangible (social, cultural, etc.) factors, which give rise to specific challenges and priorities for each local community. The trans-disciplinary and multi-scalar approach is essential for complex projects contributing to the transition towards climate neutrality, providing a range of relatively generic analyses and possible solutions. Specific challenges and optimal solutions for a given community can only be identified in dialog with that community. This ensures the effectiveness and sustainability of the solutions, the commitment of community members to their implementation and the ownership of the medium- and long-term impacts on quality of life and the environment.

Nothing about us without us is becoming the aegis of more and more communities. The relationship between government and citizens is changing from a paternalistic one to one of dialog, collaboration and participation, with each side taking responsibility. Initiatives can come from both sides:

— Top-down - initiated by the authorities with community involvement;
— Bottom-up - initiated by civil society, ideally with government support.

The complexity of sustainability issues and of the measures needed to make the transition to climate neutrality calls for coordinated, convergent and synergistic approaches. The involvement of as many entities as possible, each with its own strengths, in complementarity with the others, becomes essential. It is the responsibility of the public administration to involve all these entities, with the corresponding available resources, and to create contexts that facilitate their contribution.

Cities' transition to climate neutrality requires:

— Changes in practices and behaviors, including mindsets, at all levels;
— Analysis of the specific challenges of each community and formulation of a common vision and tailor-made solutions adapted to the context;
— Active involvement of different urban actors by taking active roles and assuming responsibilities, targets and deadlines, aiming at a synergistic effect;
— Collaboration and coordination throughout a project, from conception to implementation, throughout operation and post-operation, including monitoring, evaluation and optimization/correction processes.

The value of a project is the sum of the benefits for all stakeholders, not just the profit for the investor. Efficiency in investing and spending public money and maximizing its beneficial impact are all the more important. Community involvement brings a range of benefits for each category of urban stakeholders.

Benefits for public administration and other public institutions (initiators or partners):

— Increase the community's level of trust in the institution, i.e. the level of voter support for (potential) political leaders;
— Enhance the reputation of the institution as a working environment and as a partner;
— Efficiency and optimization of the services they deliver;
— Optimizing the management of the available or accessible budget and complementing administrative resources; in practice,

the administration expands its team by involving other stakeholders as much as possible;
- Strengthening the legitimacy of decisions, reducing opposition and increasing public support;
- The community's sense of ownership of the goals it has helped to achieve and manage leads to greater care and appreciation for them, greatly reducing the effort required from the authority in the long term;
- Social cohesion, which is created by recurrent community involvement in decision-making processes, increases community resilience and reduces the need for government efforts in critical situations. It also increases the community's capacity to understand and address the complexity of the urban ecosystem;
- Make it easier to achieve sustainability and climate neutrality objectives.

Benefits for business and private investors, including public-private partnerships:
- financial profit - the economic value increases as the solutions offered are customized to the client/community/context to which they are addressed;
- new opportunities to develop customized products and services;
- cost reductions due to financial and fiscal incentives (grants, tax reductions, subsidies, etc.);
- enhancing the company's reputation in the community, strengthening its social capital;
- enhance your reputation as an employer that attracts talent and skills;
- strengthening the loyalty of customers, collaborators, partners and employees;

Benefits for Non-Governmental Organizations (NGOs):
- increase the reputation, influence and visibility of the organization;
- access to funding and resources due to the trust of donors, sponsors and funders and their willingness to support the organization's actions;
- increasing capacity, attractiveness as a working environment and collaborator;
- increasing the organization's impact towards its mission;
- social cohesion;

Benefits for the professional community and/or communities of practice:
- Innovative solutions, resulting from the effervescence of the varied contributions of different participants;
- Gaining useful insights from the community through the life experience of its members;
- Easier implementation and more user-appreciated results over time as a result of collaborative design;

Benefits to the community, residents, users, individuals or businesses directly affected:
- Increasing quality of life, possibly reducing discomfort;
- Inclusion, accessibility, autonomy;
- Cost savings;
- Psychological needs that need to be met for a fulfilling, meaningful, lifelong life:
  - social connection and belonging to something bigger;
  - competence and autonomy;
  - to count, to be appreciated, useful, relevant;
  - having courage, having self-confidence.
- Social cohesion and resilience at community level.

2 Current Status

2.1 Legislative framework

Currently, the following legal acts regulate community involvement in decision-making:

— Law No 544 of October 12, 2001 on free access to information of public interest

— Law no. 52 of January 21, 2003 on the transparency of decision-making in public administration
Methodological Norms of June 27, 2022 on the application of Law no. 52 / 2003 on the transparency of decision-making in public administration

— Law 350 of June 6, 2001 on spatial planning and
The Order of the Ministry of Regional Development and Transport (MDRT) no. 2701 of December 30, 2010 for the approval of the Methodology for informing and consulting the public on the elaboration or revision of spatial planning and urban development plans -

— Order of the Ministry of the Environment, Water and Forests (MMAP) no. 269 of February 20, 2020 on the approval of the general guide applicable to the stages of the environmental impact assessment procedure, the guide for environmental impact assessment in a transboundary context and other specific guides for different areas and categories of projects -

— Order of the Ministry of the Environment, Water and Forests (MMAP) no. 1.825 of September 21, 2016 on the approval of the guidelines for environmental impact assessment -

Law 350 refers to the participation of the population and its representatives in the decision-making process, and the related methodology refers exclusively to public information and consultation, minimum levels of involvement, at all stages of the elaboration of urban and spatial planning documents. Article 4 expressly mentions the obligation to carry out information and consultation procedures at the following stages:

a preparatory stage - announcement of the intention to develop;
b the documentation and preparation of the background studies;
c the stage of drafting proposals to be submitted to the endorsement process;
d drafting the final proposal.

Each administration adopts a local regulation detailing how these procedures will be managed within the respective territorial administrative unit (TAU).

2.2 Practice

For a long time, public information and consultation efforts have been carried out half-heartedly and without relevant impact, which has discouraged the public. There is, however, a growing number of public administrations that are moving towards a more open governance model, starting with greater transparency and more consistent involvement of citizens.

The City of Timisoara is an OGP - Open Governance Partnership partner. The local administration runs participatory planning processes and its new website integrates Ux Design principles.

Romania's community foundations are grouped in a federation, where they provide mutual support, mentoring and exchange experiences. They do not deliver direct services to society but support the development of initiative groups and non-governmental organizations.

The Someș Delivery Festival is an example of a successful civic initiative, which has had an important impact on major public investment strategies and projects along the Someș. Each year, festival organizers have provided the community with new perspectives on its relationship with the river, new previously unexplored valences, and opportunities for civic dialogue.

Attempts to introduce **participatory budgeting** exist in a few municipalities. An analysis by the Romanian Center for European Policy (CRPE), published in February 2024, concludes that the phenomenon is not representative at national level, being implemented in few municipalities, inconsistent, superficial and non-transparent.

Public information-consultation procedures are often conducted formally, in order to comply with the minimum legal obligations, but without really capitalizing on the opportunity for community involvement to maximize the beneficial impact of projects and the efficiency of spending public money.

Credit : Someș Delivery, with permission

Shortcomings identified in practice	Recommended solutions
Initiation of public investments without the elaboration of urban plans (where appropriate) and without processes to involve community.	Compliance by the authorities with all the necessary planning and design steps for their investments and community involvement in the decision-making process.
The level of community involvement is low through information-consultation processes.	A more consistent level of community involvement through collaborative and co-creation processes.
Generic information-consultation procedures, without a clear purpose, organized as meetings of decision-makers with the public.	Engagement, collaboration and co-creation actions with a clearly defined purpose, without intimidating dominant presences, in formats that offer fair status to all participants.
The materials provided are exclusively technical and difficult for the general public to understand.	Alongside technical documentation - explanatory materials in accessible language, meetings or site visits with presentations for the general public and dialog based on them, possibly integrating game theory principles (gamification) in interactions with community members, etc.
Consultation on topics with low impact on the community. Example: participatory budgeting on a small percentage of the city budget, similar to pocket money for children.	Consultation on issues with significant impact on the community. Example: consistent budget allocations, prioritization, restructuring, etc.
Directly taking citizens' responses as justification for implementation, without exploring their genuine needs more deeply and without taking into account the medium- and long-term consequences predicted by professional expertise.	Community involvement is not a substitute for specialized professional grounding. It nuances and/or complements a consistent transdisciplinary professional approach.
Communication that is indifferent to its audience.	Analysis of relevant project stakeholders, planning and organization of communication and community engagement activities according to stakeholder categories.
Publicizing the process on channels with low visibility in the community. Examples: the physical and digital notice board of the town hall, publications with a circulation that is not relevant enough, communication by post to those directly affected.	Supplement the legally mandatory communication channels with other more effective channels, chosen on the basis of target audience profiles. Generate a consistent communication structure with the community.
One-off involvement, in a single stage of the project (not in 4 stages, as required by law), often late, with no significant effects.	Iterative involvement, throughout the project, from the first intentions to commissioning, but also during use. Integrate the results of the community engagement processes into the specifications and competition themes.
The consultation shall be deemed to be completed at the end of the deadline, regardless of the number of persons having expressed an opinion and regardless of their diversity.	Plan, organize and adapt the community engagement process to ensure inclusive and representative community involvement.
Consultation is done in one way only: publication on the Authority's website or display on the notice board of the technical documentation, on the basis of which written or verbal opinions can be submitted to the Authority within a certain time limit.	Diversify the ways of community involvement: surveys, thematic meetings, workshops, field visits, etc.
The lost trust of community members in consultative processes, which are perceived as a bureaucratic formality without substance. The perception of many community members that decisions have already been taken and that their presence and input is irrelevant.	Regaining and building trust by increasing the transparency of information, by publishing the results of community engagement activities in projects including consistent results.
Some public information is often only accessible on zrequest, which discourages access through the extra effort required.	Public information is open ex officio, which means easy, transparent access without additional effort on the part of those concerned.

It is recommended to develop (or revise) the Local Regulation (mandatory by law), which sets out how to organize and manage the procedures for public participation, in order to maximize the opportunity for community involvement, favoring processes with high levels of involvement, based on transparent, balanced information

Lack or insufficient transparency of information creates the conditions for misinformation and manipulation, with negative consequences for society. When information is not accessible, incomplete or distorted, citizens are unable to make informed decisions and are vulnerable to false narratives.

Misinformation thrives in opaque environments where authorities or institutions do not provide clear and publicly accessible data. When citizens are unable to verify the authenticity of information, they can become victims of manipulation, either through deliberate propaganda or misinterpretation. This phenomenon affects not only the individual, but also society as a whole, leading to polarization, distrust of state institutions and even political or social decisions based on false premises.

To combat these risks, it is essential that public institutions, the media and other information sources adopt rigorous transparency policies.

3 Effective community involvement and development

The complexity of the problems faced by administrations requires collaboration outside their own structures. Aggregating and linking data from different sources of local and central level institutions is a first step towards inter-institutional collaboration and more efficient public investments. But the private sector and civil society have the advantage of much greater dynamism and agility in problem identification, innovation and implementation, which is why opening up the act of local government to other urban actors is a growing necessity. The most prosperous cities benefit from some of the most open forms of governance.

The principles of open government are:

— Open;
— Transparency;
— Accountability;
— Participation;
— Trust.

The five principles underpin and reinforce each other. Openness is the foundation of transparency, which serves the accountability of the administration but also of other stakeholders. The latter have the option to remain passive or to actively inform and involve themselves, taking responsibility for the consequences of their own action or inaction.

An open data platform provides information of varying levels of quality and performance to satisfy the information needs of different categories of users. It can provide differentiated access depending on the sensitivity of the data. The interface is user-friendly, intuitive, facilitates the identification of relevant data, its interpretation and possibly its aggregation. It includes functions for queries, feedback and sometimes public input.

Some platforms may integrate online forums for those interested in discussing specific topics. Dynamic data aggregation can be extremely useful for analyzing and understanding phenomena and informing personal and community decisions. Certain types of data can also be provided and owned by different stakeholders.

An example of good practice in transparency is the Federal Reserve Economic Data (FRED) platform, managed by the research division of the US National Bank.

At the local and regional administrative level, we mention the example of the community engagement platform managed by the Métropole Grand Lyon administration.

Key considerations for policy makers:

— Always be transparent;
— Partner with citizens to deliver real change;
— Successful engagement strategies are diverse and inclusive;
— Engagement is a process, not an end;
— Build community capacity through engagement;
— Deliver with integrity.

3.1 Types of participatory processes

The most common typologies of participatory planning at local and regional level are presented below:

Public space revitalization, spatial planning and investment projects
Projects in spatial planning, such as revitalization of public spaces and buildings fall into this category, e.g. concept development, spatial analysis, architectural or urban planning feasibility studies and competitions.

Participatory budgeting
The municipality allocates a portion of its budget and the public decides what the funds will be used for. Citizens can propose projects for implementation and then vote on the winner. There are different variations of participatory budgeting that can be targeted at specific agendas or socio-demographic groups.

Creating vision and strategy
Involve the public and stakeholders in the creation of strategic documents to ensure that future development meets the needs of target groups.

Local community/demographic group involvement
Projects that focus on engaging specific socio-demographic groups to solve problems and challenges specific to those groups, e.g. young people, single parents, senior citizens etc.

Projects with a specific agenda, public policies
Projects addressing a specific agenda, e.g. climate change, water and drought, transportation, health care, etc.

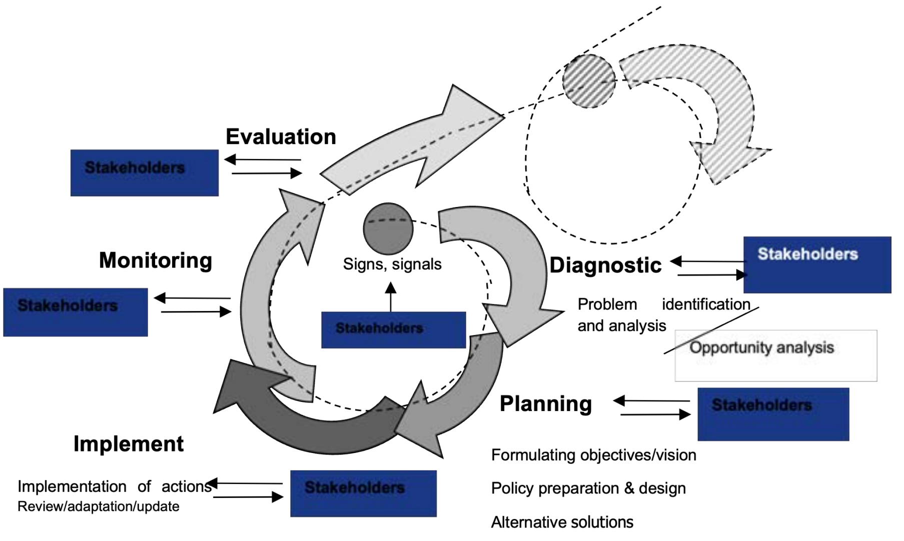


Fig. The spiral stages of participatory planning

adapted from Pamfil, C. The process of participatory governance: an analysis of 40 cases, VNG, Toolkit Participation (2002).

Regardless of the typology, a participatory process will involve stakeholders at all stages of the project, from the early stages of opportunity identification and diagnosis, to monitoring, evaluation and adjustment. Including the overall "spiral" is designed in a participatory manner, integrating the setting of responsibilities and deadlines.

3.2 Strategic approach to community involvement

Stakeholder involvement requires its own strategic approach, i.e. taking the following steps:

— **Formulate** genuine and honest **objectives** for engaging communities/stakeholders;
— **Stakeholder analysis -** stakeholder identification, analysis of the interest/decision-making power ratio to determine the levels of involvement necessary and useful for each stakeholder specifically, analysis of the relationships between them, etc.
— **Design and implementation -** Involvement, collaboration and active participation of the consistent interested or affected parties, information and possibly consultation for others. Includes the communication plan of the project, the participatory process and its actions
— **Evaluation of the participatory process** in relation to the objectives set at the level of the whole process and of each individual action, including the experience of participants.
— **Adjusting** the strategy along the way, i.e. lessons learned to optimize future participatory actions and processes

Attention!
The participatory planning spiral presented in section 3.2. applies to both project management (carried out in a participatory manner) and stakeholder management.

Different communities or stakeholders are involved, throughout the participatory process, in different ways, depending on the stage, the goals, the levels of involvement useful and necessary. Each involvement action goes through the stages of the spiral. Complex participatory processes require the budgeting of financial, material and human resources (minimum one person, ideally a team).

The stakeholder engagement experience starts with the first news about the process and ends with the final feedback form, which is why the communication plan is extremely important. A positive experience of the participatory process will build and/or strengthen a trusting relationship between community members and the administration.

Recommended:

— The communication of the approach, invitations and post-event communications should be attractive and cultivate respect for the participatory process, the participants and the objective; possibly integrating principles from gamification into interactions with community members to make the experience more attractive and enjoyable, but also to encourage authenticity and a collaborative spirit;
— The information made available to them should be understandable to them or be translated into relevant life situations;
— Explain the medium and long-term consequences of sustainable solutions compared to conventional or superficial solutions;
— Encourage them to express their opinions, possibly prioritizing the most vulnerable opinions over those that tend to dominate the conversation;
— Explore the genuine needs of community members, beyond the expressed desires;

— To highlight the results and impact of the involvement, in order to strengthen the relevance of the current approach and the interest for future participation;
— Celebrate results through events where the community can directly experience the impact of their own contributions

3.3 Community Involvement Levels and Tools

It is recommended to involve as consistently and frequently as possible at the highest levels of involvement: collaboration and participation or co-creation.

Attention!
Community involvement is not a substitute for specialized professional grounding. It nuances and/or complements a consistent transdisciplinary professional approach.

3.3.1 Information

For **informing** the community or stakeholders (low level of engagement), it is recommended to formulate messages clearly and concisely, use graphics and infographics to help make it easy to understand and make it accessible to diverse audiences.

Purpose of participation
Providing objective, balanced information, offering assistance in understanding the problem, alternatives and/or solutions.

The promise to the public
We will keep you informed.

Usual methods:
— publication on the administration's **dedicated website**; display on the notice board;
— **billboards** displayed in the territory;
— informative exhibitions;
— **newsletter** by e-mail or by post, on a recurring basis and in specific situations;
— **printed materials**: flyers, brochures, etc
— **webinars and live webcasts;**
— **radio, TV, podcasts**;
— **social media posts** through dedicated accounts on platforms chosen according to the profile of the community members or stakeholders the information is intended to reach;
— **site visits** can be organized to explain intervention or development projects in an area of the city. Depending on how they are organized and their purpose, they can be an opportunity for consultation.

3.2.2 See

The generic objective of the **consultation** (moderate involvement) is to collect data or opinions from the community. It is advisable to ensure diversity of voices, inclusiveness and representativeness for the community concerned, and to inform participants on how the results will be used.

Purpose of participation
Obtain information and opinions on analysis, alternatives and/or decisions.

The promise to the public
We will inform you, we will listen and take into account your concerns and aspirations, we will communicate how your input has influenced the decision.

Usual methods:
— online or written **surveys/interviews** including open-ended and multiple choice questions;
— **public meetings** in public spaces or online forums for dialog;
— **public hearings** are events open to anyone who wants to attend, where several people present carefully prepared and well-articulated points of view to decision-makers;
— **public debates**;
— **the public café** is a less formal context for active civic dialog;
— **focus groups** for in-depth discussions and/or interviews on specific issues in a small circle;
— **deliberative forums** explore the public's perspective by asking a group of around 100 people to attend presentations by several experts and stakeholders, who then formulate opinions on public policy options;
— **feedback forms** for collecting opinions at physical events or distributed online;
— **local** consultative **referendum**;

3.3.3 Active involvement

The active involvement of the community to develop ideas and solutions requires the creation of a collaborative climate in which the conditions are in place to ensure that every voice is heard and that the results reflect the contribution of the participants. At this level of involvement it becomes important to provide the necessary resources to remove barriers to participation (childcare, transportation, etc.).

Purpose of participation
Working with the public to identify and understand community problems and to identify solutions to manage or overcome situations.

The promise to the public
We will work together to ensure that your concerns and aspirations are reflected in the alternatives developed and communicate how your input has influenced the decision.

Usual methods
— Interactive **workshops**, brainstorming, exploration and co-creation sessions;
— **Community advisory councils** to involve representatives of different groups;
— **Citizens' groups** are representative groups for the community, made up of 500-2500 citizens who undertake to provide regular feedback to the administration on issues of public interest and to respond to about 4 questionnaires/year;
— **Hackathon** events to solve specific community challenges, resulting in one or more minimally viable products or solutions that can be piloted in the shortest possible time;
— **Participatory budgeting** gives the community the opportunity to decide how to allocate a share of available funds, and/or prioritize the allocation of funds for different public investments

3.3.4 Collaboration

A partnership relationship with the community begins at the **collaborative** level, where decision-making and implementation of solutions are shared. It is advisable to assume a long-term partnership relationship, not just a one-off, isolated one.

Purpose of participation
Partnering with the public in identifying problems, looking for solutions and finding the preferred one.

The promise to the public
We invite your input for recommendations and innovative solutions, which we will include in our decisions as much as possible.

These methods can be used in more complex community engagement processes, such as:

- **co-design processes**, where the administration invites community members to generate joint initiatives;
- **community-initiated projects**, carried out by the **community** with institutional support;
- **partnerships** with other organizations, both local, grassroots, business and NGOs with a certain level of expertise on specific topics;
- **joint working groups**, where representatives of the administration and stakeholders discuss and analyze concrete topics;
- **local action groups**, especially known in the context of rural development. The governance model can be adapted to the urban environment.

3.3.5 Co-creation

The level of **co-creation/empowerment** is the highest level of community involvement, where the role of the administration is most profoundly transformed: it provides the tools and resources for the community to lead.

Purpose of participation
Final decisions are made by the public. Sometimes the community helps implement decisions.

The promise to the public
We are implementing your decision.
Methods appropriate to this level of involvement are:

- offering **grants and funding** as financial support for projects initiated and carried out by the community; civic crowdfunding with matchfunding (where the administration or other entity supplements the amount raised from donations);
- opportunities to **influence public policy**;
- **open space** technology is a planning method for large groups, where participants are self-organizing and the resources required from the organizers are minimal; it requires a relatively experienced group;
- **leadership development programs**, through which community members are trained to take on leadership roles; e.g. Urban Leadership Academy, organized by the Sibiu Community Foundation;
- **community committees**, which take responsibility for certain decisions through trusted community representatives;
- **community centers**, which provide NGOs and civic initiative groups with space, equipment and other resources, including advice and mentoring.

The New European Bauhaus Impact Model for Collaborative Governance facilitates the understanding and practice of participatory governance in the context of the transition to climate neutrality, a complex integrative approach integrating governance, environmental, health, economic and socio-cultural aspects. It is a flexible structure for dialog and cooperation among all stakeholders, based on common strategic directions and objectives, co-benefits and performance indicators

The New European Bauhaus impact model for collaborative governance
Source: NEB Pocket Guide - digital version

3.4 Measures to change attitudes

The transition to climate neutrality requires changes in attitudes and behavior en masse, not just in isolation. These can be changed in a relatively limited way through incentives and sanctions alone, but the lasting impact comes through changing mindsets, a long-term process

This change is possible and can be planned, designed, monitored and reviewed like any complex strategy. It requires an in-depth analysis of the causes of the problems, the stakeholders and their mental models, the systemic structures and rules that contribute to the current situation. Establishing a vision and desirable mental models for each stakeholder category is followed by analyzing the conditioning relationships between stakeholders, the factors that support the desired change and those that hinder or hinder it. On this basis, the awareness-raising and sensitization campaign starts to be built, using several channels, methods and tools, adapted to the different target audiences.

The contexts in which mind-shifting frequently takes place are those that promote learning together, mutual support and empowerment:

— **Educational** - schools, universities and other adult learning environments, through curriculum-integrated programs, electives, specializations, seminars and workshops, etc.;
— Examples: the national Green Week program and the international Eco-Schools program;
— **Work environments** - through leadership and mentoring programs, collaborative teams and peer-to-peer learning, training experiences;

— **Arts and media** - art and documentary films, podcasts, youtube channels, TED talks, books, creative writing workshops, local performing arts events, festivals, etc
Examples: if in the heyday of smoking, the protagonists smoked almost continuously, the anti-smoking campaign initially led to the preservation of this habit only in some negative characters, while the positive characters no longer showed this habit that had become undesirable;

— **Family and home environment** - through role models and educational style;

— **Personal development** - through mentoring and coaching, through disruptive immersive experiences: theme camps, challenges, trips, visits, volunteering, etc.;

— **Social movements and civic activism**, supportive communities, including social media;

— **Crises or major events**, critical moments in the life of an individual or a community, which lead to a reconsideration of values and practices in life;

— Examples: the Covid pandemic has globally triggered a shift in outlook on lifestyle at all levels, which has had powerful effects on personal career and lifestyle choices, the way we work, the real estate market and more;

— **Aspirational role models** of celebrities, influencers and public figures in general who exert lifestyle, cultural or ideological influence. Leading by example has a major impact on the public. Therefore, the adoption of new attitudes and behaviors will be encouraged and reinforced by:
  — clear, transparent and consistent manifestation of those attitudes and behaviors by community leaders.
  Example: the mayor routinely cycles and introduces programs to support non-motorized travel in the institutions under his authority

PHOTO: Mayor Sam Liccardo, San Francisco Bay Area Bike to Work Day May 12
Credit: CC, author RIchard Masoner, source: flickr.com

  — co-opt the relevant influencers for the topic in order to manifest and promote the targeted attitudes and behaviors.
  Example: co-opting renowned chefs to promote responsible behavior to reduce food waste by planning food shopping, conservation methods, anti-waste recipes etc.

Last but not least, in the legal and administrative context, **financial and/ or fiscal incentives** can be introduced for the adoption and spread/scaling of habits that contribute to social, economic or environmental objectives, i.e. climate neutrality.

For example, the city of Ferrara in Italy has introduced a campaign that rewards commuting to work by bike, using an app that records commuting trips and results. The **FerrarBike2Work** app is gamified and informs on several trip metrics, including CO2 savings, points earned, weekly and overall ranking, prizes. The rules are available on the app. Employees of participating companies are rewarded with salary bonuses of €0.20/km, maximum 20 km per day, maximum €50 per month

Another example is multinational company Iberdrola, which includes useful information in its **electricity bills** to its customers to promote responsible and sustainable consumption:

— the carbon footprint associated with your home's electricity consumption;
— recommendations for energy efficiency based on the customer's consumption patterns, indicating percentage estimated cost savings;
— comparison of consumption with the average of other similar dwellings in the area (e.g. 10% more than similar dwellings in the neighborhood);
— promoting specific renewable energy packages, then indicating the percentage of green energy in that month;
— gamification of savings, to motivate small changes in behavior that lead to concrete savings over time.

The Cluj-Napoca City Council has introduced a tax incentive through reduced property taxes for buildings that have obtained green certificates from international organizations such as BREEAM and LEEDS. The market has evolved in the meantime in terms of performance and constantly changing requirements. It is therefore recommended that tax incentives should only be offered for certification for the highest level of performance.

The methods with the greatest impact on changing mindsets involve active participation, deep personal connection and experiential learning. These approaches go beyond the level of information, they create opportunities for people to reflect, to introspect, they challenge beliefs and convictions, they connect them emotionally with new ideas. Some of the most impactful methods are:

— **personal stories and narratives** - resonate on an emotional level, translating abstract ideas into ideas and experiences that audiences can relate to, broadening perspectives and deconstructing prejudices. They can be delivered through local events, in schools, theater, TV or online;
— **immersive experiences** help participants see the world from different perspectives, dissolving preconceptions. Examples:
    — simulated situations, role-playing games, VR experiences;
    — field visits to marginalized communities or problem areas;
    — Cultural immersion by attending events or environments outside your comfort zone;
— **dialog and deliberation** through:
    — moderated events that listen to the diverse perspectives of participants and develop empathy (e.g. The World Café);
    — inter-group dialog in sessions exploring differences in identity, culture, etc.;
    — deliberative forums for problem-solving that require critical thinking, questioning the status quo (e.g. focus groups).
— **experiential learning** / participatory actions generate a deeper connection with those concepts:
    — active volunteering in affected communities;
    — co-design solutions require in-depth understanding and shared ownership
    — skills-development workshops linking individual action with broader societal issues.

— **mentoring and peer learning** - connecting directly with someone who has lived certain experiences offers new perspectives in a way that other people can relate to, inviting reflection and sustained engagement:
  — mentoring programs - mentors challenge participants to reflect and develop;
  — peer learning circles - creating safe spaces for group discussion and mutual support.
— **engagement through art** - through emotions, the creative state overcomes habitual resistances and helps to deepen understanding, new ways of processing and reimagining ideas:
  — interactive art installations, including AR, with a social or other message;
  — community theater / forum theater - participating in or attending plays dealing with societal issues;
  — writing and reflection - creative journal or poetry workshops.
— **intercultural and inter-group exchanges**, through direct interaction between people from different backgrounds, increase empathy and reduce stereotypes:
  — cultural exchanges by hosting or participating in international or intercultural programs and events, travel for this purpose;
  — dialogue circles to bring diverse communities together to discuss common goals or challenges;
— **long-term commitment and increased capacity** - sustained long-term commitment produces deeper changes in mindset, gradually, as people see the results of their actions over time:
  — leadership development through programs that train and encourage individuals to take initiative in their communities;
  — advocacy training, develops skills and competences to organize and lobby for change
  — learning groups meet regularly to reflect and develop together

People change when climate neutrality becomes personally relevant, including emotionally, and recognize immediate benefits.

3.5 Forms of community organization and development (governance)

The ways of organizing community involvement are varied, depending on the national legislative framework and local culture. They will be outlined below:
— Common forms of civil society organization (grassroots / bottom-up);
— Some organizational structures of public administrations for community involvement (top-down).

3.5.1 Organizational forms of civil society

Civic initiative groups
Forms of organization without legal personality, civic initiative groups are flexible, non-legal forms of organization made up of people who share a common interest or a specific social, cultural, community or environmental problem. They often become associations and their funding possibilities are limited to donations or informal partnerships. Examples: initiative group "Favorit" in Bucharest, initiative group "Iasi loves lime trees"

Non-governmental organizations (NGOs)
Extract from Ordinance 26 of January 30, 2000:
"Natural persons and legal persons pursuing activities in the general interest or in the interest of a community or, where appropriate, in their

personal non-economic interest may set up associations or foundations". This creates the framework for (excerpt Article 2):

a exercising the right of free association;
b promoting civic values, democracy and the rule of law;
c the pursuit of a general, local or group interest;
d facilitating the access of associations and foundations to private and public resources;
e the partnership between public authorities and private legal persons without patrimonial purpose;
f respecting public order.

Examples of associations with impact at the local community level: the Incotroceni Association in Bucharest, the Citizen of Traian Association in Timisoara, Studio Govora

Associations are set up by at least three natural or legal persons with a mission of public interest, where often the associates are directly involved in the work of the organization.

Foundations are set up on the basis of an endowment dedicated to a specific cause of general interest, and strategic decisions are taken by a board of trustees.

Community foundations are a special type of NGO, supporting the development of civil society, with a common set of principles and a high level of autonomy.

Federations may be made up of at least two associations or foundations with separate legal personality.

NGOs can be recognized as being **of public utility** by a government decision if they meet a number of conditions specified in the law. They have some specific obligations that derive from the management of public money, as well as some tax incentives and support from the authorities. Some public benefit NGOs are established and operate on the basis of special laws and are mandated by the state with certain high-impact responsibilities in society.

Examples: Romanian Order of Architects, Romanian Red Cross, etc.

Other forms of stakeholder organization can involve business and professional stakeholders through communities of practice, consortia, alliances, alliances, clusters, trade unions, multi-stakeholder initiatives and the like.

Civil society, in its various forms of organization, can become an extremely valuable partner for public institutions in identifying community-specific problems and formulating context-specific solutions and contributing specialized knowledge resources.

3.5.2 Public organizational structures for community involvement

There are a variety of organizational forms for community involvement facilitated by government or other public entities, depending on the local context, purpose and duration of the involvement. Only a few of these are briefly outlined below.

Consultative assemblies

Referred to as assemblies, councils or committees, they can be set up to create an advisory body from the relevant communities to ensure representativeness and inclusiveness of views expressed and contributions made. They are most often constituted around a theme of general interest (social, cultural, digital, mobility, etc.), on a geographical or administrative basis (neighborhood, street, watershed, etc.) They can be temporary or long-term.

Neighborhood Manager

Cities such as Amsterdam, Berlin, Paris and Timisoara have introduced neighborhood managers to develop and maintain a direct, active relationship with community members in a clearly defined area. This accelerates the identification and resolution of local problems.

Community centers

Community centers are places created by municipalities to cultivate social cohesion and inclusion, community development and active community involvement, meeting specific local needs: social support, education and training, recreational and cultural activities, space for civic participation, support for health and well-being.

A well-organized community centre is easily accessible both in terms of mobility and financially, is multi-functional (flexible), involves the community in the development of initiatives and activities, is inclusive and reflects the diversity of the community.

Examples of community centers:

Casa Verde Community Center provides education and training in disadvantaged environments.

The "Maison des Associations" centers in France support the development of civil society through logistical and financial support, actions promoting solidarity and community cohesion.

NGO House in Latvia's capital city supports NGOs and promotes civic participation.

Local Action Groups (LAGs)

Local Action Groups (LAGs) are public-private partnerships, which include representatives from the public, private and civil society sectors, set up to develop and implement local development strategies, usually in rural areas. The characteristics of these partnerships are:

— a territorial approach defined around an identity or similar challenges;
— community participation in decision-making and project implementation;
— Specific Local Development Strategy (LDS) tailored to the local context;
— Innovation and multi-stakeholder, multi-scalar and multi-sectoral cooperation to streamline resources and maximize impact.

The LAGs model has been adapted to the urban environment and are funded by European regional development (ERDF) and social (ESF) programs.

Success stories of urban LAGs:

Barcelona (Spain): implemented LAG-inspired initiatives to regenerate neighborhoods through active community involvement.

Turin (Italy): Urban Action Groups have been used to revitalize disused industrial areas and transform them into cultural and entrepreneurial spaces.

Warsaw (Poland): Urban LAGs have been used to support the social inclusion of people in vulnerable situations.

Living Labs

Collaborative open innovation platforms, living labs combine community participation with research and technology to develop sustainable local solutions. They are partnerships between business, academia and government, addressing specific problems in an interdisciplinary and cross-sectoral approach, co-creating solutions, testing them in real-life contexts and implementing them.

Living labs promote innovation and skills development, practical relevance and social cohesion, reduce risks and accelerate the uptake of new technologies by adapting them to user preferences.

Coordination of partners and genuine community involvement are often difficult. Once the initial projects for which they were set up have been completed, an important challenge is to maintain activity and relevance, financial and logistical stability.

The European Network of Living Labs (ENoLL) is a support platform for such structures.

Examples of Living Labs:

Amsterdam Smart City Living Lab (The Netherlands), a platform testing solutions for urban mobility, energy efficiency and pollution reduction.

Helsinki Design Lab (Finland) promotes citizen involvement in energy efficiency and urban design projects.

Barcelona Urban Living Lab (Spain) develops solutions for inclusion and accessibility through technology and design.

National platforms. Example: CapaCITIES

The active involvement of communities is essential in the development of national platforms, as they play a fundamental role in promoting collaboration, ensuring inclusiveness and stimulating systemic change. National platforms are coordination mechanisms that facilitate multi-level stakeholder involvement, knowledge sharing and innovation in governance. The European CapaCITIES project has facilitated the development of national platforms to support the implementation of the EU's mission of 100 smart and climate neutral cities by 2030

The CapaCITIES project has promoted a co-creation and co-design approach with public authorities, using innovative tools and methods to prototype and implement multi-level governance strategies that contribute to shaping and accelerating national change, through initiatives such as the Transnational Alliance, Transition Labs, capacity development and the National Ambassadors Network.

The Transnational Alliance proposes a format to support collaboration across national borders, facilitating learning from the experiences of other actors, sharing best practices and creating an enabling environment for the development of climate neutral cities. It aims to build an ecosystem of support for cities and urban actors to facilitate and promote change. The Platform includes a series of interactive webinars, including an opening meeting and a closing event, where key outcomes of national processes, such as good practices, capacity building measures and national action plans will be shared. The Platform addresses national, regional and local public authorities, supporting them in improving the conditions necessary to promote climate neutrality within the limits of their responsibilities. The framework also stimulates learning and engagement at European level, with the aim of accelerating change towards climate neutral cities.

The Transition Labs involved a process of rapid stakeholder mobilization and learning. This initiative represents a strategic approach to the design and implementation of multi-level governance interventions to address major societal challenges such as climate change. Using theories of change and innovative methodologies, the labs promote distributed knowledge and expertise as an essential basis for action. Each lab is tailored country-specific, involving national and local actors, and follows a structured process that includes: 1) shared understanding of challenges and opportunities; 2) actively encouraging citizen participation; 3) identifying and addressing fundamental structural problems; 4) building capacity for change through skills development; 5) developing a portfolio of alternatives and prototype solutions; 6) collecting and sharing lessons learned from past successes and failures to improve future action.

Capacity development focused on the process of developing local actions, identifying funding opportunities and assessing climate neutrality impacts. These activities support local public authorities in the process of achieving climate neutrality in cities by analyzing existing competences, responsibilities, capacities and challenges.

The Ambassadors Network is designed to ensure the sustainability of initiatives supporting the implementation of the EU Mission. It comprises nationally selected Ambassadors who will play a crucial role in mobilizing relevant national and regional actors, decision-makers and other stakeholders to support the achievement of the climate neutrality objective. The Ambassadors are chosen on the basis of their ability to engage stakeholders, drive progress and contribute to the development of long-term strategies for urban climate neutrality. They will play a key role in mobilizing key actors and decision-makers in their regions, thereby helping to align local, regional and national strategies with the broader objectives of coordinating the transition to urban climate neutrality.

Creating national platforms requires a collaborative and multi-stakeholder approach that fosters cooperation, the development of governance structures and the harnessing of transnational learning. National platforms can thus successfully support the transition to climate neutrality through innovative and sustainable solutions. CapaCITIES demonstrates how a structured but flexible framework can support national and local authorities in implementing sustainable change processes.

3.6 Monitoring, evaluation and reporting (MER) of community involvement

Community involvement is a continuous learning process for both organizers and participants. Monitoring and evaluation of the process is designed to:

— Demonstrate the real value of community involvement;
— Increases confidence and reduces skepticism;
— Allows process adjustments to streamline the process and participation;
— Avoid resistance and subsequent conflicts;
— Increases the participatory capacity of the community.

The plan for monitoring and evaluating the performance of the participatory process starts from the goals and objectives of community involvement, establishes a pace of data collection in relation to the speed of change anticipated, and a set of performance indicators, qualitative or quantitative. Progress will be assessed on three levels:

— **Direct results** - measure the intervention directly. For example: number of trees planted on a stretch of boulevard, number of people invited to an event, etc.
— **Intermediate outcomes** - the change resulting from the intervention. For example: number of participants in an action, number of users of a newly regenerated area, etc.
— **Impact** - in relation to wider objectives such as increasing the number of conversations, confidence levels, air and/or water purity, biodiversity, etc.

The monitoring and evaluation criteria, as well as the level of data aggregation, shall be set to ensure the inclusion of relevant diversity at the level of the respective community, according to the identified needs and objectives. Requests for personally identifiable or sensitive information will comply with relevant data protection legislation (GDPR or others).

KPIs for inclusion

Stakeholder and/or affected parties analysis will reveal the diversity and weight of the categories of people who need to be involved in the participatory process to ensure inclusiveness and representativeness of the community. To this end, it is recommended to establish parameters by demographic categories, such as: age, gender, religion, origin, occupation/professional status, income, location/climatic vulnerability, living conditions, (dis)ability, literacy/education level, etc.

These data can be useful in identifying the specific needs and preferences of particular groups. For example, women or children may experience the city and traveling through it differently than men.

The setting of criteria and performance indicators will depend on the purpose of the community involvement and the investment objective. The weighting of categories may correspond proportionately to the weighting in the community, or it may prioritize groups that are typically under-represented.

Process KPIs
The attractiveness, level of transparency and effectiveness of the participatory process can be monitored through indicators such as:
- Number of steps/stages involving the community, i.e. different communities;
- Levels of community involvement - information, consultation, active involvement, collaboration, co-creation
- Number of people involved in the design or planning process;
- Diversity of the categories of stakeholders involved: administration, professional environment (various professions relevant in the context), institutions, business environment, investors, financiers, residents, neighbors, NGOs, etc.
- The diversity of engagement methods and tools used - online or in person, surveys, discussions, workshops, etc.
- Number of channels used for communication - the administration's website, possibly partners' websites, online or physical advertisement in a publication, invitation by e-mail or courier, etc.
- Response rate - the number of people reached compared to the number of respondents
- Depth of interaction: the number of people who reached the webpage compared to the number of people who completed the survey
- Number of reports to residents and stakeholders
- Satisfaction with the involvement - question at the end of the activity, repeated at the end of the process.

Monitoring certain indicators along the way can be useful for adjusting the strategy early in the process.

KPIs for data quality
The following parameters should be monitored to ensure data quality, relevance and representativeness:
- Amount of feedback;
- Diversity of perspectives and opinions;
- Spatial distribution of the resulting GIS-based data;
- How usable is the type of data obtained for the project in question;
- Suitability of data for the plan level and area in question;
- Compatibility of the resulting data with planning guidelines;
- Ease of data analysis.

KPIs for participatory governance
Examples of performance indicators for participatory governance:
- Frequency of data use;
- Variability in the profiles of data users (department, professional skills);
- Number of projects that include community involvement and the profile of those projects;
- Data usability in other projects;
- The number of engagement opportunities continues;
- Number of changes motivated by public input;
- Percentage of compatibility between public sentiment for a development in the area and an initial and/or updated plan.

These values can be tracked on the basis of internal procedures for monitoring the use of data in the administration's community engagement platform.

Ideally, reporting on the progress and impact of the intervention is tailored to different categories of stakeholders, according to their interests, needs and influence. Public communication empowers implementation and increases the confidence of funders and investors. The frequency and content of reporting will be tailored to avoid public fatigue.

It is recommended to describe the formats, target audiences, frequency and reporting procedures in a general reporting system at municipal level.

3.7 Recommendations

Romania joined the Open Government Partnership (OGP) in 2011, based on the following principles:

— Effective participation of citizens and organizations;
— Transparency and accountability - administrations are actively accountable for their actions and decisions and take public responsibility for them.
— Open Data - Data that is open, complete, primary, timely, accessible, machine-processable, non-discriminatory, non-proprietary, non-proprietary, license-free;
— Openness and re-use of data - public information must circulate and be freely usable in order to reach its full potential;
— Access and simplicity - easy to find and understand;
— Collaboration and co-creation/empowerment - at all levels and stages;
— Inclusion and diversity - language, technologies and methodologies accessible to minorities;

Local government buy-in and collaboration at national level is recommended to strengthen efforts to move towards an open governance model. In this respect, this chapter aims to explore concrete recommendations for public policies that can support and strengthen participatory governance, ensuring greater transparency of decision-making processes and involvement of citizens and civil society in administrative action. These recommendations will provide concrete insights on how public administration can facilitate closer collaboration with citizens and civil society organizations to build a more prosperous and sustainable future.

3.7.1 Participatory budgeting programs: state of implementation in Romanian cities

Participatory budgeting is a democratic process through which citizens can influence the way public resources are allocated and contribute to decisions on how public money is spent.

Overall, participatory budgeting gives citizens the opportunity to propose projects (following a call for proposals and on the basis of a local government regulation) and then to vote on the proposals declared eligible by the municipality. The process is structured in several distinct stages. The first stage is the submission of project proposals, which must meet the conditions stipulated in the participatory budgeting regulation published by the local government. In general, project proposals are submitted online, with some city halls (e.g. Brasov City Hall) developing dedicated platforms. After the end of the submission period, proposals are analyzed (generally by a committee composed of local public administration employees, local councillors and external experts) for eligibility and, if the projects require clarifications or adjustments, recommendations for improvement are requested and sent to the applicants. Thereafter, the projects declared eligible are put to a citizens' vote (either on the local government website or on a dedicated online platform). Citizens can vote for their favorite projects, and the projects that receive the highest number of votes are included in the municipality's budget and subsequently implemented by the local public administration.

According to the report on participatory budgeting published by CRPE - European Policy Resource Center (Damian and Ile, 2023), the participatory budgeting mechanism was first implemented in Romania in 2013 in Cluj-Napoca, followed in 2019 by Brasov and in 2020 by Alba Iulia. In 2022, a total of 13 county seats have run participatory budgeting programs, albeit with modest financial allocations and variable results. At the same time, other cities (e.g. Galati) had initiatives to introduce such programs, but they were abandoned (although the participatory budgeting program was voted in the City Council and adopted, the decision was not followed by the publication of a participatory budgeting regulation and the actual launch of the program), highlighting the complexity and challenges of sustainable implementation of participatory budgeting in the Romanian context.

The CRPE report also underlines the fact that, although participatory budgeting is introduced precisely to facilitate citizens' involvement in local public administration decisions, citizens' participation in the process of submitting project proposals and in the voting process is quite modest in most municipalities that run participatory budgeting programs, except for some large cities such as Timisoara or Cluj-Napoca. In Ploiesti, in 2021, only 9 projects were submitted and only 32 votes were registered. In Piatra Neamț, the participatory budgeting program was suspended after no project proposals were submitted in the context of a vague participatory budgeting regulation. In Brașov, the number of votes cast in the participatory budgeting program increased from 640 in 2020 to 3906 in 2022; however, in 2023, despite the reduction of the age limit (from 18 to 14 years) for participation in the voting process, the number of citizens casting their vote decreased significantly to 1879 people. Overall, in all the cities analyzed in the reports published by CRPE (Damian and Ile, 2023) and ACSD (2023), the number of votes cast in participatory budgeting programs remains low compared to the population of the respective cities, reflecting the relatively modest performance of these programs.

There are also numerous situations in which projects selected following the citizens' vote have been partially implemented or have been abandoned; most often, after the publication of the list of selected projects, the local public administration does not communicate about the status of project implementation and does not provide arguments as to why the implementation of certain projects is delayed or even abandoned. For example, in the Municipality of Brasov, data collected and analyzed by the Association Center for a Sustainable Society (2023) show that a relatively small number of projects, out of those selected following the citizens' vote, have actually been implemented by the local public administration. According to information published in the local press, some projects are being implemented late due to bottlenecks in the public procurement procedures for contracting the works. In other cases, it is found that projects cannot be implemented within the initially estimated budget, as the implementation is much more complex than presented in the project proposal (feasibility studies, obtaining approvals, etc.).

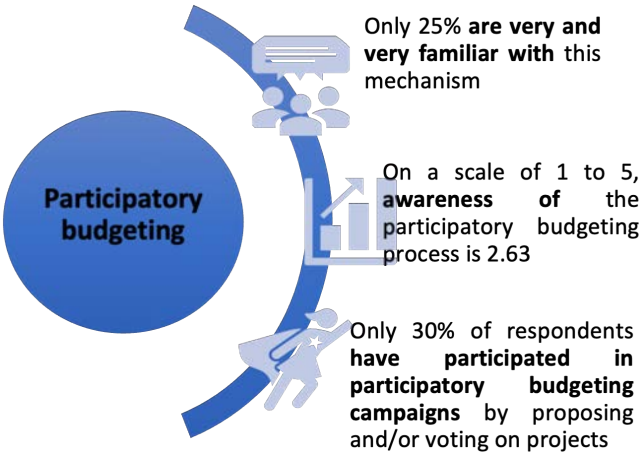
According to the CRPE report (Damian and Ile, 2023), the relative failure of participatory budgeting programs in Romanian cities is not accidental, the causes being multiple:

— **Limited administrative capacity** - municipalities fail to implement projects voted by citizens in a predictable timeframe and in a transparent manner. In most cases, after the selected projects have been included in the local budget, the local public administration no longer provides information on the status of project implementation and the reasons for delayed implementation or even abandonment of certain projects;

— **Low involvement of the local community at all stages of the program** - in many county towns, the regulation of the participatory budgeting program is put to a vote in the local council without first being discussed with citizens and representatives of civic action groups and NGOs. Also, the project selection committees are composed, in many cases (e.g. the municipality of Brasov), only of local councillors and local public administration employees. Last but not least, implementation is carried out exclusively by the administration / city hall, without the involvement of those who developed the project idea and submitted the project proposal.

— **Lack of information and awareness campaigns on participatory budgeting** - despite the adoption of a participatory budgeting regulation and the launch of a call for project proposals , few administrations run an information campaign on the programme and organize workshops or dedicated sessions for those interested in submitting project proposals. Not coincidentally, the results are modest, reflected both in a low number of project proposals received and a low number of citizens engaging in the voting process

The analysis conducted by the Association Center for a Sustainable Society (ACSD) in 2023 on the funding needs for community projects in the municipality of Brasov shows that the participatory budgeting process remains relatively little known and used even among representatives of non-governmental organizations and civic groups. Thus, of the 62 representatives of NGOs and civic groups in Brasov who participated in the survey conducted by ACSD in April3 2023, only 25% consider that they are familiar to a great or very great extent with the participatory budgeting mechanism and only 30% have participated in the participatory budgeting programs run by the Municipality of Brasov, either by submitting project proposals or by voting on the proposed projects.



Degree of familiarization/knowledge of the participatory budgeting mechanism among representatives of NGOs and civic groups in the Municipality of Brasov
Source: Center for a Sustainable Society Association, 2023

Overall, participatory budgeting in Romania faces numerous challenges, reflected in the inconsistent implementation and abandonment of programs by many county municipalities, as well as in low citizen participation and partial implementation of voted and selected projects. Although a significant number of cities have adopted local council resolutions to launch participatory budgeting programs, only a small proportion have actually managed to implement these programs. Often, even when programs are launched, they suffer from superficial preparation, lack of resources and limited community involvement, leading to disappointing results and subsequent abandonment of the initiative

Many local governments fail to implement projects selected by citizens' vote, deadlines are not respected and local public administrations do not communicate transparently about the reasons for the delay or suspension of project implementation. This lack of consistency and transparency erodes citizens' trust in the decision-making process and in the administration's ability to respond to community needs. Examples of cities that have abandoned programs after only a year or two, despite generous budgets or high initial interest, illustrate the difficulties and obstacles encountered in the sustainable implementation of participatory budgeting.

To overcome these obstacles, it is essential that local governments approach participatory budgeting with a serious and long-term commitment, actively involving the community at all stages of the process and ensuring transparency and accountability in the use of public funds. A strategic approach, with careful planning and effective communication, is crucial to transform participatory budgeting into an effective tool for local governance and civic engagement.

3.7.2 Development and implementation of civic crowdfunding tools

Civic crowdfunding is a method of raising funds from a large number of people, usually through online platforms, for projects of public interest.

It differs from traditional crowdfunding in that it targets projects for the benefit of local communities, whose aims may be social, cultural, scientific, educational, technological or environmental, initiated by citizens and civil society organizations. In implementing civic crowdfunding instruments, local public authorities can participate as matchfunders and curators of the projects proposed by the community, ensuring that the initiatives selected for implementation respond to local development needs and amplifying their impact.

A civic crowdfunding programme initiated by a local public authority starts with an open call to citizens and civil society organizations, inviting them to submit projects that respond to community needs. The public authority sets clear eligibility criteria, program objectives and funding limits, ensuring transparency and fairness in the process. The submitted projects are evaluated technically and qualitatively and the selected ones enter a crowdfunding campaign on a dedicated or partner platform.

During the campaign, the initiators mobilize the community to contribute financially and the public authority commits to co-fund projects that reach a certain funding threshold, thus validating their importance and relevance. In the end, the most relevant projects, supported by both the community and the local public administration, are implemented, creating a positive and sustainable impact in the community. This combination of public and private funding not only secures the necessary resources, but also validates the project in the eyes of the community, increasing the chances of success and creating a sense of shared ownership of the results.

The advantages of implementing civic crowdfunding programs have been documented in recent years also in Romania, in the reports published in 2023-2024 by the Center for a Sustainable Society Association (in the framework of the "Civic crowdfunding" project) and UEFISCDI (in the report "Civic crowdfunding: Alternative mechanism for financing social innovations", elaborated in the framework of the Consolid8 project). These benefits include, but are not limited to:

— Attracting additional resources to those allocated from the local budget allows the implementation of large-scale projects with a real impact on the community;
— Increased civic involvement, with citizens taking an active role in the decision-making mechanism by directly funding projects they resonate with;
— Increasing the visibility of innovative initiatives - citizens and organizations proposing projects will be directly interested in attracting resources to the project and will become active promoters of the projects and of the participatory funding mechanism in general;
— Bridging the gap between funding need and supply - by implementing civic crowdfunding programs, local public authorities will select and fund projects that resonate with the community;
— Greater traceability of the use of public funding - the entities that have proposed projects and the citizens who have financially supported their implementation will have a direct interest in following the state of implementation.

The case studies documented in the Consolid8 project[1] show that civic crowdfunding tools have already been successfully implemented in various European cities, validating the potential of these tools to transform the way local community projects are funded. For example, in London, through Crowdfunding London, local government has mobilized the community to support a wide range of initiatives, from street art to community gardens. In Rotterdam, the Luchtsingel pedestrian bridge was built as a result of a civic crowdfunding campaign, demonstrating the potential of this mechanism to transform urban spaces. In smaller cities, local governments can use existing online platforms - such as Goteo in Spain or Voor je Buurt in the Netherlands - to support cultural, social and life-enhancing projects in neighborhoods.

Some examples of civic crowdfunding campaigns in European cities are presented in the table below:

1

Funded under the Horizon Europe program, the Consolid8 project aimed at integrating social innovation actors from 15 European ecosystems through collaboration in the quadruple helix. Based on the challenges identified in five ecosystems with different levels of innovation performance (strong innovator - Ireland, moderate innovators - Italy, Greece, Slovenia, emerging innovator - Romania), the project developed five pilot programs for capacity development of social innovators. The lessons learned from the implementation of these programs have been capitalized through the development of a European accelerator, where 10 other social innovation ecosystems have been supported by applying a methodology already developed and validated by DEEP Ecosystems. The project also included the development of three crowdfunding campaigns for social innovators, research on an alternative funding program for social innovation for local public authorities and the testing and presentation of 12 social innovation models with potential for scaling up and replication. The project was implemented by the Development Consultancy Group SRL, in partnership with UEFISCDI, the City Hall of Brasov and organizations from five other European countries (Germany, Italy, Greece, Slovenia, Ireland, Italy, Greece and Slovenia).

Table 1
Examples of civic crowdfunding programs in cities

Source: European Crowdfunding Network (2018),
Comune di Milano (2023), Mayor of London (2016, 2020)

City, Country/Region	Name of the civic crowdfunding program	Short	Examples of funded projects
London, United Kingdom	Crowdfunding London 2014-2020	The program provided financial support for a variety of community-initiated projects: street art, community gardens, workshops, green infrastructure (parks and playgrounds). Nearly 20,000 Londoners got involved in the civic crowdfunding campaign, raising £4.85 million for 130 local projects, making it one of the largest initiatives of its kind in the world.	Peckham Coal Wanstead Playground People's Carnival More examples and case studies here.
London, United Kingdom	Make London 2021	It included crowdfunding campaigns for projects that helped local communities in London recover from the COVID-19 pandemic. 24 small-scale projects received funding support from local government totaling £110,714, while 15 more complex initiatives received funding totaling £355,500.	Cooking schools to facilitate local inclusion Craft projects tackling loneliness among the elderly Parks developed through a co-creation process with local communities
Milan, Italy	Civic Crowdfunding	The program is designed to support innovative projects of public interest with high social impact. The program funds initiatives that aim to promote social inclusion, sustainability and improved quality of life.	Creation and nature camps for children in Corvetto Music and entertainment programs for children with disabilities Neighborhood agro-ecological mini-farms for egg production More examples of funded projects here
South Tyrol Italy	Crowdfunding South Tyrol - Alto Adige	The program provides financial support for local businesses, start-ups and young entrepreneurs in South Tyrol. The program was developed and managed by a regional employers' association and co-funded by an ERDF project (CRAUT4SME).	Small organic farms Audio-visual productions Manufacturing workshops (wood accessories, furniture, lighting fixtures)
Utrecht, Kingdom of the Netherlands (The Netherlands)	Voor je Stadsie (for your city)	Voor je Stadsie ('For your city') supports initiatives that make Utrecht more beautiful, sustainable and citizen-friendly. The program receives financial support from the City of Utrecht and is run on the crowdfunding platform Voor je Buurt.	Green spaces in public schools Concerts and other social and cultural events Community gardens
Rotterdam, Kingdom of the Netherlands (The Netherlands)	I make Rotterdam	The crowdfunding campaign for the construction of the Luchtsingel pedestrian bridge was launched in 2012 by the Dutch architecture company ZUS, following a collaboration for the 5th International Architecture Biennale Rotterdam (IABR). As part of the campaign, citizens had the opportunity to 'buy' a wooden plank engraved with their name for €25; over 8,000 planks were sold and subsequently used to build the bridge. In 2012, "Luchtsingel" also received financial support from the local government, which allowed the project to continue and be completed.	The Luchtsingel Pedestrian Bridge - the project was awarded the Green Building Award in 2012, the Urban Intervention Award in 2013, the Rotterdam Architecture Award in 2014 and was nominated for the Golden Pyramid Award and the Building Award in 2015.
Barcelona, Spain	MatchImpulsa	MatchImpulsa is an innovative program designed to promote and develop social economy projects in Barcelona. The program aims to accelerate the digitization of the economy and facilitate the adaptation to gender perspectives and the implementation of gender equality measures in the local business environment.	Digital platforms for projects promoting feminist causes Collaborative social networks for initiatives contributing to sustainability Desfake: educational platform against misinformation The list of funded projects is available here.

PHOTO: The Luchtsingel Bridge in Rotterdam, built as a result of the I make Rotterdam civic crowdfunding campaign
Credit: Door Peter Dorsman, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=56584360

In spite of the success of civic crowdfunding programs in various European cities, the analysis conducted by the Consolid8 team revealed that, so far, there are no civic crowdfunding programs managed by local public authorities in Romania. At present, the instruments through which local governments in Romania support community projects are limited to grant-funding and participatory budgeting programs - although such programs are currently being run in several county cities - they face significant limitations in terms of administrative capacity, transparency and community involvement.

The results of the research conducted within the Consolid8 project (which included interviews with representatives of local public authorities and civil society organizations in three Romanian cities) point to a number of challenges in the development and implementation of civic crowdfunding programs in Romania. First, the lack of a clear legal framework at national level creates reluctance among local governments, which are afraid to use a funding tool that is not fully understood and regulated. Secondly, limited administrative capacity makes it difficult to allocate resources (financial and personnel) to launch and support civic crowdfunding programs. Interviews with local government representatives also revealed a certain risk aversion and reluctance to adopt new tools, as well as difficulties in engaging citizens and promoting campaigns.

However, civic crowdfunding represents a valuable opportunity for local governments in Romania to diversify funding sources, stimulate citizen involvement and promote social innovation. Although the implementation of this mechanism faces challenges related to the legal framework, administrative capacity and risk aversion, the potential benefits are significant. By adopting strategies tailored to the local context, working with specialized platforms and actively involving the community, public administrations can transform civic crowdfunding into an effective tool for participatory governance. Success stories from other European cities demonstrate that civic crowdfunding can finance diverse and innovative projects that improve quality of life, enhance the urban landscape and strengthen social cohesion.

3.7.3 Principles and recommendations for developing public policies supporting participatory governance

Open ex officio
It is a founding principle of open governance. Data and information held by authorities should be publicly accessible unless there are legitimate reasons for confidentiality, such as privacy concerns, national security or legal constraints.

Transparency and community involvement is done with purpose
Defining the purpose and some objectives helps to shape the community engagement strategy and concrete action plan, i.e. how to publish open data, how to access it, how to aggregate it, etc.

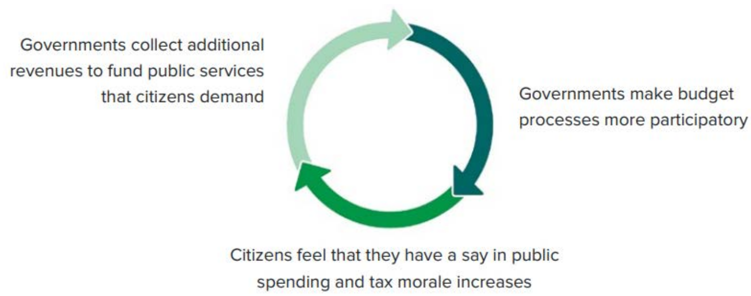
Transparency of interests
It is recommended to register in the Single Register of Transparency of Interests (RUTI) the decision-makers and specialized groups that promote, respectively the meetings between them to promote public policy initiatives.

Financial and fiscal transparency
Transparent financial management (participatory budgeting) and transparent public procurement discourage corruption and allow citizens to follow the money to ensure that public funds are spent efficiently and in ways that benefit the community as a whole.

Community monitoring can reduce the leakage of public funds and the expectation of an annual audit reduces corruption. Participatory budgeting is also associated with higher government revenues, increases "fiscal morality" and creates a virtuous cycle

Participatory budgeting prioritizes the allocation of funds to the pressing challenges of the community (increasing security, reducing child mortality, etc.).

In terms of public debt, governments that are more transparent are perceived as less corrupt, have more effective public policies, have higher creditworthiness, can benefit from lower interest rates and generally lower borrowing costs. Lack of debt transparency contributes to public dissatisfaction with government and slow economic growth. Debt transparency can help local governments sustain their debt and encourage domestic and foreign investment.



The virtuous circle of participatory budgeting
Source: The Skeptic's Guide to Open Government 2022, Open Government Partnership

Public administrations make budgeting processes more participatory

Citizens feel that their opinion counts in the spending of public money and increases accountability for paying taxes

Administrations collect extra revenue to fund public services that citizens demand

Transparency in procurement and services

has a number of benefits:

— Cost savings and speeding up the procurement process;
— Increase competition and reduce prices offered;
— Better value for money;
— Reducing corruption by cross-referencing data, linking data from different contexts that reveal conflicts of interest and deterring corruption;
— Social inclusion through inclusive procurement, supplier diversification programs, or by identifying inequality gaps in procurement.

Civil society audits raise awareness of available public services (educational, social, health, etc.) and can improve health, education and quality of life outcomes, help to understand gaps and address problems, including providers and services, promote collaborative working environments and increase trust through direct involvement of participants.

Transparency of algorithms

Administrations are increasingly using algorithmic decision making (ADM) to support public decision making in sensitive areas such as public procurement, grants, social benefits or justice. The complexity of algorithms can range from sets of criteria and associated scores to interactive AI systems, often streamlining public services involving bureaucratic processes.

The risks of discrimination and (de)favoritism are significant, and in order to reduce them and ensure fairer decisions, algorithms need to be made transparent. The level of public trust increases accordingly.

It is recommended to introduce a Register of Algorithms, which spells out all algorithm tools, their purpose and intended benefits, principles and functionality, target audience, responsibilities, traceability, datasets and how to process them, human oversight, risks, rationale for decisions and references to related documents.

Useful resources are:

— General Data Protection Regulations (GDPR)
— National legislation on openness of information on administrative activity
— EU Commission High Level Expert Group on Artificial Intelligence:
  — *Ethics Guidelines for Trustworthy AI*
  — *Assessment List for Trustworthy AI (ALTAI)*
— Council of Europe report - Unboxing *Artificial Intelligence: 10 Steps to Protect Human Rights*

Digitization of public administration

Coherent, comprehensive digitization of the administration means:

— Digital transformation of internal data, processes and procedures, not just digitization of old procedures;
— Integrating databases with those of other institutions for data aggregation and maximizing their use to streamline work;
— Ppenness of data (including data integrated with other institutions) with differentiated access rights for professional information and input, general public, etc.;
— Digitizing the relationship with citizens through public service portals, quick-referral apps, interactive maps and community engagement platforms for local projects.

UX Design

The lived experience of community members is invaluable for identifying problems that need to be solved, for formulating alternative solutions and for adopting new spaces, services, technologies and behaviors.

The Ux, or user experience, of the platform for public services and/or open data is designed and tuned so that access, use and interpretation are as simple, intuitive, even enjoyable as possible. The experience will be designed (UxDesign) according to the likely purposes and uses, differentiated by user categories.

The experience of participating in a community engagement process starts with the first news that the citizen receives and ends with the final feedback message at the end of the process, informing them about the results of the process and how they will influence the ongoing project and perhaps future policies and strategies. This experience also needs to be carefully planned, monitored and evaluated, respectively optimized.

Creating spaces for assembly and free speech

The expression of opinions has migrated in recent years from the public space of the locality to cyberspace, especially in social media and on the couch. From behind the screen, opinions are spewed without accountability, the algorithms of social media platforms promote negative and outrageous posts, and tend to isolate us in bubbles of similar opinions and attitudes, polarizing society.

Bringing urban dialogue back into the public space would be a gesture of renaturalization, whereby neighbors, people of different ages, cultures and abilities can meet, get to know and listen to each other in order to identify common interests and lay the foundations for dialogue and collaboration in the common interest.

Less civic space means that people with less power are left powerless, leading to greater inequality.

Consistent, relevant and inclusive community involvement

It is recommended to involve the community at a collaborative and co-creative level in as many projects as possible.

Ensure that the medium- and long-term consequences of alternative solutions are explained in a simple, clear, complete and balanced way, including benefits, risks, costs, time and other criteria relevant to the project.

Organize the engagement process in a way that makes it easy for participants to understand the topics under discussion and make informed choices. The purpose, communication materials and activities are linked to the profile of the target audience.

Ensuring the representativeness of the community, in all its diversity and complexity, even with an emphasis on giving priority to the voices of minorities or the generally marginalized.

Creating support structures for community development

Any thriving innovation ecosystem prioritizes early-stage investments, which is lacking in Romania. More local funding for the conceptual (pre-seed) stage and the development of the business model, a minimum viable product or service and market entry (seed) are essential for a healthy ecosystem.

Local communities need support from local governments to develop initiatives and increase the chances that they will be sustainable. Among the most needed resources that government can provide free of charge or subsidized are:

— Meeting **spaces** for dialogue, for organizing events, for day-to-day work - coworking, for storing equipment and props, etc.
— **Furniture and equipment** for office work and events;
— **Information resources** through physical and virtual public libraries, learning centers;
— Counseling, mentoring and leadership **programs**, civic, entrepreneurship and volunteering education, access to external educational platforms;

- **Open data**, possibly participatory;
- **Digital platforms** for virtual meeting spaces, cloud storage, online collaboration tools, graphic and video design software, CRM for volunteer, donor and supporter management, etc.

Each community will have specific pressing needs, which will evolve over time and will need to be related to the resources available to the respective government and other urban actors.

Developing partnerships for mindset change campaigns

Desirable attitudes and behaviors to accelerate the transition to climate neutrality are common to many communities. Campaigns aimed at changing mindsets can be very complex and lengthy processes, with many stakeholders involved, each with their own interests and mechanisms for raising awareness and sensitization.

It is very useful to join international initiatives relevant to the problem you are facing in order to benefit from exchanges of experience. Also, generating regional partnerships to develop and roll out these campaigns in larger communities creates the preconditions for accelerating changes in mindset, reaching the critical mass needed for a significant community-wide impact more quickly.

Taking role modeling by your own example

Formal or informal community leaders are behavioral benchmarks for others, who, consciously or unconsciously, take on their attitudes and behaviors.

A change in behaviour demanded from citizens will have a much faster and more consistent effect if it is first and foremost manifested by community leaders and the organizations they lead. That is why public investments should set high standards, be examples of good practice for their communities and beyond.

The legislation imposes a minimum.
Prosperity needs more.

Useful resources

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Mirror Mission Cities Hub Romania

Possible Cities

Integrated toolkit
for climate neutrality

Good practice examples

Mădălina Butnaru
Cezara Matei
Alexandra Mocioiu
Alexandru Roșu

Glossary of terms

Biographies

Good practice examples

Mădălina Butnaru
Cezara Matei
Alexandra Mocioiu
Alexandru Roșu

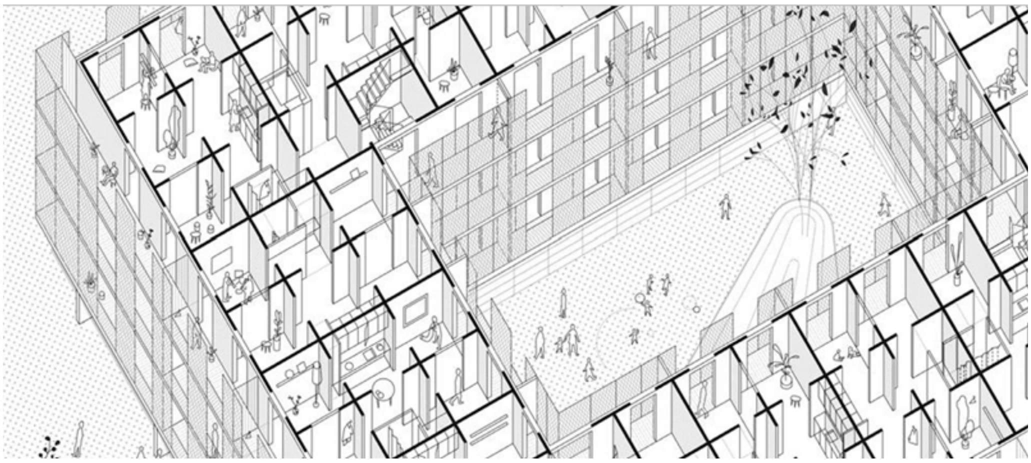
Cornellá del Llobregat
Barcelona, Spain

Procurement procedure	Public commission
Investor	Public funding
Cost	£9,304,049.42 (950 €/m²)
Year of inauguration	2021
Built surface	2.137 m²
Public engagement	None

Architecture	Peris+Toral Arquitectes
Engineering	Jaume Pastor
Structural engineering	Manel Fernández, Meri Blanco
Environmental	Albert Sagrera, Luca Volpi
Landscape	AB Pasatgistes

Modulus matrix: 85 Social Housing Units in Cornellà

Photography:
Jose Hevia
© Peris+Toral



Drawing:
© Peris+Toral

Built Space

Project Description

The essence of the project lies in an excellent management of space, in favor of material savings and a sustainable execution process. The configuration of the apartments is based on a matrix of equal, non-hierarchical rooms, which are combined in sequences of 13 m^2 spaces with different functions, but linked by an uninterrupted path. The result is a project with a well-argued social housing policy: it eliminates corridors, offers flexibility in the way space is inhabited, minimizes construction waste and adheres to a strict budget according to social housing standards.

The choice of wood as the main structural material also shortens construction time by using prefabricated elements and significantly reduces carbon emissions. Thus, the building allows a circular approach where disassembly and potential reuse of materials remains a possibility.[1]

Mobility and Public Space

Although participatory design was not a feasible option due to a still unformed community of residents, the design considers the composition of a public space dedicated to them. The inner courtyard becomes this space, at the boundary between the street and the individual unit, which integrates a gradient of privacy between common and private spaces. In this case, access to housing through terraces sets up a fluid transition between these zones, where the doorways act more like filters than barriers. Connecting the terrace to two modules allows double access, providing flexibility of use and long-term adaptability. The layout thus stimulates interaction between residents and reinforces a sense of community.[2]

Green Infrastructure

The project integrates new green spaces by turning the inner courtyard into a small garden for residents. This place filters the air, improves the thermal comfort of the development, and increases urban biodiversity. The facade shading system, also made of biodegradable materials, solves the issue of reducing indoor temperatures. Although the possibility of expanding green space is not at the top of the priority list, green infrastructure is adequately addressed and contextualized.

Energy and Resources

The architectural solution adopts passive energy strategies to optimize natural light and air ventilation. The suitable orientation of the facades, the integration of shading devices, and the predominant use of natural materials reduce the need for artificial heating and cooling. The choice of wood as the main load-bearing material commits to renewable resources and energy performance, with reduced carbon emissions and a significant reduction in embodied energy.[3]

1

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2

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3

Idem

Millennium Park 20, Lustenau, Austria

Procurement procedure	Direct commission
Investor	Private investment
Cost	1200€/m²
Year of inauguration	2013
Total surface	4037 m²
Floor surface	543 m²
Usable surface	2421 m²

Architecture	Baumschlager Eberle
Author	Dietmar Eberle
Project architect	J. Stoppel
Structural engineering	Ernst Mader, Markus Flatz
Energy optimization	Lars Junghans

2226 Lustenau

Photography:
© Eduard Hueber |
© 2226

Photography:
© Baumschlager Eberle

Built Space

Project Description

The 2226 method makes a pioneering contribution to the architectural questions of energy efficiency. The Lustenau Haus 2226 does not require heating, ventilation or cooling. Heating is provided by the waste heat from the people present, the technical systems and the lighting. In addition, sensor-controlled ventilation flaps regulate the temperature and the CO2 content and thus ensure a globally accepted comfortable temperature of between 22 and 26 degrees Celsius. A key feature is the low U-value of the building envelope. This means that the heat or cold outside has little influence on the temperature inside. The compact structure acts as an insulating and storage mass and keeps the cool in summer and the heat in winter inside in an energy-efficient manner. The envelope has a cavity wall structure with each wall consisting of 36-centimetre bricks. The inner layer of this interconnected shell ensures high compressive strength while the outer layer guarantees efficient insulation.[1]

Contrary to the belief, it is not a typical office building, but a mixed-use typology. In the early stages of designing the building it was quite important to make the building as flexible as can be. Now there are offices,a gym, a plastic surgeon, a yoga studio and an apartment in the Haus 2226.

Energy and Resources

The cooling required in the building is not produced but stored. On cool summer nights, the window flaps are opened and the thermal mass of the building cools down from the inside and outside. The thick walls release the cold back into the room air during the day and keep the room temperature below 26°C. The windows are designed and positioned in such a way that they do not allow direct sunlight in the summer, but still allow enough sunlight to reach the interior. The principle of mass deceleration also has a positive effect on the interior temperature in winter. Since the nights in winter are not suitable for heat compensation, the interior climate is dependent on heat sources. Thanks to strong insulation, the low outside temperatures can be compensated by the people, machines and light sources in the building. At an outside temperature of -5°C, only 8 watts/m^2 are needed to heat the interior to a comfortable temperature above 22°C. A person constantly radiates 75 - 80 watts, a computer workstation 230 watts and an artificial light source 12 -14 watts. As a result, the target minimum temperature of 22°C is never undercut and also works with energy-efficient devices that are intended according to the SIA target value.[2]

Green Infrastructure

The surrounding landscape is carefully designed to support a sustainable green environment. Trees are strategically positioned to provide optimal shading based on the building's sun exposure, helping to regulate indoor temperatures. This green infrastructure plays a key role in reducing energy consumption by minimizing heat absorption and enhancing natural cooling. By integrating vegetation into the design, the system contributes to a more efficient and environmentally responsible approach to thermal management.

1

Baumschlager Eberle, „22–26 Lustenau," accessed February 15, 2025, https://www.baumschlager-eberle.com/werk/projekte/projekt/2226/.

2

Idem

Donaustadt, Vienna, Austria

Procurement procedure	Design competition / Direct commission
Investor	Public-private partnership (PPP)
Cost	Around 6.000.000.000 € (6 bn EUR)
Year of inauguration	2010 - Ongoing
Built surface	2.400.000 m² (240 ha) of which Public/ green surface: 1.200.000 m² (120 ha) m²
Public engagement	Community consultation

Masterplan	Tovatt Architects & Planners
Public space	Gehl Architects

Aspern Seestadt

Photography:
© Aspern Seestadt

Photography:
© Aspern Seestadt

Urban Development

Project Description

In the landscape of Austria's economic rise at the turn of the century, Aspern Seestadt was an answer to the exponential demand for housing in Vienna. The underlying philosophy of this urban initiative, defined in 2004 and implemented since 2010, is based on an extensive partnership between public institutions and the private sector. In this context, Aspern Seestadt has developed symmetrically, responding simultaneously to both the demands for quality private housing and the need to maintain high standards for community spaces.[1]

Energy and Resources

The first defining intervention for the sustainable development of Aspern Seestadt was the excavation of 600,000 tons of earth in the centre of the neighbourhood area, which was later transformed into an artificial lake and beach. The excavated soil was then processed locally, used to produce materials and construct new housing. With the same intention, the airfield runways, which had previously occupied this area, were demolished and the resulting concrete was recycled and reintegrated into the road infrastructure, contributing significantly to the reduction of CO_2 emissions in the construction process, estimated at 8,400 tons by 2024.[2]

In terms of construction, the architecture of Seestadt's social housing estates is driven by rigorous efficiency and sustainability criteria. The standards imposed on developers have been steadily increasing, reaching today (2025) a mandatory 800 points on the Total Quality Building (TQB) scale. Projects therefore include advanced renewable energy solutions and focus on optimizing all resources. Examples of architectural innovation include HoHo Wien, an 84-metre high, predominantly timber-framed building housing private apartments, hotel rooms, a restaurant and offices, integrating into its identity the public-private dialogue that has been at the base of the whole development.[3]

Mobility and Public Space

From the early stages of planning, the project has been based on the integration of two metro stations (U2), multiple bus lines and the extension of tram lines, with the aim of reducing reliance on private cars to just 20%. As a result, the success of the implemented mobility strategies has led to a balanced regime between walking, cycling (40%) and public transport (40%). Green corridors and pedestrian infrastructure have thus made a major contribution to the quality of the urban environment, with Aspern Seestadt being a district with a particularly low car ownership rate of only 242 cars per 1,000 inhabitants.

Green Infrastructure

Green infrastructure dominates almost half of Aspern Seestadt, consisting of the 5-hectare lake in the centre of the district, a system of public squares and community gardens. An important aspect concerning green space maintenance is the planning of stormwater management strategies. These follows the "Sponge City" principle, which is based on redistributing rainwater, reducing pressure on drains and ensuring water availability in times of drought. To optimize drainage and tree irrigation, a double infiltration model has been implemented. Thus, almost 50% of the area is given over to green spaces, therefore, the Yella-Hertzka and Madame-d'Ora parks providing residents with plenty of socializing areas.[4]

1

aspern Seestadt. EN_Factsheet_November_2024. Vienna: Wien 3420 aspern Development AG, 2024.

2

Idem.

3

„Vienna: Aspern & Nordbahnhof," We Are Municipal, accessed February 10, 2025

4

Sweco, „Seestadt Aspern," accessed February 10, 2025, https://www.sweco.se/projekt/seestadt-aspern/.

Barcelona, Spain

Procurement procedure	Design competitions & Direct commissions
Investor	Public funding
Cost	95.000.000 € (95 mil. EUR)
Year of inauguration	2023
Total surface	2.000.000 m²
Public engagement	Participation of all stakeholders and the general public

Architecture	Urban Ecology Agency of Barcelona
Concept	Salvador Rueda

Barcelona's Superblocks

Photography:
© Martí Petit
© Ajuntament de Barcelona

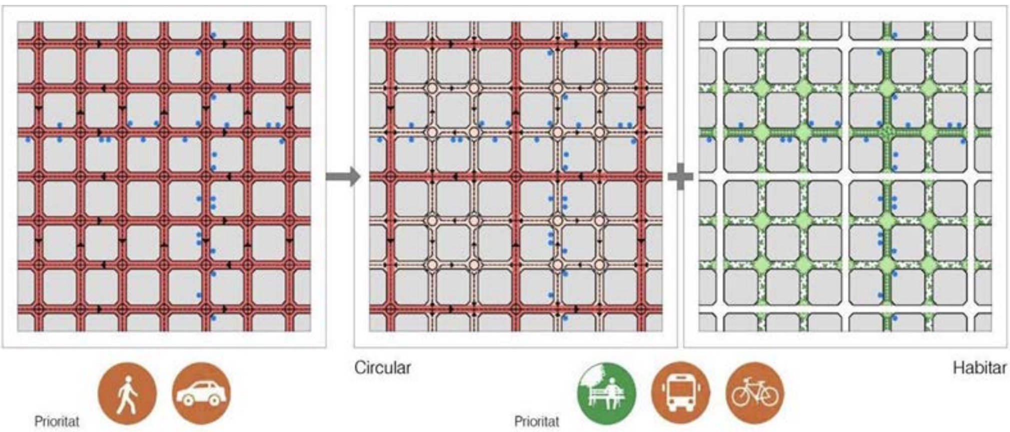


Diagram:
© Ajuntament de Barcelona

Urban Development

Project Description

It is well known that the urban form of the central area of Barcelona is shaped by the Cerdà Plan. Less well known is that it also envisaged generous, more airy public spaces with a more domestic character. Unfortunately, this part of his vision has not been fully realized.[1] The beginning of the 21st century finds Barcelona as a city characterized by gentrification, with a future oriented towards tourism, affected by a speculative urban economy and exposed to the challenges of climate change.

The "superblock" concept (*superilla* in Spanish) is based on a 3x3 block format in the Cerdà grid, in which road space is eliminated and replaced with urban functions and activities such as playgrounds, green spaces, services, commerce and more. Streets are remodeled as public space, which reduces car traffic. This philosophy calls for the design of cities that prioritize care, health and social well-being over traditional models based on individual use of personal cars. The concept is, in fact, a global solution to many of the problems of big cities: climate change, mobility, lack of green spaces and urban living.

Mobility and Public Space

Urban change starts with mobility: limiting the privileges of the private vehicle allows public spaces to be reconfigured for play, sport, culture and leisure. The Superblock model brings citizens closer to the city, improving quality of life and green spaces. Its implementation reduces car traffic by 21% and thus enhances public transport, bicycle paths and pedestrian spaces for sustainable accessibility.

The concept opens up the possibility for public spaces to be used for other purposes: children and teenagers can play, play sports, engage in cultural or financial exchanges, expressive actions or protests, the streets become a space for convergence between several generations of people and groups. The aim is to restore people's status as citizens, now reduced to pedestrians, and to encourage local residents to reclaim their public spaces by improving the quality of their housing and greening the streets.[2]

Green Infrastructure

The project addresses issues such as urban heat islands and water management while improving urban resilience. The strategy includes transforming streets into areas that are not only pedestrian-friendly but also rich in vegetation. This is achieved by planting large areas, creating green corridors and replacing typical impervious surfaces with materials that have a low thermal impact.

Key interventions include the use of natural materials such as granite and natural stone in place of high-emitting materials, and the design of paving systems that facilitate efficient water management through permeable surfaces. These measures contribute to climate change mitigation by reducing heat absorption and improving stormwater management.[3]

1

Commission for Ecology, Urban Planning and Mobility, „LET'S FILL STREETS WITH LIFE Establishing Superblocks in Barcelona", Ajuntament de Barcelona, May 2016

2

Idem.

3

Sanz, Janet. Superilla Barcelona: Urbanisme Ecofeminista per un Futur Millor. Barcelona: Ajuntament de Barcelona, 2023.

Van Brienenoord 5, 3077 AE
Rotterdam, Netherlands

Procurement procedure	Direct commission
Investor	Public-private partnership (PPP)
Cost	450 000 €
Year of inauguration	2020
Built surface	287 m²
Public engagement	Participatory design

Architecture	Superuse Studios
Structural engineering	IMd Raadgevende Ingenieurs

Buitenplaats Brienenoord

Photography:
© Riccardo de Vecchi

Desen:
© Superuse Studios

Reuse & Circular Economy

Project Description

The Buitenplaats Brienenoord (Brienenoord Shelter) is a pavilion that stands out by being made of 90% reused materials, recovered from the previous construction on the same site. Completed in January 2019, the space is used for various social, cultural, culinary, artistic and educational activities.[1]

Mobility and Public Space

The project is located on a small island in the Nieuwe Maas River, accessible via a bridge that can carry a maximum load of 15 tons. This significantly influenced the solution, limiting the transportation of heavy materials and encouraging the use of available resources.

The resulting space has a versatile character, giving users the opportunity to actively contribute to defining its function by hosting workshops, theatre performances, coworking activities and even gastronomic events.[2]

Green Infrastructure

The Buitenplaats Brienenoord project incorporates a green roof that helps to naturally insulate the space, reduce water run-off and support biodiversity. Located in a nature reserve (Brienenoord Island), this also helps to ensure a harmonious balance between the built environment and the surroundings.[3]

Energy and Resources

Buitenplaats Brienenoord is an example of circular architecture. It achieves a material reuse rate of 90% thus significantly reducing its environmental impact.

The building's structure is largely made of materials recovered from the former construction. By reusing them, the new development minimizes waste and reduces environmental impact. For example, elements such as the old roof trusses have been integrated into the new design, and the original foundation has been reinforced so that it can be reused. Only the fasteners, five wooden beams, the post supports and the window panes on the south side are new.

Translucent panels provide uniform illumination of interior spaces. The image created by the interaction of the trusses, window frames and roof panels reflected the designers' careful use of recycled materials, making them stand out.

The final solution was shaped through participatory design sessions in which stakeholder contributions were synthesized and integrated into the final design. The construction process was carried out with the support of volunteers and people with limited access to the labour market, thus reinforcing the social dimension of the project.

In collaboration with Superuse Studios, Buitenplaats Brienenoord adopts a philosophy based on utilizing available resources and highlighting them in a creative way. Instead of large-scale interventions, small but significant changes help to create dynamic and functional spaces. The result has both a minimal environmental footprint and a high social impact.[4]

1 Superuse Studios, *Buitenplaats Brienenoord project documentation*

2 Superuse Studios, *Buitenplaats Brienenoord project documentation*

3 Superuse Studios, *Buitenplaats Brienenoord project documentation*

4 Superuse Studios, *Buitenplaats Brienenoord project documentation*

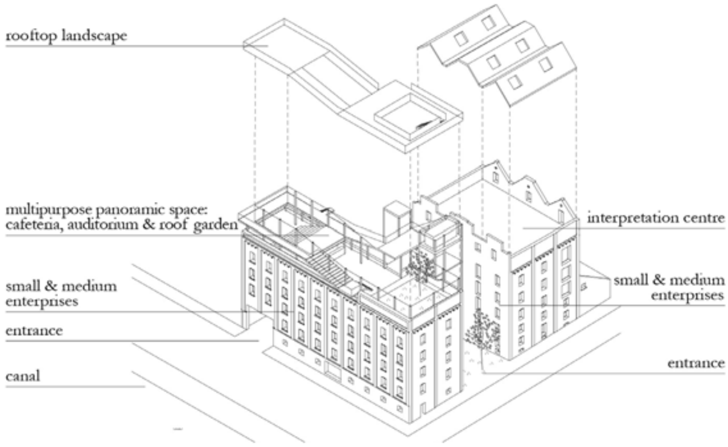
Quai F. Demets 23, 1070
Anderlecht, Brussels, Belgium

Procurement procedure	Design competition
Investor	Private funding
Cost	€ 6.400.000 excl. VAT and fees
Year of inauguration	2016
Built surface	5.099 m²
Public engagement	Community consultation

Architecture	BOGDAN & VAN BROECK
Structural engineering	NEY & partners
Scenography	Håkan Harrysson - Svensk Idé
Cultural expert	Hendrik Vanmolkot
Techniques	CES

COOP

Photography:
© Laurian Ghinițoiu, Luca Beel | © BOGDAN & VAN BROECK



© BOGDAN & VAN BROECK

Conversion, Restoration & Built

Project Description

COOP is the rehabilitation and conversion project of a former industrial mill on the banks of the Brussels-Charleroi canal in the Anderlecht district into a multifunctional space for entrepreneurial development and local community interaction. The building now houses an incubator for small and medium-sized enterprises, an interpretation centre and a creative space, as well as a workshop specializing in the design and construction of boats and barges for water transport, combining the practice of traditional techniques with technological innovation. In addition, the centre includes an exhibition space dedicated to the evolution of local heritage, a media library and community spaces to support diversified educational programs.[1]

Energy and Resources

The architects proposed to reconfigure the two monument buildings into two open and functionally flexible structures. Between them, a light structure was inserted to house secondary functions such as vertical circulation, technical spaces and service areas, functionally freeing the two "containers" for varied uses.

At the ground floor level, conceived in an open plan without partitions, the reception and administrative offices become a space of direct connection with the public space. This innovative principle of rehabilitation, utilized as a part of a larger urban strategy, allows for the permanent adaptability of the space. Consequently, the process of 'recycling' the mill gives a new life to industrial heritage, functioning as a regenerable resource, continuously adapting to the specific spatial and social needs of the neighbourhood. By this, the architects have not considered these buildings as fixed structures, but as evolving projects, capable of adapting to socio-economic changes and new community needs.[2]

Mobility and Public Space

The project manifests itself at multiple scales of intervention, connecting the neighbourhood urbanistically with the entire city. The ground-floor spaces are designed to encourage community interaction, hosting publicly accessible reception and administration areas. Above, the panoramic terrace becomes an urban focal point, bringing together a restaurant, green gardens and platforms open to the canal landscape. The dynamics of the site are not rigid but evolving as the spaces can be reinterpreted over time, responding to new demands. This fluid vision supports both cultural regeneration and the principles of sustainability, transforming the project into an urban organism capable of continuous adaptation.[3]

1

Bogdan & Van Broeck, „COOP Anderlecht, BE," accessed February 10, 2025, https://www.bogdan.design/projects/coop-anderlecht-be/

2

Bogdan & Van Broeck, „COOP Anderlecht, BE," accessed February 10, 2025, https://www.bogdan.design/projects/coop-anderlecht-be/

3

Bogdan & Van Broeck, „Do Not Rebuild If You Don't Have To: COOP – Reconversion of an Old Mill," Zeppelin, accessed February 10, 2025, https://e-zeppelin.ro/en/do-not-rebuild-if-you-dont-have-to-bogdan-van-broeck-coop-reconversion-of-an-old-mill/

503 Av. des Bancs de Flandres,
59140 Dunkerque, France

Procurement procedure	Design competition
Investor	Public funding
Cost	12 mil €
Year of inauguration	2015
Built surface	11 129 m² (9.157 m2 new building + 1.972 m2 existent)
Public engagement	–

Architecture	Anne Lacaton & Jean Philippe Vassal with Florian de Pous chief project, Camille Gravellier construction supervision, Yuko Ohashi ;
Structural engineering	Secotrap (structure, mechanical systems), Cesma (metal structure)
Sustainability	Cardonnel (thermal studies);

FRAC Nord-Pas de Calais

Photography:
© Alexandra Mocioiu

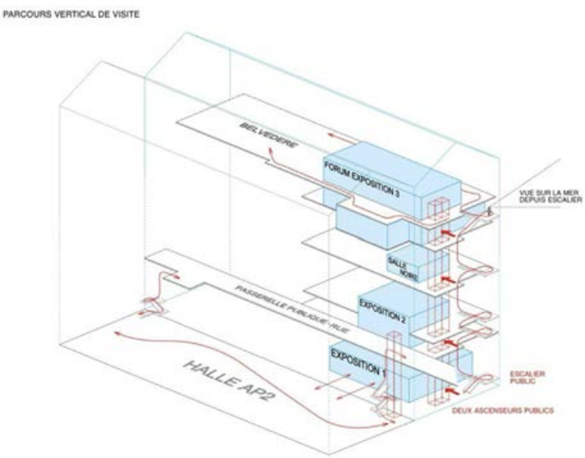


Diagram / Drawing:
Lacaton & Vassal

Restoration and Conversion

Project Description

FRAC Nord-Pas de Calais is a model of adaptive reuse, contributing to the enhancement of industrial heritage. The intervention involved the restoration and extension of a former naval warehouse, known as Hall AP2, located in the port area of Dunkerque, France.

"Hall AP2 is a singular and symbolic object. Its volume is immense, bright and impressive, and its potential for use is exceptional".[1] Its extension includes the addition of a building of the same size and geometry as the existing hall, designed in such a way so that it does not detract from its architectural qualities. The new volume integrates both innovative architectural solutions and flexible building systems. Together, the spaces house the FRAC (Fond Régional d'Art Contemporain) contemporary art center, providing a creative environment for its artists and the community as well.[2]

Energy and Resources

Combining innovative design with effective adaptive reuse strategies, the FRAC Nord-Pas de Calais project is an example of energy and resource management.

First of all, preserving the existing warehouse had a positive environmental impact, significantly reducing the negative effects associated with the construction of a new building. This decision limited the generation of waste and contributed to the conservation and enhancement of a valuable industrial structure.

Although it reproduces the existing volume, the extension can easily be distinguished from the former warehouse. It is clad in a translucent envelope which, in addition to achieving a special visual effect, has the role of providing natural light, thus reducing the need for artificial lighting. It also helps with passive solar heating, increasing indoor thermal comfort.

Prefabricated elements were used to create the new structure. In this way, the construction process is optimized and the consumption of materials is reduced.

Thanks to its modular composition, the space obtained is functionally versatile, and can be reconfigured for various uses. This aspect offers adaptability without the need for major modifications, extending the life cycle of the building.

By restoring, converting and expanding Hall AP2, the project manages to capitalize on existing resources, generating a flexible space for exhibitions and events. This type of intervention reflects an example of a sustainable approach, managing to combine architectural innovation with responsible energy and resource management without significant costs.[3]

1 Lacaton & Vassal 'projects' accessed February 9, 2025, https://www.lacatonvassal.com/index.php?idp=61

2 Lacaton & Vassal 'projects' accessed February 9, 2025, https://www.lacatonvassal.com/index.php?idp=61

3 Lacaton & Vassal 'projects' accessed February 9, 2025, https://www.lacatonvassal.com/index.php?idp=61

Rue Picard 11, 1000 Brussels, Belgium

Procurement procedure	Design competition
Investor	Public-private partnership (PPP)
Cost	Over 100.000.000 €
Year of inauguration	2020
Built surface	62.500 m² of which 45.000 m² new built Green surface: 17.000 m² solar panels
Public engagement	–

Architecture	Neutelings Riedijk Architects + Bureau Bouwtechniek (architectural engineering) + Jan de Moffarts (restoration)
Structural engineering	Ney & Partners
Sustainability	Boydens engineering part of SWECO
Landscape	OMGEVING
Artist	Henri Jacobs

Gare Maritime

Photography: © Filip Dujardin | © Neutelings Riedijk Architects

Photography: © Filip Dujardin | © Neutelings Riedijk Architects

Conversion, Restoration & Build

Project Description

Gare Maritime is an exercise in the restoration and functional conversion of one of Europe's most impressive industrial heritage buildings, defining a model for integrating a historic structure into a contemporary strategy of sustainability at all scales. Described by Neutelings Riedijk Architects as "a city where it never rains", the Gare Maritime has all the attributes of a public space, housing under the metal structure a complex mix of boulevards, squares, green spaces and shopping centres; a major urban node of the region.[1]

Mobility and Public Space

The mobility strategy of the new complex of squares and inner streets is integrated into the unitary logic of the Tour & Taxis urban development, which foresees the construction and conversion of a large area around Gare Maritime into a housing neighbourhood. As a result, the project assumes the role of an urban centre of the city, connected to different areas of Brussels by multiple public transport routes and bicycle paths, minimizing dependence on private cars and reducing the need for parking spaces per residence.[2]

Inspired by the urban configuration of Barcelona's Ramblas boulevard, the composition of the new Gare Maritime complex is aligned with long interior boulevards, with alleys up to 16 meters wide and a considerable area of vegetated fields. These boulevards are accentuated by a number of 100 tall trees and variations of themed gardens (groups of shrubs, solitary plants, organic planting schemes or linear planting schemes, etc.) The themed gardens are designed to provide a diversified urban landscape and optimize the microclimate.

Energy and Resources

In terms of energy performance, Gare Maritime is completely climate neutral, integrating a range of renewable energy, energy efficiency and circular economy strategies without sacrificing the architectural quality or historic value of the building. The new pavilions built along the interior boulevards are one of the most ambitious CLT (cross-laminated timber) projects in Europe, which have significantly reduced the amount of cement required for construction and therefore the CO_2 footprint during this time.[3]

In addition, an innovative geothermal system extracts heat from the ground through several 150-meter-deep wells. On the roof, a surface of 17,000 m^2 of solar panels helps generate the necessary electricity for the functioning of the heritage building, while glazed facades and passive ventilation systems optimize energy consumption. Rainwater is collected and reused for irrigation and toilet systems while public space is naturally ventilated which finally helps to regulate indoor temperature, creating a constant and comfortable climate.

1

Tour & Taxis, „Home," accessed February 6, 2025, https://tour-taxis.com.

2

Neutelings Riedijk Architects, and Plus Bureau Bouwtechniek, „Gare Maritime Offices," *ArchDaily*, April 27, 2020, https://www.archdaily.com/949630/gare-maritime-offices-neutelings-riedijk-architects-plus-bureau-bouwtechniek.

3

Neutelings Riedijk Architects, and Plus Bureau Bouwtechniek, „Gare Maritime Offices," *ArchDaily*, April 27, 2020, https://www.archdaily.com/949630/gare-maritime-offices-neutelings-riedijk-architects-plus-bureau-bouwtechniek.

Gudrunsvej 32, 8220 Brabrand, Denmark

Procurement procedure	Design competition
Investor	Public-private partnership (PPP)
Cost	13,340,000 €
Year of inauguration	2020
Green surface	230.000 m²
Public engagement	Community consultation / Participatory design

Architecture	SLA, EFFEKT Architects, COWI A/S,Boris Brormand Jensen
Landscape	EFFEKT Architects

Gellerup City Park

Photography: © Rasmus Hjortshøj

Photography: © Rasmus Hjortshøj

Project Description

The project managed to transform the area from a socially challenged neighbourhood into an attractive and referencial part of Aarhus. The greenery in Gellerup plays a pivotal part in the development of the area as an attractive outdoor space for the locals. Through anthropological and biological studies, the social and biotic growth and development of Gellerup was continuously monitored to make it a thriving social neighborhood.

The activity park introduces a human scale between the large apartment blocks and creates an open arena for social gathering between the many residents, both in the surrounding apartments and in the city of Aarhus. The activity park holds community gardens, playgrounds, sports and cultural facilities.[1]

Mobility and Public Space

The main goal was to use biodiversity to increase the quality of the locals, improve the feeling of engaged community, encourage social cohesion and to contribute to the area's efforts to become more green. The design process of the park was developed in three stages: 1) The citizens were consulted regarding the programs that would suit them best: ballparks, football fields, nature playgrounds, picnic areas, community gardens etc; 2) The new architectural elements of the park (paths, lighting, pavilions) created cohesion and a feeling of safety; 3) The renaturalisation process was realised in collaboration with the citizens to set an example through such a process which strengthens the desired social change. The project that resulted is a new form of 'social nature' that has indoubtedly improved the safety, the natural factor and the overall quality of the area which contributes to a better life for the residents.[2]

Green Infrastructure

"More than 2000 new trees have been added, all specifically selected based on their functional, social and aesthetic capabilities. They are planted to create a good microclimate in the park, effectively handle cloud bursts The varied species make the park robust to climate change and allow for a maximum of animals, bees and insects to find habitat in the park: from rare bee species to rabbits, squirrels and foxes."[3]

The modernist park is reimagined and restored to its original, more natural and diverse state. The terraced landscape is reshaped into softer and more gradual inclination, and more types of vegetation and biotopes are introduced, including fruit trees and a lake that doubles as a rainwater reservoir.

1 https://www.metalocus.es/en/news/a-new-form-social-nature-gellerup-city-park-effekt-sla

2 https://eumiesawards.com/heritageobject/gellerup-new-nature-park/

3 https://www.effekt.dk/gelleruppark

Bogtrykkervej 43, 2400
Copenhagen, Denmark

Procurement procedure	Direct commission
Investor	Public funding
Cost	6 mil .€
Year of inauguration	2024
Built surface	20.000 m²
Public engagement	Community consultation

Architecture	SLA
Hydraulic engineer	NIRAS
Art project	Kerstin Bergendal and Efterland
Landscape	SLA

Grønningen-Bispeparken

Photography: © SLA

Diagram / Drawing: © SLA

Mobility and Public Space

Project Description

Grønningen-Bispeparken (Bishop's Park) is an urban development project that transforms an unused space in a 1950s social housing estate into a multifunctional and sustainable public park. The park integrates green infrastructure and effective climate strategies to combat current urban challenges such as flooding, greenhouse effects and biodiversity loss. The project was developed with the involvement of the local community in collaboration with the design and planning teams.[1]

Mobility and Public Space

Initially, the space was in a state of decay, making it impossible to be used recreationally by residents. Following the intervention, it was transformed into a versatile place for social and recreational activities, responding to the needs of the community. The local school can use the park for play and learning activities and both children and adults can enjoy its various facilities. Also, accessible walkways for both pedestrians and bicycles provide connectivity and encourage sustainable transportation alternatives.[2]

Green Infrastructure

To enhance the natural landscape and support biodiversity throughout the year, over 149 trees of 23 different local species and over 4 million seeds from specially created mixes were planted. The result contributes to a healthy ecosystem while regulating temperature and improving air quality.

The park zoning was designed around five typologies that harmoniously combine nature with recreational spaces. These include wetland oases, where flora and fauna thrive freely, dry areas with varied vegetation, lawns for sports activities, event spaces and special places for socializing.[3]

Energy and Resources

One of the Copenhagen municipality's requirements was to design a project to protect the surroundings during storms. The park is therefore designed to effectively manage a large amount of rainwater and prevent flooding. This was made possible by the generous permeable surfaces as well as the 18 existing retention basins that can collect, retain and infiltrate up to 3,000 cubic meters of water. Just five days after the inauguration, a severe storm hit Copenhagen, flooding many parts of the city. In Grønningen-Bispeparken, the downpour only made the new park more beautiful while protecting the surrounding infrastructure.

Designed with a strong focus on sustainability, another way the project achieves its goal of minimizing its carbon footprint is by using reused materials as well as leftover surplus from other projects in Copenhagen.

So, through a design adapted to climate challenges, the designers transformed 20,000 m^2 of barren, flood-prone lawn into a natural, nature-friendly urban park.[4]

1

SLA ‘Grønningen-Bispeparken’, accessed February 7, 2025, https://www.sla.dk/cases/gronningen/

2

SLA ‘Grønningen-Bispeparken’, accessed February 7, 2025, https://www.sla.dk/cases/gronningen/

3

Idem.

4

Idem.

Waterrijkweg, 1051 PJ
Amsterdam, Netherlands

Procurement procedure	Design competition / Direct commission / Other
Investor	Public-private partnership (PPP)
Cost	Undisclosed
Year of inauguration	1998
Built surface	29.000 m² / Green surface: 30.000 m²
Public engagement	Community consultation, Participatory design

Architecture	Atelier Zeinstra van de Pol, Neutelings Riedijk, DKV, Meyer & Van Schooten, KCAP
Structural engineering	KCAP
Sustainability	KCAP
Landscape	West 8

GWL Terrain

Photography:
© Jan Bitter

Urban Development

Project Description

GWL Terrein managed to become an environmentally responsible project- one of the most important references of its kind in Amsterdam. One of the key aspects of the project was to create a cohesive community on an environmental mission that would integrate sustainable materials in the development of the project, and propagate the necessity for reduced energy and water use, therefore generate an efficient waste system.

Mobility and Public Space

A car-free lifestyle was made possible through the provision of public transportation access, reduced parking, and a bike/pedestrian-friendly design.

There are generous outdoor spaces, apartments with roof gardens, private gardens for the ground floor properties and a green public space intended not only for the residents, but also for those living in the densely built adjacent neighbourhoods.[1]

Green Infrastructure

The site was designed to feature abundant green spaces in the form of private, shared and public gardens, which are most common places in which people can meet and interact throughout the ensemble. There are also green roofs, which help collect rainwater and combat heat island effect.[2]

Energy and Resources

Energy savings were obtained by collecting solar energy through the north-south orientation of buildings and most notably through a cogeneration plant, which heats homes with the excess heat generated from energy production. An innovative 'greywater collection system' designed to keep rainwater out of the sewer system and also provide water for flushing toilets contributes to reduced overall consumption. GWL was also one of the first districts to have waste collected underground with recyclables separated by type.

The city also established a solar energy cooperative with the goal of making each resident a member, subsidizing the cheap purchase and installation of solar panels on building roofs.

Several innovations were employed to achieve a unit energy performance norm (EPN) of 750 m3 (natural gas equivalent) per year – much lower than the standard at the time, which was 1400 m3. The largest energy savings come from building a dedicated cogeneration plant (combined heat and power, or CHP) for the district. This uses excess heat from the energy generation process to heat the homes, resulting in a 50% carbon dioxide reduction compared to baseline systems.[3]

1

https://urbanitarian.com/masterplans_post?id=345#resources

2

https://sustainableamsterdam.com/2016/02/gwl-terrain-amsterdams-first-car-free-neighborhood/

3

Idem.

Warmtecentrale Nieuw Zuid,
Antwerp, 2000, Belgium

Procurement procedure	Design competition
Investor	Public funding, Fluvius
Cost	Undisclosed
Year of inauguration	2019
Built surface	850m²
Public engagement	–

Architecture	noAarchitecten, Brussels
Structural engineering	Mouton, Ghent
Sustainability	Fluvius, Antwerp
Landscape	Bureau Bas Smets, Brussels

Heating Plant Antwerp

Photography:
© Olmo Peeters

Photography:
© noAarchitecten

Energy system

Project Description

As the city of Antwerp is experiencing rapid urban growth, neighborhoods become more resilient as sustenability strategies push towards a more climate neutral city. Thus, following European climate ambitions, the city of Antwerp strives to emit 55% less CO2 by 2030 and become climate-robust 25 years from now (consuming more CO2 than produced). In this context, many strategies have been implemented at the urban level, such as innovative waste management tools or water management systems, that build up a more efficient living ecosystem and encourage circular economies.[1]

One such example is the Antwerp Heating Plant, an integral part of a newly developed neighborhood supported by a community heating source. Mediating between private and public, the heating plant becomes not just a resource of energy produced in a much more efficient way but, through design, a landmark in the mundane life of the neighborhood.

Mobility and Public Space

In terms of mobility, the idea that stands at the basis of the design strategy has been to integrate the powerplant into the nearby growing park landscape of Park Nieuw Zuid, which gathers around several critical public institutions, office buildings, new social housings and the South Station of Antwerp. Consequently, the latest heating plant's first floor facilitates the often populated park with a visitor center, becoming a hotspot for community gatherings. The slight slope in which the tower integrates protects the park from the nearby motorway, while the heating plant connects the two levels. The intentional landscape integration enhances pedestrian accessibility, encourages active mobility (such as cycling and walking), and protects against noise pollution produced by the motorway.[2]

Moreover, the upper levels of the Heating Plant serve as an observation tower, offering visitors expansive views of Antwerp. This elevated platform provides educational and recreational opportunities, promoting insights into urban sustainability alongside scenic views of the city's evolving skyline.

Energy and Resources

The Antwerp Heating Plant is part of a series of advanced technologies that push to minimize resource usage, employing renewable energy sources and optimized heat recovery processes in the housing and business district. It significantly cuts energy waste by integrating heat production closely with consumption, ensuring reduced emissions compared to individual heating systems. Photovoltaic panels, carefully designed into the plant’s architecture, provide renewable electricity directly for on-site use.[3] Centralized heating infrastructure simplifies energy distribution, cutting operational complexities and minimizing resource use. These practical, community-oriented solutions reinforce Antwerp’s commitment to sustainability and directly support its ambitious CO2 reduction objectives.[4]

1 noAarchitecten, „Heating Plant Antwerp,” accessed March 24, 2025, https://noaarchitecten.net/projects/27/070-heating-plant-antwerp

2 Idem.

3 Kameleon Solar, „Heating Plant Nieuw Zuid Antwerp,” accessed March 24, 2025, https://kameleonsolar.com/project/heating-plant-nieuw-zuid-antwerp/.

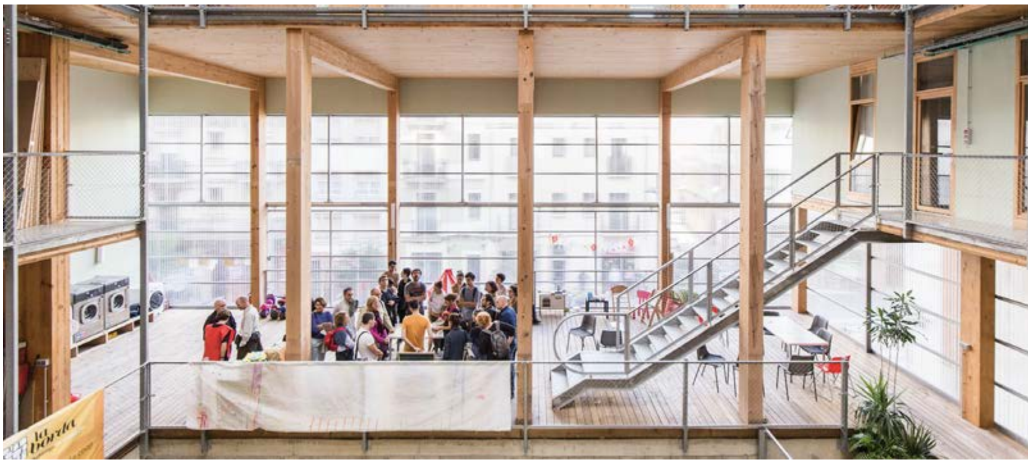
4 „Circular South," *Antwerpen Morgen*, accessed February 10, 2025, https://www.antwerpenmorgen.be/nl/projecten/circular-south/over.

Carrer de la Constitució, 85,
08014 Barcelona, Spain

Procurement procedure	Direct commission
Investor	Public-private partnership (PPP)
Cost of development	3,275,000 €
Cost of construction	2,460,000 € (840 €/m²)
Year of inauguration	2018
Built surface	627 m²
Floor surface	3000 m²
Public engagement	Participatory design

Architecture	Lacol
Engineering	Arkenova
Structural design	Miguel Nevado
Cost control and work supervision	AumedesDAP
Environmental consultant	Societat Orgànica

La Borda



Photography: © Institut Municipal de l'Habitatge i Rehabilitació de Barcelona | © Lacol

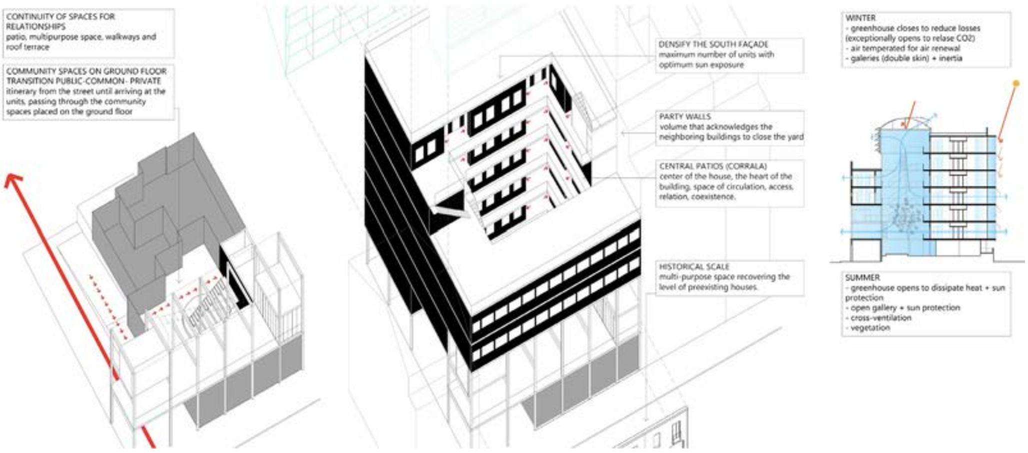


Diagram: © Lacol

Housing cooperative

Project Description

1

Lacol, „La Borda," accessed February 16, 2025, https://www.lacol.coop/projectes/laborda/

La Borda is Barcelona's first cooperative housing project. It is built with an orientation towards a community-based model rather than conventional public or private developments. This approach allowed the project to overcome several limitations typically faced by architectural projects, mainly through the participatory design process. Throughout the design phase, participation was facilitated through an architectural committee, which acted as a liaison between the technical team and the tenants' association. This committee was responsible for organizing a series of architectural workshops, including sessions on photo viewing, program development, project strategies, environmental considerations, typologies, preliminary design validation, and detailing of specific project elements. In a project of this scale, this type of workshop ensures that the community's collective vision has been fully integrated into the design while promoting collaboration and shared decision-making. The cooperative prioritized realizing a building with minimal environmental impact during construction and use.

Mobility and Public Space

La Borda reimagines collective living by prioritizing shared spaces that foster social interaction and mutual support. Unlike conventional multifamily housing, where common areas typically make up just 10% of the floor area and are limited to circulation and shared utilities, La Borda dedicates nearly 25% to communal spaces. These spaces serve three key functions. First, they create an intermediate realm between public and private life, strengthening social ties among residents. Second, they enhance efficiency by centralizing infrastructure, reducing redundancy across the 28 homes, and improving both economic and environmental sustainability. Third, they significantly expand the usable living space, granting residents access to shared amenities without increasing overall costs. By making domestic life more visible and encouraging collaboration in daily tasks and care work, La Borda fosters a more interconnected and sustainable model of urban living—one that challenges conventional housing norms and promotes a stronger sense of community.

Energy and Resources

La Borda meets the highest bioclimatic standards to achieve a truly passive building, integrating solutions that involve residents in the climatic management of their homes. This results in near-zero net energy consumption, ensuring comfort at minimal cost. A key decision to reduce environmental impact was eliminating an underground car park, cutting lifetime CO_2 emissions by 500–800 tons while promoting sustainable mobility. The six-story structure, Spain's tallest cross-laminated timber (CLT) building at completion, is made from a lightweight, renewable material that enables circular construction, unlike energy-intensive, non-renewable materials like steel or concrete. To reduce energy demand, private living areas with higher thermal requirements were minimized in favor of shared spaces with more flexible comfort needs. Passive strategies maximize efficiency: a courtyard roof acts as a greenhouse in winter and aids ventilation in summer. Additional measures include superior insulation, minimal construction waste, and a centralized biomass heating system, ensuring 100% renewable, non-fossil energy use.

Emscherstraße 71, 47137
Duisburg, Germany

Procurement procedure	Design competition
Investor	Public funding
Cost	Undisclosed
Year of inauguration	2002
Built surface	1.800.000 m²
Public engagement	Community consultation / Participatory design

Architecture	Latz + Partner, Latz-Riehl, G. Lipkowsky
Structural engineering	Ingenieurbüro Rothe
Landscape	Latz + Partner, Latz-Riehl, G. Lipkowsky

Landschaftspark

Photography:
© Marius Vasile

Diagram / Drawing:
© Latz + Partner

1

https://arquitecturaviva.com/works/parque-duisburg-norte-duisburg-

2

https://www.landschaftspark.de

3

https://www.landschaftspark.de/en/background-knowledge/introduction/

Project Description

In Duisburg, the redevelopment of the Thyssen factory site into a 200-hectare park preserves the region's industrial legacy while fostering ongoing natural reclamation. Rather than replicating a natural landscape, the project integrates the area's industrial remnants—now protected and preserved monuments—within the park's design. This "park of parks" concept combines diverse functional zones, using the existing industrial framework of railways, warehouses, and other structures, resulting in a cohesive yet dynamic space that celebrates both heritage and ecological rebirth. The design respects the historical context while providing a modern public space.[1]

Mobility and Public Space

A circular trail highlighting the area's industrial history offers insight into both the past and present. Visitors can explore various gardens, meadows, water features, and natural landscapes where nature has gradually reclaimed land from industry. Information columns and signs located throughout the park guide visitors, allowing them to choose their own route and learn more about the site's history and transformation.[2]

Green Infrastructure

In addition to its recreational offerings, the park has implemented several initiatives to restore the contaminated landscape, with water playing a pivotal role. The canal, once used to discharge waste from the steel industry into the Emscher River, now transports clean water collected from building roofs and horizontal surfaces, nourishing ponds and gardens along its path.

Landschaftspark is internationally recognized as a prime example of "Further Development of European Garden Art." Over 700 plant species thrive here, fostering biodiversity in the region, with the Western Ruhr Region Biological Station operating a branch on-site.

The landscape is reshaped to support both ecological biodiversity and sustainable water management. The park's design preserves many of the site's industrial relics, such as the blast furnaces and railways, while introducing natural elements that enable the area to thrive ecologically. Over time, nature has reclaimed the land, with vegetation growing spontaneously, enhancing biodiversity and fostering natural habitats for flora and fauna.[3]

Kassák Lajos 1134, Budapest, Hungary

Procurement procedure	Direct commission
Investor	Public funding
Cost	2.5 mil €
Year of inauguration	2016
Built surface	2 640 m²
Public engagement	–

Architecture	Csaba NAGY, Károly PÓLUS Ádám PÁSZTOR, Ágnes TŐRÖS
Structural engineering	Tibor PINTÉR
Sustainability	Imre MISKOLCZY

Meséskert Kindergarten

Photography:
© Bujnovszky Tamás

Photography:
© Bujnovszky Tamás

Built Space

Project Description

Meséskert Kindergarten (Fairytale Kindergarten) is the first kindergarten in Hungary to meet the requirements of a passive house. For its construction, the city administration decided to commit to the highest standards in sustainable buildings, setting an example of sustainable architecture among public buildings.[1]

Mobility and Public Space

The kindergarten is an important element of public infrastructure, providing convenient access for local families. Located between office buildings and high-rise residential developments, it provides a modern educational environment that combines sustainability with community needs.

Its strategic street-side location reinforces its role as a community center, while preserving room for a spacious garden with playgrounds.[2]

Green Infrastructure

A key feature of the project is the roof garden, an integrated part of the green infrastructure. It provides diverse spaces for children to play and exercise, doubling the available outdoor area and responding to limited space.

Energy and Resources

To achieve passive house certification, solutions were used to drastically reduce energy consumption, such as innovative technical systems, efficient building materials, and a compact spatial configuration. Maintaining a comfortable temperature with minimal energy loss is achieved by using a ventilation system that recovers up to 90% of the heat contained in the exhaust air. The system is equipped with a dust and pollen filter to ensure air purification.

To minimize heat loss as much as possible, high performance thermal insulation has been used, together with triple-glazed windows. There are also adjustable, automatic exterior blinds that prevent overheating in summer and allow the sun's rays to penetrate in winter, naturally warming the space.

Where possible, the architects chose eco-friendly materials such as paints and adhesives that do not contain volatile organic compounds (VOCs).

Modern taps with aerators were installed to reduce water consumption. This system mixes air with water, creating the impression of a stronger spray and limiting consumption. Rainwater is collected and redirected to irrigate green areas.

Thanks to innovative solutions, the building's energy consumption is ten times lower than comparable buildings. Although this type of project requires time and resources, it is a sustainable and recommended choice in the long term.[3]

1 European Commission 'Living Spaces', accessed February 9, 2025, https://culture.ec.europa.eu/de/cultural-and-creative-sectors/architecture/living-spaces/catalogue/budapest

2 European Commission 'Living Spaces', accessed February 9, 2025, https://culture.ec.europa.eu/de/cultural-and-creative-sectors/architecture/living-spaces/catalogue/budapest

3 European Commission 'Living Spaces', accessed February 9, 2025, https://culture.ec.europa.eu/de/cultural-and-creative-sectors/architecture/living-spaces/catalogue/budapest

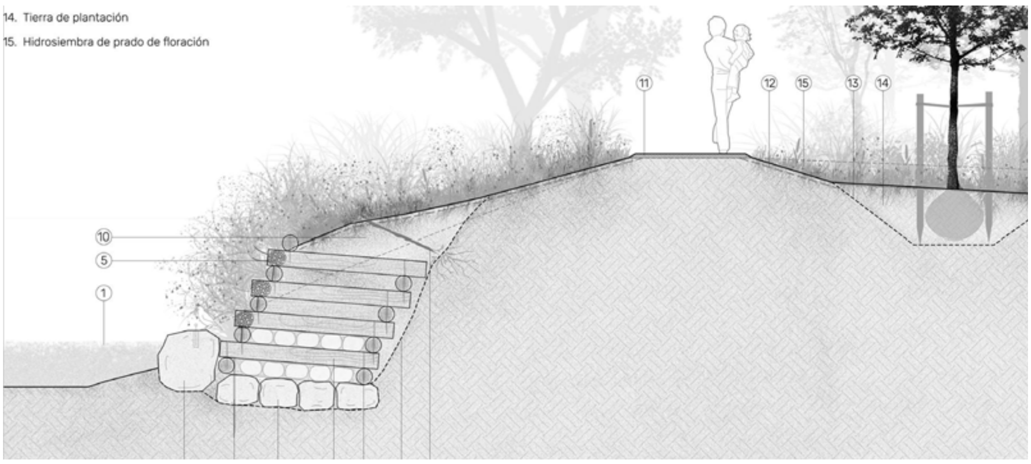
Sallent de Llobregat, Spain

Procurement procedure	Direct commission by the Sallent de Llobregat City Council in collaboration with ETSA del Vallès
Investor	Public funding
Cost	108,839 € (16.36 €/m²)
Year of inauguration	2020
Green surface	6550 m²
Public engagement	Participation of students

Architecture	Álvaro Alcázar Del Águila / Roser GarciaLlidó / Eduard Llargués i Asensio / Sergio Sangalli Borrego

Oasi: Renaturalization of Llobregat river

Photography: © Álvaro Alcázar Del Águila, © Roser Garcia Llidó, Eduard Llargués i Asensio, © Sergio Sangalli Borrego;



Drawing: Álvaro Alcázar Del Águila, Roser Garcia Llidó, Eduard Llargués Asensio, Sergio Sangalli Borrego

Landscape and Public Space

Project Description

Oasi is a renaturalization project that restores a once-industrialized area, reconnecting it with the Llobregat River and reviving its lost relationship with the fluvial ecosystem. By applying natural processes, the transformation strengthens the landscape's long-term resilience.

In collaboration with the Sallent Town Council, the project reorganizes the river spaces within the municipality and focuses on ecological connectivity, water management, biodiversity, and reshaping public perception of the river. Developed at a cost of €16.36 per square meter, it also includes comprehensive project management. OASI prioritizes sustainability and minimizes its ecological footprint through carefully planned interventions: the site is revitalized using locally sourced materials, reduces waste and limits external inputs to ensure an environmentally responsible transformation.[1]

Mobility and Public Space

The project redefines mobility and public space by prioritizing accessibility, connections with existing ecosystems and a renegotiated relationship with the Llobregat River. These new pedestrian routes create a network that encourages urban mobility and, at the same time, strengthens the public's connection with the landscape. By reorganizing riverside spaces, the project transforms previously inaccessible or neglected areas into welcoming and multifunctional public spaces. The intervention minimizes the presence of vehicles and encourages a slower, deeper experience that reconnects people with nature. Access paths are strategically located and improve connectivity between urban areas and the river to promote a seamless transition between the built and natural environment. The project also improves biodiversity and water management so that mobility solutions are aligned with ecological restoration efforts.[2]

Green Infrastructure

The project integrates natural filtration systems, including wetlands and permeable surfaces, to regulate water flow, reduce erosion and improve water quality. These features not only support the river ecosystem, but also help mitigate the effects of climate change such as flooding and rising temperatures. Bioengineering techniques stabilize exposed banks and strengthen weakened slopes by removing invasive species. Vegetation is selected according to slope and exposure to water to help restore the long-term ecology. A prime example is the 'Krainer' wall — a double system of 8-inch logs set on a stone base. Willow branches inserted between the logs take root and gradually replace the structure while slowing floodwaters. The topography is also designed to manage flooding, directing excess water into a storage pond before returning it to the river via a spillway. Roads are raised on protective mounds to protect urban areas, while native planting restores riparian woodland, increasing resilience and biodiversity.[3]

1

Arquitectura Catalana, "OASI. Renaturalisation of the Llobregat River as it passes through Sallent," accessed February 16, 2025 ,https://www.arquitecturacatalana.cat/en/works/oasi-renaturalitzacio-del-riu-llobregat-al-seu-pas-per-sallent#anchor1.

2

Tectonica, "OASI. Renaturalisation of the Llobregat River as it passes through Sallent," accessed February 16, 2025 https://tectonica.archi/projects/oasi-renaturalizacion-del-rio-llobregat-a-su-paso-por-sallent-por-alcazar-del-aguila-garcia-llido-llargues-i-asensio-y-sangalli-borrego/

3

idem

Nordhavn, Copenhagen,
Denmark

Procurement procedure	Design competition
Investor	Public funding
Year of inauguration	2020
Built surface	380 m²

Architecture	Lendager
Structural engineering	Per Hagemann
Material testing	Pelcon

Recycle Centre

Photography:
© Rasmus Hjortshøj
© Lendager

Photography:
© Rasmus Hjortshøj
© Lendager

Project Description

To meet its green ambitions the Nordhavn municipality needed a local recycling center. Through a public competition, Lendager won and designed a facility where waste is treated as a resource and a meaningful environment the users enjoy visiting. Effective waste sorting is the most important prerequisite for effective recycling. Therefore, it is relevant to make waste sorting more user friendly and instructive. At Local Recycling Centre Nordhavn, the waste handling is intuitive and at the same time an exhibition of the possibilities that recycling and reuse offer. Apart from a recycling centre, Nærgenbrugsstation Nordhavn is a meeting place for the local community and hub for exchange of ideas and experience regarding recycling. The aim of the local recycling centre in Nordhavn was to create a place where waste handling is as effective and easy as possible for the users, thus increasing the value of the material fractions generated here.[1]

Mobility and Public Space

Waste is treated as a resource. The center hosts lectures, flea markets, and workshops focused on repairing broken items. The flexible design of the swap area allows for various activities, making it a dynamic space for community engagement. There is also a place for lectures on recycling and educational sessions for school classes By adding this feature, the center serves as a hub for recycling-related activities, where people can connect, learn about upcycling, and develop new skills. Integrated workshops enable visitors to repair broken items, reducing unnecessary waste while fostering social interaction and knowledge exchange. This initiative not only benefits the environment but also strengthens the local community and creates new job opportunities in the process.[2]

Energy and Resources

The walls are built from waste, showcasing how discarded materials can be transformed into valuable resources. These curved “material walls” serve both as a visual statement and a functional guide, making waste sorting intuitive. Each section of the wall represents a specific material—plastic waste is disposed of through the plastic wall, textiles through the textile wall, and so on. This low-tech wayfinding system simplifies sorting, ensuring materials are correctly separated at the source. By making waste disposal effortless, the center enhances recycling efficiency and increases the value of collected materials. The intuitive design encourages proper waste management, accelerating reuse and reducing unnecessary waste. Through effective sorting and material exchange, the center not only promotes sustainability but also fosters a deeper public understanding of recycling’s potential.[3]

1

Lendager, "Recycle Center," accessed February 17, 2025, https://lendager.com/project/recycle-centre/.

2

idem

3

idem

Rijnvliet, Utrecht, Olanda

Procurement procedure	Design competition / Direct commission / Other
Investor	Public funding
Cost	752,500 €
Year of inauguration	ongoing
Green surface	15.000 m²
Public engagement	Participatory design

Landscape Design	Felixx Landscape Architects and Planners
Masterplan Development	De Zwarte Hond
Development Food Forest	Æ Food Forestry Development
Design Tree Top Walk	Anouk Vogel
Developer	Van Wanrooij + the residents of Rijnvliet

Rijnvliet, Edible Neighborhood

Photography: © Felixx Landscape Architects & Planners

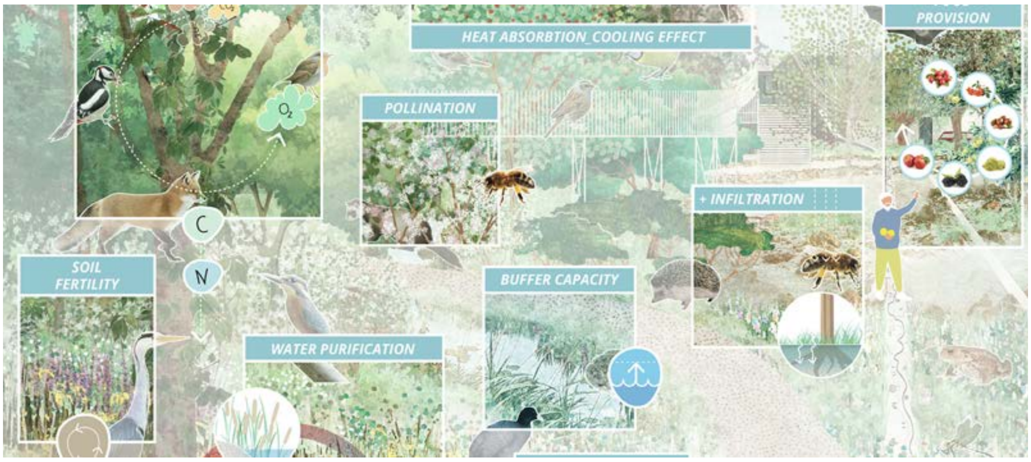


Diagram: © Felixx Landscape Architects & Planners

Urban Food Forest

Project Description

The 'Rijnvliet' neighborhood in Utrecht would have been a normal residential development project if it weren't for the initiative of its residents. Through participatory design, the design process led to an edible and climate-resilient neighborhood. The new agroforestry garden is thus a place at the heart of the community, simultaneously contributing to ecosystem improvement, climate change adaptation and promoting social cohesion.[1]

Mobility and Public Space

”A strong community based on mutual responsibilities is more resilient in the face of other challenges including climate change; it is healthier, more supportive of its members and happier.” according to Felixx Landscape Architects and Planners. During the harvest season, the edible landscape becomes the backbone of the residents, who come together to care for and maintain the gardens. Residents are encouraged to initiate educational, recreational and nature-inclusive policies. Additionally, the introduction of such extensive green spaces has a direct impact on mobility: pedestrians are encouraged to walk rather than drive.

However, for the long-term maintenance of the garden, it was essential to set up a maintenance team, supported by an outstanding partnership with the municipality. The municipality has allocated a specialized group for the proper care of all species of vegetation to ensure the sustainability of the project.[2]

Green Infrastructure

A 15-hectare agri-food forest in the middle of a residential neighbourhood is truly unprecedented. Over 100 fruit trees and 200 species of edible flora provide a good habitat for birds, bees, bats and other species. This results in a rich experience for residents and a healthy bioclimate.

Each part of the neighbourhood has its own identity, with special plantings, and in the central park all the layers come together. In this way, the edible forest improves the area's services, including water management, heat reduction and air purification. Residents have access to information boards, a tree map and a dedicated app, which provides information on plant species, harvest times and uses.

Finally, quality of life is improved. The food forest principle can, in fact, be applied to any existing or newly built neighbourhood. By planting a wide diversity of edible vegetation in different layers, it provides an example of healthy and resilient living, adaptable to today`s climate change problems.[3]

1 Felixx, ”Rijnvliet, Edible Neighbourhood”, accessed February 16, 2025, https://www.felixx.nl/projects/rijnvliet-edible-neighborhood-1.html

2 idem

3 idem

Jef Van Hoofstraat 2 -32, Karel Candaelstraat 2, Antwerp, Belgium

Procurement procedure:	Unknown
Investor	Public funding
Cost	12 691 000 € (897 € / m²)
Year of inauguration	2019
Plot surface	8600 m² / Gross surface: 14155 m²
Public engagement	None / Community consultation / Participatory design / Other

Architecture	Atelier Kempe Thill
Collaborators	RE-ST architecten

Rozemaai Housing Antwerp

Photography:
© Ulrich Schwarz

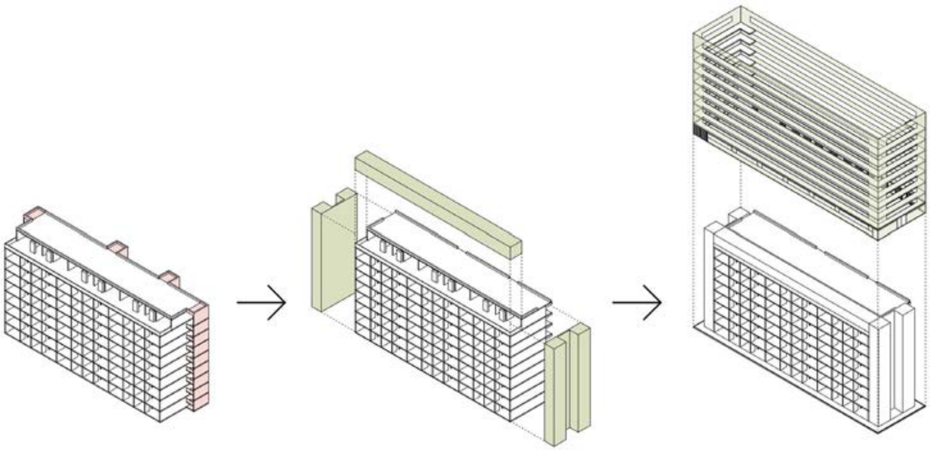


Diagram:
© Atelier Kempe Thill

Refurbishment

Project Description
source: Atelier Kempe Thill

The original Rozemaai housing estate was built on modernist principles with gallery-accessed slab buildings. However, this design limited street connectivity and hindered social interaction, compounded by its isolated location between a tranquil park and a busy motorway and harbor. The renovation reconfigured access and circulation to better integrate the estate into the urban fabric.

Mobility and Public space
source: Atelier Kempe Thill

Obstructive elements were removed to restore connectivity.
A 150-meter abandoned parking garage and several garage boxes—previously blocking interaction between the housing blocks and the park—were eliminated. Access zones were reconfigured by demolishing outdated staircases, lift shafts, and balustrades. New staircases and lift cores were strategically placed on the previously closed head façades, ensuring visible entrance halls and unobstructed views. A connecting piazza now serves as a welcoming gateway to an emerging park and low-rise housing, while ground-level apartments gained direct street access, fostering enhanced community interaction.

Green Infrastructure
source: Atelier Kempe Thill

Expansive balconies, averaging 8 meters wide and absent in the original design, provide outdoor space and panoramic views of surrounding trees and the "Oude landen" park. This connection with nature enriches the living environment and public realm. The renovation redefines the building envelope by removing obstructive gallery balustrades and introducing large windows and glass elements, creating a “second skin” that harmonizes indoor and outdoor spaces.

Energy and Resources
source: Atelier Kempe Thill

Instead of demolishing the aging modernist structure, the housing building preserved its original skeleton. This choice avoided significant CO_2 emissions and reused about 50% of the existing materials, reducing waste and conserving resources.

A new layer was added atop the original gallery to meet modern standards, including full wheelchair accessibility and more flexible, spacious interiors. Over fifty connecting openings were cut into the slabs, and load-bearing walls were removed to create open living spaces. Insulated façades, featuring large windows in light bronze anodized frames and complemented by glass balustrades, ensure optimal daylighting and thermal performance.

Economically, the project is cost-effective, with construction costs at roughly 75% of a new build, while also benefiting the local labor market.

Rue des Frères Portmann Résidence G,H,I, Bordeaux, France	Procurement procedure	Direct commission
	Investor	Public funding
	Cost	Over 27.2 million € for rehabilitation + 1.2 million € for new housing
	Year of inauguration	2017
	Built surface	68.000 m^2 (44.210 m^2 existent + 23.500 m^2 extensions)
	Public engagement	Participatory design
	Architecture	Anne Lacaton & Jean-Philippe Vassal, Fréderic Druot and Christophe Hutin
	Structural engineering	SECOTRAP, CESMA
	Sustainability	Cardonnel
	Landscape	Cyrille Marlin

Transformation of 530 dwellings

Photography:
© Laurian Ghinițoiu

Diagram / Drawing:
Lacaton & Vassal

Built Space

Project Description

The project consists of the rehabilitation and extension of three social housing buildings, marking the first phase of a larger program of interventions in the Grand Parc district of Bordeaux, France. Built in the early 1960s, the high-rise buildings, up to 15 storeys high, comprise 530 apartments (hence the name of the project) which are being modernized to improve the quality of housing and comfort for residents.[1]

Mobility and Public Space

On the ground floor of the blocks there is a garden area, which has been revitalized to activate the public space and encourage social interaction.

At the same time, accessibility has been improved by adding elevators to each floor and modernizing the staircases, bringing them in line with today's comfort and mobility requirements.[2]

Green Infrastructure

The intervention incorporates large green spaces at the base of the buildings, improving both biodiversity and public accessibility. The rehabilitated green areas contribute to the overall ecological value of the site, while at the same time creating opportunities for interaction for the tenants of the buildings through the proposed common spaces. Integrating vegetation into the project reduces the climate footprint and supports local efforts to improve urban sustainability.[3]

Energy and Resources

The project is based on the intervention on the existing buildings, without major architectural changes.

The main element that contributed to the transformation is the addition of extensions with their own structure made of prefabricated elements in the form of deep balconies (3.8 meters). Called by the authors of the project “winter gardens”, these are unheated areas that act as a thermal buffer, reducing the need for heating in winter and cooling in summer. To regulate the thermodynamic exchanges according to the needs of each season, four adjustable layers were provided: double-glazed sliding windows, solar curtains with aluminum strips, thermal wool curtains and transparent polycarbonate panels.

The extensions amplify the usable space, improve the thermal performance, while preserving the integrity of the original construction and transforming an architecture lacking qualities into a modern image of urban living.

Thermal insulation of the entire envelope and the replacement of all problematic plumbing are further interventions that increase energy efficiency and extend the life of the buildings.

Sustainability is a key element in the design strategy, so the focus is on adaptive reuse rather than demolition.[4]

1

Lacaton & Vassal ‘projects’ accessed February 6, 2025, https://www.lacatonvassal.com/index.php?idp=80#

2

Lacaton & Vassal ‘projects’ accessed February 6, 2025, https://www.lacatonvassal.com/index.php?idp=80#

3

Lacaton & Vassal ‘projects’ accessed February 6, 2025, https://www.lacatonvassal.com/index.php?idp=80#

4

Lacaton & Vassal ‘projects’ accessed February 6, 2025, https://www.lacatonvassal.com/index.php?idp=80#

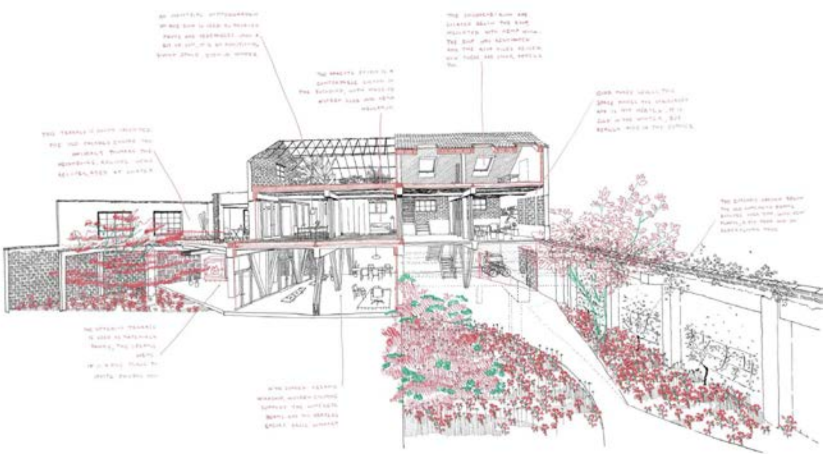
Sint-Jans-Molenbeek, 1080
Brussels, Belgium

Procurement procedure	Direct commission
Investor	Private investment
Cost	€ 400.000 excl. VAT
Year of inauguration	2020
Built surface	600 m² / Heated surface: 250 m² / Green surface: 410 m²
Public engagement	–

Architecture	AgwA + Evelia Macal
Structural engineering	JZH & Partners
Sustainability	AgwA
Landscape	AgwA + Evelia Macal + Denis Dujardin

Verbiest

Photography:
© Severin Malaud;
Familia Fallon-Macal
© AgwA



Drawing:
© Severin Malaud;
Familia Fallon-Macal
© AgwA

Family Housing and Ceramic Workshop

Project Description

Verbiest, named after the street on which it is located, is composed of a single-family dwelling and one ceramic workshop and gardens, inserted into the partially dysfunctional structural system of an abandoned warehouse built in 1976 in Molenbeek, Belgium. Designed and inhabited by architects who have developed a predilection for themes such as the reuse of materials and strategies to reduce and monitor carbon emissions in construction, Verbiest is a model of responsible design and living.[1]

Mobility and Public Space

Ever since the conversion, Verbiest has been an architectural experiment both in its design process and in the way it invites new ways of inhabiting a house. It challenges conventional ideas of comfort, with living conditions that shift noticeably across seasons. Thus, in collaboration with the public representatives of the Brussels region, the building opened its doors at times to question and inform public opinion.

The discussions addressed the opportunities and challenges of such an initiative, reinforcing the role of the project in the urban landscape.

Green Infrastructure

To make way for 600 m^2 of green space and to create a filter zone between the street and the private dwelling, a portion of the former warehouse shell was demolished, retaining the post and beam structure as aesthetic elements in the memory of the place. Gardens and terraces were organized at the entrance, at the rear of the building and on the upper floors, serving both private functions and workshops. In the name of a reuse approach, the roof that could no longer be used was transformed into a private greenhouse, actively contributing to the thermal behaviour of the building.[2]

Energy and Resources

From an energy efficiency point of view, the project takes a radical path, monitoring and critically analyzing the performance of several insulating materials. Thus, although hemp concrete blocks emerged as the most efficient solution in the long term, the only viable method to achieve the proposed parameters was to minimize the heated space. Only half of the living area is insulated, the rest being activated according to the season and temperature, forcing a clear organization of the spaces. In terms of building materials, local options were favored and concrete and steel were considered undesirable. Some materials were salvaged from the Palais des Expositions site in Charleroi, while other were brought from other sites.[3]

1 AgwA, Verbiest: House and Workshop in Molenbeek-Saint-Jean, May 31, 2021.

2 AgwA, Verbiest: House and Workshop in Molenbeek-Saint-Jean, May 31, 2021.

3 Idem.

Energiewendeplatz 1, 2115
Ernstbrunn, Austria

Procurement procedure	Design competition
Investor	Private Investment
Cost	€ 5.600.000 excl. VAT
Year of inauguration	2024
Built surface	1.128 m²
Public engagement	–

Architecture	Juri Troy Architects
Structural engineering	Strobl Bau - Holzbau GmbH
Sustainability	Larix Engineering GmbH
Landscape	outside landschaftsarchitektur GmbH

Windkraft Simonsfeld Headquarter

Photography:
© Patrick Johannsen
© Juri Troy
Architects

Photography:
© Patrick Johannsen
© Juri Troy
Architects

Extension

Project Description

Against the backdrop of strong economic growth in its sector, Windkraft Simonsfeld's company headquarters felt the need to expand its premises with an extension that continued the architecture of the building constructed several years ago by the Reinberg office and that reflected the contemporary values of the company. The theme of the project, in addition to creating much-needed office space, focuses on aspects related to the socio-architectural quality of a workplace by adding variations of public and semi-public spaces.

Mobility and Public Space

The proposal by Yuri Troy's architects is based on the creation of an open atrium to create a protected outdoor social setting. The U-shaped extension attaches to the existing building at two points, accommodating new reception, catering and event rooms in addition to offices overlooking the central atrium.

In doing so, the design team paid particular attention to methods of encouraging informal social interactions between employees and clients, creating a balance between work and public spaces. The architectural solution emphasizes logical layout, flexibility and intuitive visual connections, fostering a collaborative environment and encouraging professional relationships.

Energy and Resources

In terms of energy consumption, the Windkraft Simonsfeld headquarters extension is certified with the highest rating of 1000 out of 1000 points possible, according to the Climate Active Gold Standard. The roof area is completely covered in photovoltaic panels, providing enough electricity for the entire building, while a number of eleven deep geothermal boreholes power the heating system. The building utilizes a timber structural frame, which provides flexibility, foreseeing future extensions. Inside, a solid beaten clay core helps regulate temperature and humidity, optimizing thermal comfort. This innovative energy system allows the building to have a positive carbon footprint right from the construction phase.

Image: © Juri Troy Architects

3-7 Boulevard du Général Jean Simon, Paris XIII, France

Procurement procedure	Design competition
Investor	Private investment
Cost	€ 25.100.000 excl. VAT
Year of inauguration	2024
Built surface	8.949 m2
Public engagement	–

Architecture	LAN Paris
Fluid engineering	Elioth
Environment, structure and facade	SINTEO
Landscape	Atelier Georges

Wood Up Tower


Photography:
© Charly Broyez
© LAN Paris

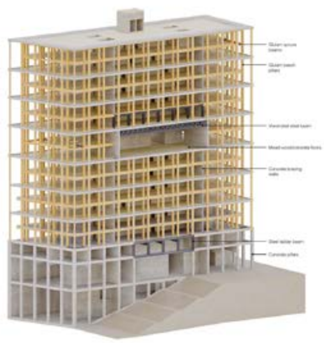



Image |
Photography:
© LAN Paris
© Daisy Reillet

Social Housing

Project Description

Wood Up Tower is a residential project by LAN Paris architecture office, which stands out as one of the pioneering timber-frame buildings in Europe and one of the tallest of its kind in France. At 50 meters high, the building accommodates several particular functions and spatial organization, largely determined by the structural constraints of such an ambition. As a result of mediating between its urban integration and functional needs, the building includes a commercial base, 132 residential units and a series of common areas for residents, connected by open-air walkways.[1]

Mobility and Public Space

From an urban planning point of view, Wood Up Tower is part of the Paris Rive Gauche development, a project that aims to connect the 13th arrondissement with the banks of the Seine, Ivry and the centre of Paris. Situated on the periphery of this arrondissement, the building facilitates the transition between the different levels of the Boulevard Général d'Armée Jean Simon and the riverfront, acting as a mediator of urban mobility.

Together with other projects that promote the same urban coherence, Wood Up Tower is becoming an iconic silhouette in the landscape of contemporary Paris, both for its distinctive aesthetics and for its contribution to the development of the Seine banks as a residential area.[2]

Energy and Resources

The wood that makes up the structural elements of the building was delivered on the Seine River, after being selected from sustainably managed forests, certified as PEFC or FSC. As a material, wood stands out for its minimal necessity of resources in the harvesting process, absorbing CO_2 and retaining it throughout the building's lifetime. The essence chosen for the structural elements was beech, due to its compressive strength, offering architects greater freedom in the planimetric unfolding of the residential units.

The processing of this locally sourced material not only significantly reduced the amount of carbon emissions generated during construction, but also accelerated the assembly process and provided jobs that cannot be outsourced by the nature of the process. In addition, all the leftover material resulting from the processing of structural elements was reused in the design of street furniture and elements in the common areas of the building.

The underlying philosophy behind this real estate development is sustainability and responsible construction. For this reason, all stages, from the processing of construction materials to the completion of the building, were monitored and evaluated accordingly, and the building was finally certified for low emissions with the BBCA (Bâtiment Bas Carbone) label.[3]

1

LAN (Local Architecture Network) and REI Habitat. "Wood Up - Press Kit." October 2021.

2

Idem.

3

Idem.

Glossary of terms

A

Active Involvement: in the context of community involvement, it refers to the medium level of community involvement, whereby the administration works with the public to identify and understand community problems and generate solutions. Subsequently, the administration informs the participants on how the input of the participants is integrated into decisions.

Active mobility includes all movements of people and goods in the urban environment, which are carried out by means of travel that are based on human physical effort: walking, cycling, scooters, etc..

Advocacy: public support for a cause or solution.

Alternative mobility encompasses all modes of transport that are alternatives to the personal car, the most intensively used mode of travel in an unsustainable city. Alternative transport options are healthier and more sustainable, generating pollution and GHG emissions per passenger at much lower levels than private cars, or not at all.

Autonomous Vehicles (AV): vehicles that operate without human intervention, using sensors, artificial intelligence, machine learning for navigation. In climate-neutral cities, AVs can be electric and integrated into shared mobility systems.

B

Bicycle/cycling infrastructure: a system comprising a network of bicycle paths, bike sharing (rental), parking, including at intermodal nodes, and other elements that encourage and facilitate safe, comfortable and enjoyable cycling.

Broker: any operator which undertakes the recovery or disposal of waste on behalf of others, including brokers who do not physically take possession of the waste.

C

Carbon footprint: total greenhouse gas emissions produced directly or indirectly by an activity, product or organization.

Car-free zones: areas where cars are not allowed.

Charging infrastructure: the network of electric vehicle charging stations critical to the adoption of electric vehicles. Each mode of travel using electric vehicles in a city must have its own charging infrastructure: buses, cars, bicycles, etc..

Circular economy: a model of production and consumption, which involves sharing, renting, reusing, repairing, refurbishing and recycling existing materials and products for as long as possible. This extends the life cycle of products.

Clean mobility encompasses all low or zero-carbon travel such as electric vehicles, hydrogen vehicles, walking/cycling, etc..

Climate neutrality: emissions of greenhouse gases generated by human activity, such as carbon dioxide (CO_2) from burning fossil fuels, are drastically reduced in the atmosphere to ensure that there is no impact on the climate system.

Co-creation: in the context of community involvement, it corresponds to the highest level of involvement, where decision-making power and at least part of the responsibility for implementation is transferred to the community.

Collaboration: in the context of community involvement, partnering with the community throughout the project, identifying problems, seeking alternative solutions and identifying the preferred one. The administration integrates the findings of the participatory process as much as possible into decisions.

Community: a group of people who share a territory, common interests, values or social, economic and cultural concerns. A community can be defined geographically (a neighborhood, a city) or on the basis of common interests (e.g. a professional or cultural community).

Congestion charge: a system of charging those who travel in certain areas, at certain times of the day, with heavy traffic, in order to reduce congestion and pollution and to encourage active mobility and public transport.

Consultation: the process by which the public reacts, on its own initiative or at the invitation of the administration, to proposals for alternative solutions and/or public decisions. It is a two-way communication, with the administration requesting and the public providing information on a given issue.

Conversion: the action of changing the function or use of an object or space.

D

Disposal: any operation that is not a recovery operation, even if one of its secondary consequences would be the recovery of substances or energy.

Downstream Emissions: emissions resulting from the use, distribution or disposal of a product after manufacture, such as fuel consumption by users or recycling processes.

E

Ecosystem services: the benefits that human communities derive from the ecosystems they use.

F

Facilitation: in the context of community engagement processes, is a process whereby a neutral person, who is accepted by all members of the group and has no decision-making power, helps group members to identify problems, find solutions and make decisions in an effective way. The facilitator creates a framework for analysis, dialog and negotiation that encourages the participation of all group members.

G

Gamification: the use of elements and principles from game theory in non-game contexts in order to make an activity more engaging, more dynamic, to increase participant engagement and to stimulate successful completion. Among the elements borrowed from games, we find in various contexts one or more elements such as reward systems through scoring systems, badges, leaderboards, challenges and the like.

Green infrastructure: a strategically planned network of natural and semi-natural elements, designed and managed to provide a wide variety of ecosystem services and contribute to the protection of biodiversity in both rural and urban areas.

I

Influencer: a term used to refer to people with power to influence public opinion, not only those who manifest themselves in social media platforms, but also those who have formal or informal leadership status within communities.

Information: in the context of community involvement, the process by which the government provides the public with objective information that enables the public to understand the problem, alternative solutions, their benefits and risks. It is a one-way communication from the administration to the public.

Intermodal node: a place that centralizes several modes of transport (buses, trams and trains, car and/or bicycle parking, sharing systems, etc.).

Internet of Things (IoT): A network of interconnected devices that collect and exchange data over the internet without direct human intervention. It includes sensors, smart home appliances, connected vehicles and digital urban infrastructures.

K

KPI (Key Performance Indicators): indicators used to measure the effectiveness and success of a process, project or strategy in achieving its objectives.

L

Living Labs: collaborative innovation platforms that actively involve the community in the process of developing, testing and implementing solutions to local problems. They are open spaces, where end-users (community members) work together with researchers, organizations and authorities to co-create, prototype and test innovative solutions that address real needs.

Living streets: streets that prioritize people's needs and create a community-oriented environment. They can be shared or un-shared streets, with wide sidewalks and street furniture that invite people to spend more time in public spaces, social interaction and play.

Low Emission Zones: according to Law 155 / 2023, areas delimited by the local public authority within which restrictions and/ or charges for vehicle access are introduced to improve air quality.

M

Metadata: A descriptive information about a dataset that is essential for understanding, organizing and using it. It may include details about source, methodology, format, updates and access conditions.

Mobility as a Service (MaaS): a digital platform that integrates various transport services into a single, accessible and easy-to-use interface, allowing users to plan, book and pay for multimodal journeys.

N

Nature-based solutions: are solutions inspired by, supported by or copied from nature, which are designed to respond to a variety of societal challenges in an adaptable and resource-efficient manner, while delivering economic, social and environmental benefits.

O

Open data is publicly available without legal or technical restrictions and can be freely accessed, used and redistributed, usually via a web-based platform.

P

Participatory budgeting: the municipality allocates a part of its budget, for which the public can propose projects and decide by voting. There are different variants of participatory budgeting that can target specific agendas or socio-demographic groups.

Participatory process: the process of actively involving the community and/or stakeholders in a project to ensure that the project outcomes, i.e. the decision-making process, integrate the needs and realities of the target user group and stakeholders.

Pollution refers to the direct or indirect introduction of substances, vibrations, heat or noise into the air, water or soil, as a result of human activity, which may damage human health and the quality of the environment.

R

Recovery: in the context of the 7Rs of the circular economy, recovery is the valorization as fuel for energy generation.

Recycling delimits any recovery operation by which waste is transformed into products, materials or substances to fulfill its original use or for other purposes. This includes the reprocessing of organic materials, but not the energy recovery or the conversion to fuel or for filling operations.

Return on Trust: a concept developed by the neuro-economist Paul Zak and his team of researchers, which designates the impact of trust on business performance, i.e. the activity of any organization. The integration of trust as a core value of an organization has a beneficial impact on all stakeholders and the relationships between them: shareholders, employees, collaborators, customers, etc. It has a positive direct and indirect financial impact, through better collaborative relationships, creativity and productivity, accountability, talent attraction and retention, more energy, engagement and satisfaction, fewer health problems, etc.

Reuse: Involves using a product more than once for the purpose for which it was created. Adaptive reuse is a type of conversion approach, where the new use adapts to the available space with minimal intervention.

S

Selective/separate collection: collection where one waste stream is kept separate from the others according to the type and nature of the waste in order to facilitate its specific treatment.

Semi-open data is accessible only to specific users or under specific conditions, with partial restrictions on use or redistribution. They are usually available through a web-based platform that requires authentication and a user validation process.

Shared mobility encompasses on-demand short-term vehicle rental schemes to reduce the individual need to own a car, bicycle or scooter for occasional use. This reduces the total number of vehicles present in urban environments and promotes electric and hybrid vehicles.

Shared streets: are streets on which the different modes of travel are not demarked and vehicle speeds are greatly reduced for the safety of all road users, leading to a more fluid use of space based on mutual respect. They are often implemented in central city areas or residential areas.

SMART City: an urban environment that uses technology and innovation to create a sustainable, connected and citizen-centered ecosystem. By integrating data, artificial intelligence (AI), the Internet of Things (IoT) and other digital solutions, a Smart City optimizes infrastructure, public services and community participation, transforming cities into more efficient, inclusive and resilient places.

SMART (or connected) mobility: the integration of digital technologies, including IoT (internet of things), AI (artificial intelligence), real-time data, with the aim of increasing service efficiency and user comfort, as well as reducing emissions.

Stakeholder: a person, group or organization that has a direct or indirect interest in a public decision or project. Stakeholders can include citizens, companies, NGOs, public institutions and other entities affected by a project. They are specific entities with an active interest in the decision, either members of the community or external organizations.

Sustainability: the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs.

T

TOD: transit oriented development, a principle of urban development that supports the development of proximity communities, integrating mix-use and higher densities of population and buildings around transit stations, reducing the need for people to travel by car.

Traceability: a characteristic of a system to allow the history, use or location of a waste to be traced through recorded identifications.

Tree crown cover in urban area: the total area covered by trees in cities and small towns and suburbs, calculated on the basis of tree crown cover density data provided by the Copernicus Land Cover Monitoring Service and other appropriate additional data provided by the Member State concerned.

U

Upcycle: the activity by which new products of higher value are made from used materials and/or objects. Some situations are covered by adaptive reuse (new uses for old objects), others are associated with recycling (re-assembly of components).

Upstream Emissions: Emissions generated in the stages prior to the production of a good or service, including extraction of raw materials, transportation and intermediate industrial processes.

Urban biodiversity: variability among living organisms, from genes and species to ecosystems in urban environments.

Urban ecosystems: a dynamic complex of communities of plants, animals, fungi and micro-organisms and their abiotic environment interacting in an urban functional unit and includes habitat types, species habitats and species populations.

Urban green infrastructure: part of regional green infrastructure (sometimes called green infrastructure). Thus, urban green infrastructure is a strategically planned network of natural, semi-natural, restored and human-made areas, including natural ecosystems, agricultural land, all categories of green spaces and urban water surfaces, ecosystems in various degrees of restoration, with the aim of providing a wide range of ecosystem services to improve urban livability, safety, resilience and sustainability, including the conservation of biodiversity and ecosystem services.

Urban green space: the total area of trees, shrubs, perennial herbaceous vegetation, lichens and mosses, ponds and watercourses found in cities or small towns and suburbs, calculated on the basis of data provided by Copernicus land cover monitoring service under the Copernicus component of the Union Spatial Program and other appropriate additional data provided by the Member State concerned.

Urban mobility: covers all movements of people and goods in urban areas, which are carried out by public or private means of transport.

Urban mobility ecosystem: the totality of elements that contribute to a sustainable and efficient mobility system in a given urban area: the interconnected network of transport systems, public policies, technologies, services, etc.

Urban nature: the assemblage of species and the places where these species occur in the urban environment.

Urban operations: mechanisms that guide large-scale functional, social or infrastructural transformations of areas. These tools continue the provisions of the general urban plans, by detailing and operationalizing them. Subsequently they are materialized at the planning level through zonal urban plans, including measures and provisions tailored to specific operations. The operations involve separate attributions, but also private and public partnership contracts.

Urban regeneration: the process of a complex transformation of an urban area, delimited in terms of area and duration of the process, in the framework of cooperation between the local authority and local actors (residents and users). The effects of regeneration are materialized through concrete projects, but also through cooperation mechanisms and temporary or permanent administrative, fiscal or urban planning facilities.

Ux Design (user experience design): the process of creating a solution, product or service that solves a specific problem, ensuring easy, relevant and enjoyable use. It involves the design of the entire solution acquisition and integration process, including branding, design, functionality and usability.

W

Waste: is any substance or object that the holder discards or intends or is required to discard.

Waste management: the collection, transportation, recovery (including sorting) and disposal of waste, including the supervision of such operations and the subsequent maintenance of disposal sites.

Z

Zero-Emission Zones: areas in the city where only zero emission vehicles are allowed.

Biographies

Possible Cities
Experts

	Laura Nicoleta Alexa	Marketing and Management	Marketing Manager at Genesis Biopartner, Member of the Baupartner Group Master in Marketing and Marketing Management, Bucharest Academy of Economic Studies (ASE) Member of the Environmental Working Group of AHK Romania
	Alina Bahna	Communication and PR	Communication expert at UEFISCDI Marketing and communications coordinator at Upgrade education Project manager at Grow Up Galati Master's degree in Communication and PR
	Dorin Beu	Building Services Engineering	Professor at the Technical University of Cluj-Napoca European Projects Manager at the Romania Green Building Council (ROGBC) PhD in Civil Engineering, Technical University of Cluj-Napoca
	Iulia Sabina Calu	Marketing and economy	Project Manager at the Romanian Order of Architects Founder and Project Manager Access Nature (NGO) Project management certifications, European funds and public-private partnerships.
	Alina-Gabriela Catrina	Architecture	Manager proiect la Ordinului Arhitecților din România Master in Architecture at the "Ion Mincu" University of Architecture and Urbanism in Bucharest"

	Andrei Ceclan	Electrical Engineering	Urban energy manager within the energy engineering and services company Servelect President of the Association of the Society of Energy Auditors and Managers in Romania (SAMER) Associate professor at at the Technical University of Cluj-Napoca Ex Chairman of the Board of Directors of the Romanian Energy Efficiency Fund (FREE) PhD in Electrical Engineering, Technical University of Cluj-Napoca
	Alexandru Ciobotă	Landscape Architecture	Expert green - blue infrastructures within the Project Support and Technical Expertise Office West RDA Founder of the Romanian Landscape Architects Association (AsoP) PhD in Architecture, Faculty of Architecture and Urbanism of Timișoara (FAUT) Master of Urban Planning, FAUT
	Raluca Coșcodaru	International relations	International projects expert at UEFISCDI Author of studies and research reports on the Romanian innovation ecosystem, public policy advisor PhD in political science, SNSPA
	Mirona Crăciun	Architecture	Coordonator of the Competitions Department of the Romanian Order of Architects Member of the Working Group on Solutions Competitions and Public Procurement of the Council of Architects of Europe (ACE) Member in the International Union of Architects (UIA) Expert Commission for Architectural and Urban Planning Competitions
	Oana Crușmac	Political Science	International projects expert at UEFISCDI Evaluator for the European Commission PhD in political science, SNSPA
	Mihai Alexandru Dinu	Gender studies and politics	International projects expert at UEFISCDI Master in Gender studies in politics Phd Candidate in Management, SNSPA

	Anamaria-Sidonia Fărcășanu-Răvar	Economics	International projects expert at UEFISCDI Researcher, author of development strategies, research reports, ex-ante assessments and public policy proposals Cultural projects manager at ARCHÉ association Senior consultant at Ernst & Young EU projects consultant at fonduri-structurale.ro PhD in economics, Bucharest University of Economic Studies
	Luana Floricică	Procurement	Deputy general manager at National Institute of Heritage Public procurement certifications
	Maria-Cristina Găvozdea	Architecture and urbanism	Co-founder of the architecture and urban planning office of A.PLAN Vicepresident on the committee of the Sibiu Community Foundation Member of the International Union of Architects (UIA) Work Programme on Community Architecture and Human Rights Master in Urban Planning, "Ion Mincu" University of Architecture and Urbanism of Bucharest (UAUIM)
	Ionuț Georgescu	International Business	Founder and Chairman of the Board of Directors of the FEPRA Group Member of the Environmental Working Group of AHK Romania Executive _Studii in Organizational Leadership, Stanford University School of Business Studii of Sustainability, Massachusetts Institute of Technology (MIT) Master in Business Administration, Tiffin University
	Mihaela Hărmănescu	Architecture and urbanism	Associate Professor at the "Ion Mincu" University of Architecture and Urbanism in Bucharest Vice President of the Order of Architects of Romania (OAR) in the field of Legislation and Regulation Member of the Commission for Sustainable Development within the International Union of Architects (UIA) Doctor in Urban Planning, "Ion Mincu" University of Architecture and Urbanism in Bucharest (UAUIM) Master in Sustainable Development — integrated concept of the built space and energy audit, UAUIM
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Good practice examples
Experts

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Instead of closing

Fundamentals of new practices for climate neutral cities

Eugen Pănescu
Katrín Jónsdóttir
Iulia Sabina Calu

“A city is not just a place to live, but a way of living.” - Peter Ackroyd

Innovation, a key ingredient for transformation

Thanks to partners in Norway and Iceland, the M100 project has benefited from the exchange of ideas, advice, examples of good practice and future support to align efforts. In the paragraphs below is the intervention of Ms. Katrin Jonsdottir, Senior Advisor at the Icelandic Research Center (Rannís), who encourages to look for and use process and relational innovation in Romania in the coming years

“As a funding agency managing both local and international funds, we see an urgent need for disruptive innovation in urban development to meet the accelerating demands of climate neutrality. Cities are at the forefront of the climate crisis, yet they also serve as dynamic hubs of creativity, entrepreneurship, and technological advancement. To close the gap between ambition and action, we must rethink how cities are designed, built, and operated — placing innovation at the heart of sustainable transformation.

We recognize the growing potential of startups, climate-tech ventures, and cross-disciplinary urban solutions, which are often overlooked in traditional city planning processes. By actively supporting these changemakers, we help foster a more agile and inclusive approach to urban development — one that not only cuts emissions but also enhances liveability, equity, and resilience. Startups should not simply be funded and left to scale alone; they must be intentionally connected to larger urban development efforts from the outset. This ensures their solutions are integrated, scaled, and sustained through long-term partnerships, inclusive governance, and strategic investment in both people and systems.

As a state-owned funding agency, we are uniquely positioned to mobilize collaboration between cities and startups by leveraging our role as a trusted intermediary and enabler. While we do not directly shape city policy or urban planning, we can influence the ecosystem by funding innovation, building strategic partnerships, and creating spaces for dialogue and co-creation.

We aim to bridge the gap between early-stage innovation and large-scale urban implementation by encouraging cities to open to pilot projects and agile experimentation, while also helping startups navigate public sector requirements and align their solutions with long-term urban goals. Through targeted calls, matchmaking platforms, capacity building, and support for public-private partnerships, we could for example work to embed startup-driven innovation into broader city development frameworks. In doing so, we help ensure that promising solutions are not only developed but are also given a pathway to scale and long-term impact.”

A publication-collection and the basis of a manifesto for our cities

In our cities are the people, here is the economy, here is the culture, with the opportunities we pursue every day. But there are also the challenges - some minor, some huge - from rising emissions to resource depletion. Climate neutrality is no longer an opportunity or a challenge and by no means an option - it is a necessity.

The guide was generated by the efforts of the 10 cities selected in the M100.ro national mission, but we hope that this publication will circulate in many more cities, to become an inspiration for small and large towns, even municipalities, because everywhere something from this guide can be applied. In this way, we contribute, as a professional organization with active partners in all strata of Romanian society, to confirming a direction for our cities that is neither optional nor a short-term perspective

The information and recommendations in the guide cover areas relevant to achieving climate neutrality, describing tools and methods, good practices and expected impacts. The drafters are specialists with many years of experience in their fields, with academic, professional, civic and administrative practice. In this way, we have covered points of view of these directions for action, which in real life are not always aligned or sufficiently known

Government and administration priorities, aligned with those of the European Union, are sometimes different from the pace of everyday reality. It is precisely at this point that the theoretical and, above all, practical support of the professional society, of which the Romanian Order of Architects is a member is useful.

We are aware of obstacles and delays; we encounter them almost every day. We all frequently hear questions, stemming from the unclear path, lack of knowledge, lack of financial and human resources and the fragmented and sometimes conflictual relationship with civil society:

- Why start first? Technical or social innovation? Addressing cities as a whole or by neighbourhood? Big infrastructure or renovations?
- Should we experiment or write a legislative framework before the change?
- Is energy an end or a means?
- Do we want immediate or lasting results?
- Do we follow international standards or local culture
- What are the real benefits and when can we enjoy them

The guide aims to provide an integrated response to these dilemmas. Each chapter is relevant in the sectoral implementation of strategies and plans, and we support the linkage between areas to provide an overview of the different contributions to neutrality. This is the only way to set priorities in an integrated and above all feasible way

The large volume of information contained in this publication supports the transition between more concise documents with a mobilizing role and scientific and professional publications complemented by legislation in each field. In addition, it occupies a necessary place in translating more technical terms and practices into accessible language

The publication, with its large amount of information, facilitates the transition from concise documents with a mobilizing role, to scientific and professional works, complemented by the legislation in each field. It also plays an essential role in translating technical terms and practices into accessible language. In this way we aim to provide cities, professionals and citizens with a comprehensive document to support further research and action

As practicing professionals in architecture, urban planning, education and public policy, we promote the alignment of sustainability as an integrated part of every aspect of city development. As an organization, we will stand with the institutions responsible for promoting a state policy for architecture that blends the built environment, nature, community and resources in a wise balance through planning capable of preventing and adapting to climate, social and economic changes that will make a real difference

We join other professionals, administrators, politicians and citizens in this effort for cities that:

- Use energy efficiently by designing evolved buildings, integrating renewable energy and reducing and transforming waste;
- They are mobile but also friendly through well-planned public transport, shared mobility and pedestrian and nature-friendly streets;
- Go greener by protecting biodiversity, expanding natural spaces and using nature-based solutions;
- Minimize waste by continuously using the existing built stock, adopting circular economy principles and rethinking the use of materials;
- Engages local communities by stimulating active participation, education and collaboration;
- It preserves its identity by protecting its tangible and intangible heritage, through an appropriate balance between memory and evolution.

The M100 Guide developed by the Romanian Order of Architects is a commitment to action and describes a framework for those who plan, build and manage cities. But it is also directly addressed to those who live and will live in them, for a sustainable future, as responsible citizens regardless of their role in the social fabric of cities.

This material has been developed by the Romanian Order of Architects within the project „Towards Climate-Neutral and Smart Cities through Mutual Learning, Engagement and Capacity-Building”.

The project is implemented by UEFISCDI (programme operator), the Romanian Order of Architects, Urbanize Hub, Nordic Edge, NTNU and RANNÍS and is supported by EEA and Norwegian Grants through the Bilateral Relations Fund, enabling valuable international collaboration and knowledge exchange.

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Adrian Pop
Andrei Ceclan
Horia Petran
Dorin Beu
Alexandra Stoica

C2

Energy systems

Andrei Ceclan
Horia Petran

C3

Mobility

Tudor Măcicășan
Maria Cristina Găvozdea

C4

Green infrastructure and nature-based solutions

Cristian Ioja
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Waste management and circular economy

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Participatory governance

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Oana Crușmac
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Good practice examples

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Glossary of terms

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